# ICES IBPBASS2 REPORT 2016

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# Report of the second Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea (IBPBass2)

1 December 2015–31 March 2016

by correspondence

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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## Executive summary

The second Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea (IBPBass2) was conducted via several Skype conferences and by correspondence from December 2015 to March 2016. The main goal of the IBPBass2 was to review quality of a new age composition dataset for French fishery landings that was recently provided by Ifremer (France) as well as evaluate performance of the stock assessment model with the new dataset included. The IBPBass2 also examined overall model structure and input data as well as evaluated the appropriateness of existing reference points.

IBPBass2 slightly deviated from the terms of reference (ToR) and did not address ToR (b) related to including empirical weight-at-age data in the model, ToR (c) related to developing age compositions for the Channel groundfish survey, and ToR (d) related to the evaluation of biological reference points. Empirical weight-at-age data were not included, because in its current configuration the assessment model does not need to rely on this type of data to effectively model fishery fleets and surveys. Instead, IBPBass2 focused on including in the model length and age composition data for those fleets where both types of data were available. The age compositions for Channel groundfish survey were not looked at due to time constraints. During the IBPBass2, the assessment model was updated to include several key improvements. However, not all the suggested changes were incorporated in the model. Therefore, several important recommendations were developed for the next benchmark. The changes made to the assessment for use in subsequent update assessments are: fixing all growth parameters of the von Bertalanffy growth equation; inclusion of both length and age composition data for French and UK fishery landings; using an emphasis factor (lamda) of 0.5 each for length and age composition data where both are included in the model; combining the UK Autumn Solent bass survey data for ages 2–4 as a single survey rather than three separate survey series; treating the UK commercial lines fleet separately from trawls and nets for estimation of selectivity; inclusion of the recreational catch at a separate fleet with same selectivity as the UK commercial lines fleet; and revision of input effective sample sizes using the Francis *et al* (2010) method. In combination, these changes improve the model and alter the absolute values of SSB and fishing mortality compared with the WGCSE 2015 assessment, but have relatively little effect on the relative trends.

# 1 Introduction

## 1.1 Purpose of the Interbenchmark protocol for sea bass

The second Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea (IBPBass2) was established to review the quality and use of a new age composition dataset for French fishery landings that was provided by Ifremer (France) at the 2015 meeting of the ICES Working Group on the Celtic Sea Ecoregion (ICES, 2015a). The assessment of this sea bass stock is carried out using the Stock Synthesis integrated modelling framework (Methot and Wetzel,2013), for which the input data for sea bass include age composition data for UK fishery landings and surveys, but only length compositions for French landings and surveys. The WGCSE 2015 meeting agreed that the new French age data could only be used following a full review through the interbenchmark process. The Terms of Reference established for this interbenchmark were:

2015/2/ACOM32 The Second Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea (IBPBass2) that will serve as in Inter-Benchmark Protocol, chaired by Michel Bertignac, France, and Vladlena Gertseva, USA, will meet by correspondence (01 December 2015–31 March 2016) to:

a ) Review quality and performance of age composition data for French fishery landings in the Stock Synthesis model formulated by IBP-bass;
b ) Develop input data are for stock assessment including empirical weights at age;
c ) Develop age compositions for the Channel groundfish survey and test in SS3 model.
d ) Evaluate the appropriateness of existing reference points and estimate new if necessary based on conclusions form WKMSYREF3 and 4.

The Interbenchmark process was conducted via several Skype conferences and by correspondence from December 2015 to March 2016.

## 1.2 Structure of report

The structure of this report follows the chronological order of the IBPBass2 discussions:

- Section 2 reviews the derivation and quality of the new age composition data for the French fishery (ToR (a)).
- Section 3 discusses the updates to the assessment input data including the derivation of the length frequency data from the UK commercial fleets (Part of ToR(b) and (c)).
- Section 4 describes the developments of the Stock Synthesis model carried out during the IBPBass2 along with description of the final assessment model agreed upon by the group.
- Section 5 addresses biological reference points (ToR (d))
- Sections 6 and 7 are the external reviewers report and recommendations for a future benchmark, respectively.

# 2 Derivation and quality of new age composition data for French fishery landings.

This section provides a general overview of the sampling in France to provide data on length and age compositions of fishery landings, the sources of age data, and the method used for deriving age compositions from length compositions.

## 2.1 Issue description

WGCSE 2015 carried out a Stock Synthesis run using French age compositions from 2000–2014 rather than length compositions as done up to that time in the assessment for sea bass. The WG considered that the methods to convert length data to age data needed to be reviewed by an Inter-benchmark workshop before including the data into the assessment.

## 2.2 Sampling of French fishery landings for length compositions

Fleet-raised numbers at length in French fishery landings are available only from 2000 onwards, based on a programme of sampling at ports. Although the sea bass stock in the Irish Sea, Celtic Sea, English Channel, and southern North Sea is distribution over eight ICES divisions (Figure 2.2.1), the French fishery is mainly in Divisions 7.e, 7.h and 7.d, and the bulk of sampling is at ports where French vessels fishing in these Divisions land their catches. In the WGCSE assessment up to 2015 (ICES, 2015a), a single French fleet is defined ("French fleet"), and is the combination of several types of sub-fleets using various fishing gears: pelagic trawlers, bottom trawlers, netters, liners, Danish seiners and purse-seiners. The numbers of trips sampled per year, and the total numbers of fish measured, are given for each gear group in Table 2.2.1.

## 2.3 Raised length compositions for French combined fleets

For the years 2000–2010, numbers at length for sampled trips have been combined and raised to the landings by strata defined by gear group and by subarea (ICES Divisions, or groups of Divisions such as 7.e,h). The raised numbers at length are then summed across the gear and area strata to produce total numbers landed at length for the entire fleet and for the entire area. From 2011 forwards, the raising procedure was changed to remove any area stratification, so that samples for each gear group are combined for all samples taken across the stock area and raised to the total landings by gear for the entire area before summing across gear groups. Raised number at length estimated using these methods are presented in Table 2.3.1. IBPbass2 was not provided with a full time-series of raised length compositions using the combined-area method adopted for 2011 onwards, and was therefore not able to evaluate the impact of the change in raising method on the assessment. This should be evaluated in a future benchmark.

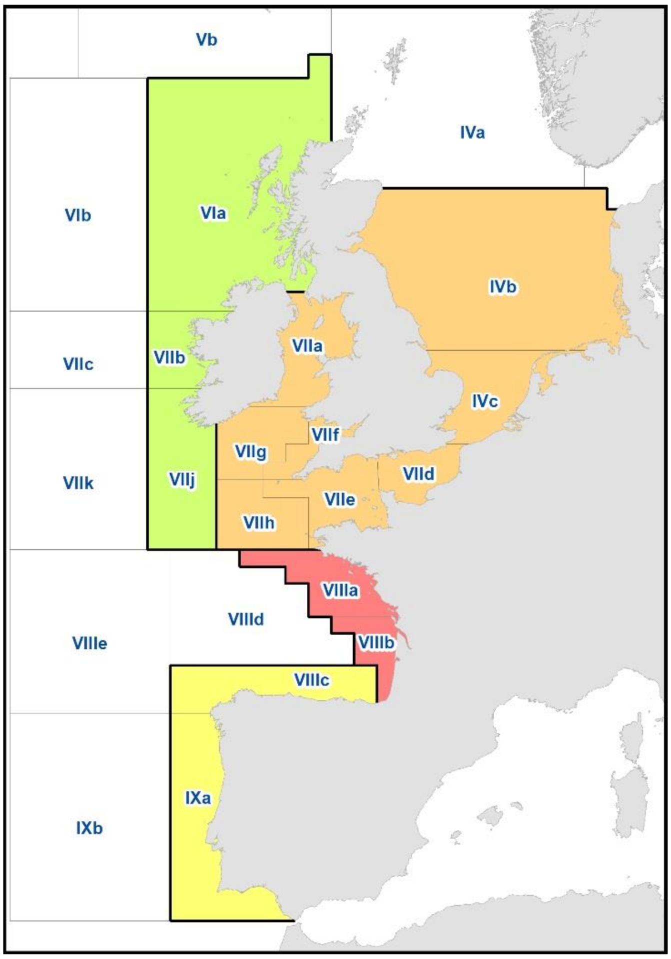



**Figure 2.2.1. The four stock areas for sea bass defined by ICES for assessment and fishery management, and the component ICES Divisions. IBPbass-2 covers the stock in ICES Divisions 4.b,c and 7.a, d-h.**

**Table 2.2.1: Details of sampling for length by gear group for French fleets (2000–2014). From 2000–2010, the samples are further subdivided into area strata.**

| | FR lines | | | FR nets | | | FR bottom trawl | | |
|---|---|---|---|---|---|---|---|---|---|
| | No trips | No fish | landings | No trips | No fish | landings | No trips | No fish | landings |
| 2000 | 53 | 1613 | 305 | 2 | 72 | 108 | 2 | 196 | 692 |
| 2001 | 101 | 2659 | 375 | 1 | 5 | 110 | 0 | 0 | 713 |
| 2002 | 79 | 2075 | 349 | 0 | 0 | 128 | 4 | 710 | 911 |
| 2003 | 78 | 1732 | 438 | 1 | 4 | 152 | 8 | 998 | 1087 |
| 2004 | 78 | 1748 | 381 | 6 | 84 | 150 | 12 | 887 | 1236 |
| 2005 | 34 | 949 | 439 | 4 | 110 | 148 | 14 | 689 | 1239 |
| 2006 | 73 | 1719 | 554 | 11 | 291 | 140 | 11 | 1240 | 1110 |
| 2007 | 69 | 2235 | 560 | 28 | 641 | 158 | 11 | 588 | 1187 |
| 2008 | 41 | 1280 | 425 | 25 | 496 | 128 | 18 | 1927 | 1145 |
| 2009 | 33 | 1339 | 251 | 25 | 159 | 94 | 93 | 1468 | 1052 |
| 2010 | 10 | 334 | 278 | 49 | 615 | 160 | 64 | 626 | 819 |
| 2011 | 17 | 540 | 359 | 156 | 278 | 129 | 151 | 1955 | 791 |
| 2012 | 10 | 681 | 295 | 60 | 408 | 142 | 87 | 1204 | 824 |
| 2013 | 16 | 309 | 291 | 26 | 512 | 126 | 73 | 2060 | 737 |
| 2014 | 10 | 299 | 285 | 29 | 218 | 163 | 137 | 2139 | 571 |

| | FR pelagic trawl | | | FR Danish seine | | | FR others | | |
|---|---|---|---|---|---|---|---|---|---|
| | No trips | No fish | landings | No trips | No fish | landings | No trips | No fish | landings |
| 2000 | 2 | 629 | 681 | 0 | 0 | 0 | 0 | 0 | 20 |
| 2001 | 0 | 0 | 659 | 0 | 0 | 0 | 0 | 0 | 27 |
| 2002 | 3 | 680 | 415 | 0 | 0 | 0 | 0 | 0 | 22 |
| 2003 | 4 | 753 | 773 | 0 | 0 | 0 | 0 | 0 | 23 |
| 2004 | 6 | 938 | 820 | 0 | 0 | 0 | 0 | 0 | 17 |
| 2005 | 11 | 1239 | 1319 | 0 | 0 | 0 | 0 | 0 | 17 |
| 2006 | 16 | 2597 | 1420 | 0 | 0 | 0 | 0 | 0 | 35 |
| 2007 | 8 | 1800 | 841 | 0 | 0 | 0 | 0 | 0 | 24 |
| 2008 | 8 | 1065 | 1012 | 0 | 0 | 0 | 0 | 0 | 40 |
| 2009 | 55 | 899 | 1098 | 0 | 0 | 27 | 0 | 0 | 127 |
| 2010 | 28 | 1299 | 1828 | 0 | 0 | 61 | 2 | 2 | 90 |
| 2011 | 30 | 2309 | 1142 | 2 | 6 | 43 | 36 | 292 | 62 |
| 2012 | 9 | 1649 | 1143 | 6 | 370 | 112 | 7 | 154 | 91 |
| 2013 | 10 | 1253 | 1516 | 2 | 28 | 18 | 1 | 1 | 82 |
| 2014 | 23 | 455 | 242 | 12 | 23 | 9 | 1 | 1 | 25 |

**Table 2.3.1: Raised total numbers at length for French fleet landings (all gears combined), as used in the assessment (WGCSE 2015)**

| Number at length_french commercial fishery 2000_2014 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 717 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 3455 | 0 | 0 | 0 | 0 | 0 | 292 | 0 | 0 | 1219 | 0 | 0 |
| 30 | 0 | 0 | 1015 | 13054 | 14 | 0 | 15689 | 0 | 0 | 473 | 0 | 0 | 0 | 146 | 0 |
| 32 | 0 | 0 | 0 | 58717 | 13057 | 9903 | 32459 | 181 | 8250 | 2239 | 9811 | 1976 | 1583 | 0 | 3076 |
| 34 | 9931 | 17962 | 12469 | 105655 | 78811 | 29872 | 179130 | 4715 | 28986 | 10714 | 28290 | 13885 | 6518 | 1504 | 3620 |
| 36 | 34932 | 19809 | 38249 | 125326 | 127801 | 97890 | 285704 | 39335 | 229758 | 124925 | 169311 | 57121 | 85760 | 29667 | 33532 |
| 38 | 85866 | 68920 | 46427 | 180475 | 124051 | 128022 | 217657 | 102714 | 263071 | 211881 | 177571 | 87842 | 172510 | 88507 | 68262 |
| 40 | 126730 | 76594 | 62503 | 119495 | 227214 | 231750 | 178250 | 146272 | 266408 | 225545 | 182105 | 128838 | 140273 | 149070 | 74871 |
| 42 | 102836 | 98008 | 82461 | 145456 | 282390 | 266905 | 196868 | 145122 | 237160 | 193030 | 283064 | 187586 | 147895 | 146130 | 82684 |
| 44 | 80478 | 109595 | 91064 | 104545 | 243107 | 344681 | 289998 | 164011 | 270810 | 222613 | 251956 | 201447 | 162333 | 123170 | 51365 |
| 46 | 93344 | 106857 | 86723 | 130023 | 188494 | 270532 | 285451 | 130859 | 228996 | 238849 | 230227 | 199487 | 180752 | 140677 | 61292 |
| 48 | 80934 | 77694 | 62163 | 115806 | 126685 | 239265 | 263272 | 100043 | 142650 | 155222 | 188149 | 194697 | 158490 | 127136 | 39844 |
| 50 | 55399 | 57055 | 55905 | 91915 | 72581 | 169478 | 200874 | 99210 | 112385 | 159658 | 186310 | 145447 | 130759 | 116842 | 38109 |
| 52 | 52948 | 51658 | 46180 | 93878 | 82331 | 115269 | 119836 | 75929 | 74336 | 114530 | 109212 | 124239 | 107214 | 99156 | 29929 |
| 54 | 42094 | 36737 | 35998 | 48742 | 50633 | 62106 | 99509 | 74405 | 66260 | 84649 | 120550 | 92526 | 90638 | 103818 | 39911 |
| 56 | 26460 | 35839 | 26001 | 60839 | 60284 | 67741 | 99674 | 55147 | 48853 | 96257 | 71590 | 72471 | 78934 | 89197 | 32298 |
| 58 | 27357 | 22762 | 19019 | 31614 | 31334 | 61132 | 54522 | 46087 | 39689 | 51578 | 62211 | 46869 | 54869 | 59004 | 30016 |
| 60 | 23581 | 25834 | 14210 | 33688 | 19126 | 43591 | 45908 | 28056 | 29840 | 36547 | 31544 | 31690 | 35387 | 65851 | 21467 |
| 62 | 14295 | 18773 | 11129 | 30691 | 23996 | 35774 | 23763 | 23057 | 28335 | 57472 | 19076 | 19998 | 33085 | 64579 | 16797 |
| 64 | 18044 | 13532 | 16771 | 18823 | 14799 | 25788 | 20607 | 18091 | 14420 | 24016 | 62005 | 17624 | 17714 | 53482 | 16261 |
| 66 | 10773 | 11068 | 11011 | 13230 | 10650 | 12456 | 14969 | 8715 | 12694 | 21415 | 26388 | 14720 | 15170 | 37744 | 8387 |
| 68 | 9903 | 9120 | 5447 | 7960 | 8569 | 13360 | 13976 | 8793 | 9039 | 27466 | 9340 | 7906 | 9374 | 23884 | 5579 |
| 70 | 5709 | 11771 | 4795 | 5374 | 4880 | 8908 | 9653 | 4835 | 6821 | 20198 | 8541 | 6114 | 8114 | 32512 | 8995 |
| 72 | 5721 | 5733 | 4559 | 5617 | 2974 | 8053 | 4521 | 2707 | 4714 | 12083 | 29128 | 2082 | 4147 | 14996 | 3027 |
| 74 | 2345 | 5345 | 1825 | 3275 | 2675 | 9811 | 3424 | 1962 | 1623 | 7551 | 1884 | 1163 | 2313 | 9001 | 642 |
| 76 | 2595 | 2782 | 1260 | 1356 | 2567 | 5020 | 2883 | 1010 | 1257 | 979 | 2114 | 1096 | 1540 | 2640 | 773 |
| 78 | 2102 | 1691 | 357 | 297 | 548 | 2378 | 731 | 399 | 534 | 1765 | 182 | 476 | 1134 | 2073 | 0 |
| 80 | 888 | 583 | 155 | 783 | 425 | 1365 | 201 | 158 | 261 | 264 | 5525 | 148 | 282 | 176 | 198 |
| 82 | 1021 | 296 | 109 | 112 | 149 | 107 | 261 | 37 | 8 | 1004 | 6097 | 104 | 451 | 1566 | 0 |
| 84 | 548 | 204 | 0 | 148 | 295 | 0 | 30 | 59 | 0 | 0 | 863 | 0 | 29 | 0 | 0 |
| 86 | 123 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 27 | 1115 | 0 |
| 88 | 0 | 61 | 0 | 0 | 149 | 0 | 0 | 0 | 0 | 0 | 1207 | 0 | 0 | 0 | 0 |
| 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 92 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 94 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## 2.4 Sampling for age compositions of French landings

Age composition data for sea bass have been collected in France since 2000. The sampling scheme consists in collecting at least 3 scales per cm and quarter. Samples are available for subdivisions 7.e,h and (from 2008 onwards), 7d. Annual raw data are presented in Appendix 1. As the coverage of the age sampling can lead to very low sample numbers for some years and age groups, Ifremer provided a combination of samples from fishery sampling and from the Ifremer trawl surveys. This is valid only if the age compositions within length classes are the same for the fishery and for the survey in each year. IBPBass2 was not able to carry out statistical tests on the separate fishery and survey data to determine if this assumption is valid, and proposes that this is done for the next benchmark.

## 2.5 Use of age samples to derive age compositions from length data

Age compositions for French commercial fishery landings of sea bass are derived from annual age–length keys (ALK) constructed as unweighted sums of raw age data collected from all fishery and survey sources for the whole area, by quarter. The proportions by age class in each length class are applied to the fleet-raised, combined-gear numbers at length (from the length sampling) to give raised numbers-at-age which are then summed over length classes. This is analogous to the procedure used for deriving the age compositions for UK fishery landings, with the exception that the UK derives four separate area-based ALKs (7.a,f,g; 7.e; 7.d; 4.b,c), separately for two 6-month periods in each year. The raised annual age compositions are given in Table 2.5.1.

**Table 2.5.1. Raised total numbers-at-age for French fleet landings (all gears combined), as used in the IBPBass2 assessment.**

| Age | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | 0 | 0 | 2611 | 3 | 0 | 3138 | 0 | 1208 | 315 | 717 | 0 | 0 | 0 | 0 |
| 3 | 0 | 2651 | 8114 | 10800 | 4 | 24195 | 74600 | 5307 | 79917 | 23355 | 1962 | 0 | 406 | 60 | 603 |
| 4 | 9440 | 55640 | 73892 | 364427 | 80483 | 77794 | 131099 | 73224 | 175402 | 119979 | 39409 | 6087 | 14357 | 569 | 6846 |
| 5 | 222655 | 47734 | 125531 | 241694 | 627951 | 253455 | 564668 | 135809 | 545960 | 282754 | 221063 | 172404 | 65157 | 52216 | 11735 |
| 6 | 273687 | 298773 | 90294 | 318445 | 438799 | 735235 | 361515 | 460583 | 401231 | 473020 | 515711 | 252236 | 262593 | 96064 | 123435 |
| 7 | 139562 | 211740 | 236147 | 96562 | 297961 | 352182 | 841651 | 124606 | 456312 | 238022 | 411737 | 312186 | 346334 | 609903 | 149938 |
| 8 | 79413 | 90962 | 86108 | 254050 | 65297 | 443765 | 146484 | 139879 | 143871 | 408951 | 437222 | 303804 | 308183 | 377156 | 133129 |
| 9 | 47258 | 44742 | 31151 | 114829 | 131612 | 39104 | 253945 | 79978 | 147881 | 100487 | 200328 | 314164 | 264012 | 367869 | 143241 |
| 10 | 43924 | 21074 | 23025 | 57883 | 77533 | 161572 | 13655 | 69214 | 40719 | 200417 | 172430 | 125800 | 214803 | 481247 | 39242 |
| 11 | 49293 | 39908 | 17823 | 26223 | 25416 | 69617 | 132370 | 33191 | 57341 | 73570 | 109342 | 89188 | 83939 | 245982 | 39476 |
| 12 | 20207 | 36007 | 14760 | 19879 | 14848 | 26314 | 84910 | 65868 | 17882 | 37114 | 75421 | 34465 | 50701 | 158757 | 12679 |
| 13 | 10767 | 17787 | 15912 | 14232 | 14254 | 17996 | 22068 | 68599 | 35092 | 32657 | 46461 | 28352 | 24784 | 43008 | 7347 |
| 14 | 4925 | 4394 | 9752 | 18088 | 13528 | 19238 | 6648 | 11131 | 12669 | 55506 | 21880 | 12942 | 8470 | 21825 | 3067 |
| 15 | 4927 | 6838 | 3743 | 6600 | 7628 | 17974 | 6999 | 9034 | 5518 | 33537 | 4806 | 5585 | 3191 | 14812 | 198 |
| 16+ | 10901 | 8034 | 1553 | 4028 | 5270 | 22718 | 16069 | 5486 | 6091 | 23529 | 16480 | 337 | 1583 | 11520 | 0 |

## 2.6 Quality of French age data

Characteristics of ageing error in sea bass were reviewed in a working document to IBPBass-2 (Armstrong and Drogou, 2016). Ages of sea bass sampled in France are obtained primarily from scales, which are considered to be a reliable method for sea bass. The uncertainty (bias and imprecision) in ageing of sea bass has been evaluated during exchanges and workshops conducted in 2011, 2013 and 2015 (ICES, 2015b, Mahé *et al.*, 2012 & 2014). Only relative bias can be evaluated, in the absence of a reference collection with known ages. If the ages recorded from a scale by a group of readers are normally distributed (mean age not significantly different from modal age), it is assumed that age errors are random. If the mean and mode differ widely, due to a skewed distribution of age values for a given scale, especially if evident across many modal ages, this suggests a strong persistent difference between agers.  No significant bias was identified in age estimates for sea bass from different labs. The standard deviation of age readings for individual fish within and between readers increased with fish age, which is common especially for long-lived species. These results provide no indication that new age composition data from French fishery are inferior to age data from UK fleet already used in the assessment. It was agreed to that new data are adequate for use in stock assessment.

During the ICES benchmark for sea bass in 2012 (ICES, 2012), a review of the French ALK was carried out by Laurec *et al* (2012). A large dispersion of length-at-age was observed (as for the age length key from UK), leading to substantial overlap in the length distribution at age for older fish (Figure 2.6.1). For example, in 7.e&h, lengths of 8-year-old sea bass varies between 42 cm and 64 cm. Furthermore, some length distributions at age are multimodal which may reflect some errors in ageing. For example, for fish with 5 rings, there is a clear main mode at 39 cm, but a distribution tail also appears on the right side of this main mode with a secondary mode at 48 cm, close to the main mode exhibited by 8-ringed fish. The main conclusion of that review was that, if the French age composition were to be used in an age-based assessment, it should probably be better to consider a plus-group at around 9 or 10. The findings of Laurec *et al* (2012) do not preclude the use of French age data in the assessment, as Stock Synthesis can include an age error matrix which allows for imprecision of age composition data when fitting observed age composition data to the model estimates of age compositions. Based on the results of ICES age exchanges and workshops, IBPBass2 adopted an age error matrix where the precision of age readings was expressed as a CV of 0.1–equating to an age error standard deviation of 0.5 yr for a 5-year-old fish, 1 year for a 10-year-old, and 2 years for a 20-year-old.

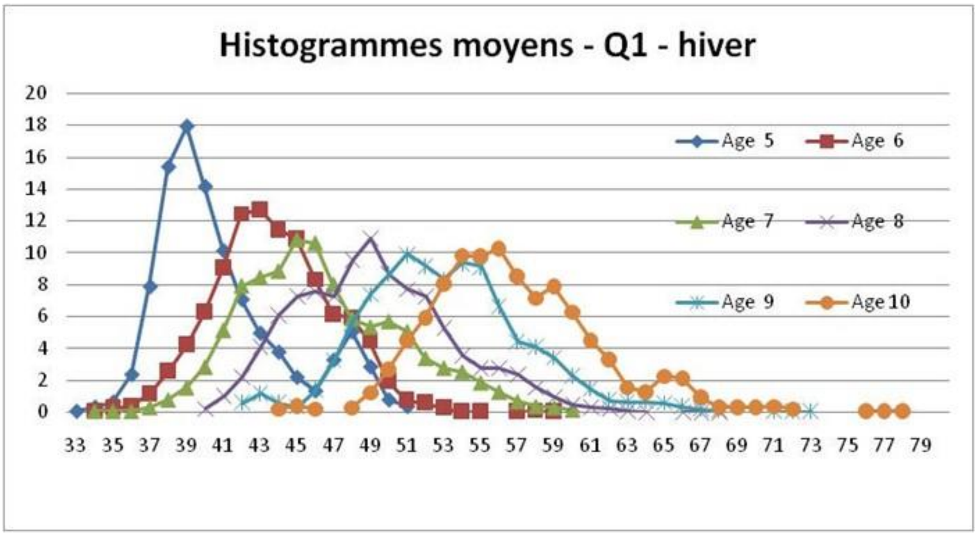



**Figure 2.6.1 Relative length frequencies at age for sea bass aged in France, averaged over the period 2000–2010, for ages 5–10, and for the first quarter (Q1: winter) of the year. (Laurec *et al* 2012)**

# 3 Development and update of input data for the stock assessment (ToR (b))

## 3.1 Issue description

During IBPBass2, it was proposed to include the length frequency distributions together with age distribution for the UK fleets to allow estimation of length-based selectivity and hence estimation of mean weights at age in catches that reflect selectivity (as was done for the French fleets).

The Autumn Solent survey in ICES Subdivision 7.d covers a major nursery area and only the ages 2–4 have previously been used in the assessment. Due to initial problems with trying to fit selectivity for this survey in the first sea bass benchmark (ICES IBP-New), the three age groups were entered in the data file as three independent surveys, therefore losing covariance information due to year-effects affecting each age class similarly. During IBPBass-2, it was proposed to combine the age groups into a single survey with age distribution data and associated age selectivity.

This section provides a brief description of the data compilation which was carried out for these purposes. It addresses only part of Terms of Reference (b); the inclusion of empirical weight-at-age data in the model was not addressed as the configuration of the assessment model using length-based selectivity does not need this type of data.

## 3.2 UK data: Compiling length frequency distributions by fleets

The length frequency distributions of sea bass landings into England are estimated from the port sampling programme carried out by Cefas. Sampling events are selected from a sampling frame of ports and days of the year for sampling of multiple finfish species from the vessels landing on the day. The samples collected for sea bass are post-stratified into five gear types (otter trawl; nets; lines; midwater trawl and "other"), four areas (7.a,f,g; 7.e; 7.d; 4.b,c) and two periods of the year (Jan–June; July–December). Coverage of these strata is good however it can be variable between years and gears (see WGCSE reports for numbers of trips and fish sampled each year). No samples of midwater trawls are available since 2013 due to very low catches. Sample length compositions are first vessel-raised using ratios of landed live weight to predicted live weight of the length frequency sample calculated from a length–weight relationship:

W (kg) = 0.00001296 (L+0.5)^2.969

Raised LFDs are then summed over vessels within a sampling stratum and raised to give total raised fleet LFDs per stratum, then summed over areas and periods of the year for each gear stratum. This procedure ensures sums-of-products ratios of 1.0, but will lead to some bias in numbers-at-length due to discrepancies between true fish weights and calculated fish weights from the length–weight relationship.

## 3.3 Combine UK Solent survey data into one single survey

This was achieved simply by specifying a single survey with the combined abundance index for ages 2–4 (with associated CV), with a separate entry of age composition data including ages 2–4.

## 3.4 Compilation of other data for the assessment

IBPBass-2 started with the input data that had been compiled for WGCSE 2015, and adjusted the inputs in stages during the model development. This included (not in order of development):

- Addition of French landings age composition data
- Addition of UK landings length frequencies
- Disaggregation of UK fishery landings and composition data to allow a separate UK lines fleet
- Combination of Solent survey indices into a single survey

# 4 Assessment model development carried out during IBPBass2 and conclusions

## 4.1 4.1 Base case WGCSE 2015 assessment–starting point for IBPBass2

WGCSE 2015 conducted an assessment using Stock Synthesis 3 (SS3) (Methot and Wetzel, 2013). The software used was Stock synthesis v3.23b, following the procedures given in the Stock Annex developed by IBPBass1 (ICES 2014) with the inclusion of fishery data for 2014. The assessment requires a modelling framework capable of handling a mixture of age and length data for fisheries and surveys (fleet-based landings; landings age or length compositions, age-based survey indices for young bass) and biological information on growth rates and maturity. Landings-at-age were available for four UK fleets from 1985 onwards (otter trawl; nets; lines; midwater trawl), whereas French fleets had length composition data for all fleets combined, and available only since the 2000s. The assessment developed by IBPBass1 (ICES 2014) combined the UK otter trawl, nets and lines into a single fleet. The Stock Synthesis assessment model was chosen, primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. The model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html.

The following table summarizes key model assumptions and parameters for the WGCSE 2015 assessment. Other parameter values and input data characteristics are defined in the SS3 start file Starter.ss, control file Bass47.ctl, forecast file Forecast.SS and the data file BassIVVII.dat as used by WGCSE 2015.

**Key model assumptions and parameters from the WGCSE 2015 final run.**

| Characteristic | Settings |
|---|---|
| Starting year | 1985 |
| Ending year | 2014 |
| Equilibrium catch for starting year | 0.82* landings in 1985 by fleet. |
| Number of areas | 1 |
| Number of seasons | 1 |
| Number of fishing fleets | 4 |
| Number of surveys | two surveys: CGFS; Solent autumn survey (Solent spring and Thames survey removed). |
| Individual growth | von Bertalanffy, parameters fixed, combined sex |
| Number of active parameters | 68 |
| Population characteristics | |
| Maximum age | 30 |
| Genders | 1 |
| Population length bins | 4–100, 2 cm bins |
| Ages for summary total biomass | 0–30 |
| Data characteristics | |
| Data length bins (for length structured fleets) | 14–94, 2 cm bins |
| Data age bins (for age structured fleets) | 0–16+ |
| Minimum age for growth model | 2 |
| Maximum age for growth model | 30 |
| Maturity | Logistic 2-parameter – females; L50 = 40.65 cm |
| Fishery characteristics | |
| Fishery timing | -1 (whole year) |
| Fishing mortality method | Hybrid |
| Maximum F | 2.9 |
| Fleet 1: UK Trawl/nets/lines selectivity | Double normal, age-based |
| Fleet 2: UK Midwater trawl selectivity | Asymptotic, age-based |
| Fleet 3: Combined French fleet selectivity | Asymptotic, length-based |
| Fleet 4: Other fleets/gears selectivity | Asymptotic: mirrors French fleet |
| Year-invariant recreational fishing mortality vector (F(5-11) = 0.09) | Asymptotic, age-based (fixed, not estimated). Added to M vector |
| Survey characteristics | |
| Solent autumn survey timing (yr) | 0.83 |
| CGFS survey timing (yr) | 0.75 |
| Catchabilities (all surveys) | Analytical solution |
| Survey selectivities: Solent autumn: | [all survey data entered as single ages; sel = 1] |
| Survey selectivities: CGFS | Double normal, length based |
| Fixed biological characteristics | |
| Natural mortality | 0.15 |
| Beverton–Holt steepness | 0.999 |
| Recruitment variability (σR) | 0.9 |
| Weight–length coefficient | 0.00001296 |
| Weight–length exponent | 2.969 |

| Characteristic | Settings |
|---|---|
| Maturity inflection (L50%) | 40.649 cm |
| Maturity slope | -0.33349 |
| Length-at-age Amin | 19.6 cm at Amin=2 |
| Length-at-Amax | 80.26 cm |
| von Bertalanffy k | 0.09699 |
| von Bertalanffy Linf | 84.55 cm |
| von Bertalanffy t0 | -0.730 yr |
| Std. Deviation length-at-age (cm) | SD = 0.1166 * age + 3.5609 |
| Age error matrix | CV 12% at-age |
| Other model settings | |
| First year for main recruitment deviations for burn-in period | 1965 |
| Last year for recruit deviations | 2011 (last year class with survey indices) |

## 4.2 Stages in model development

### 4.2.1 Initial adjustments to WGCSE model to develop base case model for IBPBass2

Based on recommendations from the external experts, a number of improvements were made incrementally to the SS3 model configuration used by WGCSE 2015, and some minor errors were corrected (which had only small effect on results). At each stage the changes in model diagnostics were tabulated, plotted and evaluated. Results were progressively presented over video conferencing meetings at which agreement was reached on models to take forward to the next stage of development:

- A more recent version of Stock Synthesis was used (V2.24f)
- The input data file was reconfigured to make it easier to handle data records that are to be excluded from the model fit
- Ageing error was entered as standard deviations at each age rather than CVs as done previously
- The standard deviation of length-at-age distributions was specified in the CTL file as a linear function of age rather than length.
- Growth age for L2 (maximum age–Amax) set to 28–oldest age observed in data.
- Length at Amax fixed to 80.26 cm.
- Inclusion of advanced options for recruitment deviations;
- Switching on an option to allow the model to inflate the standard deviation of the abundance indices from the French Channel groundfish and Solent Autumn Bass surveys;

The stock trends from the base case model for IBPBass2 differ from those given by WGCSE mainly in showing a stronger downward trend in SSB and upward trend in F in recent years (See Figure 4.2.1).

The base case including these adjustments was then used to explore the performance of a series of runs that: i) included French age compositions for landings; ii) included UK length and age compositions; iii) represented recreational fishing mortality in a more appropriate way; iv) explored alternative weighting of datasets. The runs are numbered 1, 2,…n.

### 4.2.2 Exploration of the base case model with changes to input fishery length and age compositions

<u>Runs 1 & 2:</u> Inclusion of French age composition data (Run 1: Age only; Run 2: Length + Age data)

The WGCSE 2015 assessment only used length compositions for the combined French fleet, fitting length based selectivity. IBPBass2 Run 1 replaced the length composition data with the age compositions shown in Table 2.5.1, and fitted a 2-parameter asymptotic (logistic) age-based selection model. Run 2 incorporated both the age and length composition data for French landings, and fitted an asymptotic length based selectivity model.

Run 1 shows that the main effect of adding the age compositions and fitting an asymptotic age selectivity model for the French fleet is an increase in SSB compared with the base case model, particularly in the most recent periods, and a reduction in fishing mortality (Figure 4.2.1). Estimates of recruitment are slightly higher historically.

Run 2, with length based selectivity and both age and length data input for the French fleet, gives similar trends to Run 1 up to around 2000, but the subsequent SSB estimates do not increase to the same extent as in Run 1. SSB remains higher than the WGCSE 2015 assessment for the full time-series (Figure 4.2.1).

The fit to the age compositions (Figure 4.2.2) show similar patterns for both run 1 and 2 showing some cohort effects, however, the residuals are smaller for run 2. When comparing run 2 with the base case, the fits to the length composition is slightly improved with smaller residuals overall.

IBPBass2 concluded that for the French fleet, selectivity should be a function of length with both age and length composition data.

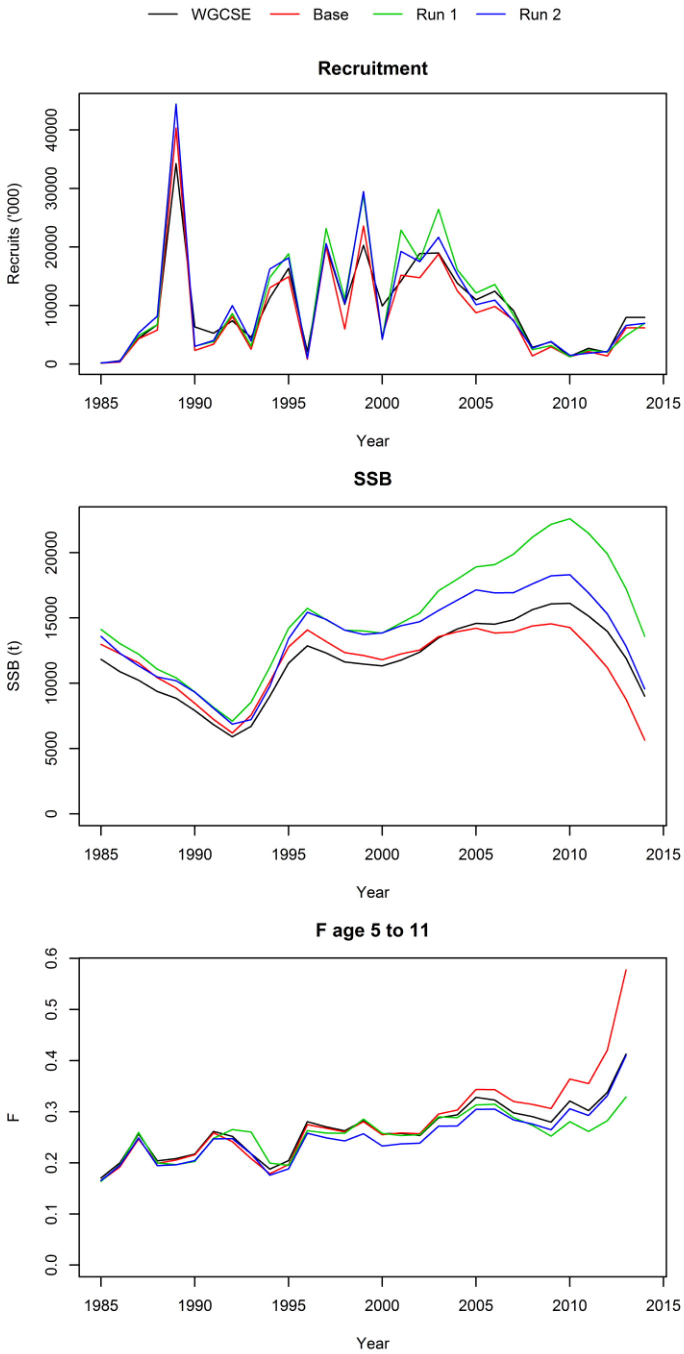



**Figure 4.2.1. Stock trends from SS3 runs incorporating French age compositions: Run 1: Addition of French age frequencies with asymptotic age selectivity, and removal of French length frequencies. Run 2: Addition of both age and length frequency distributions and asymptotic length selectivity.**

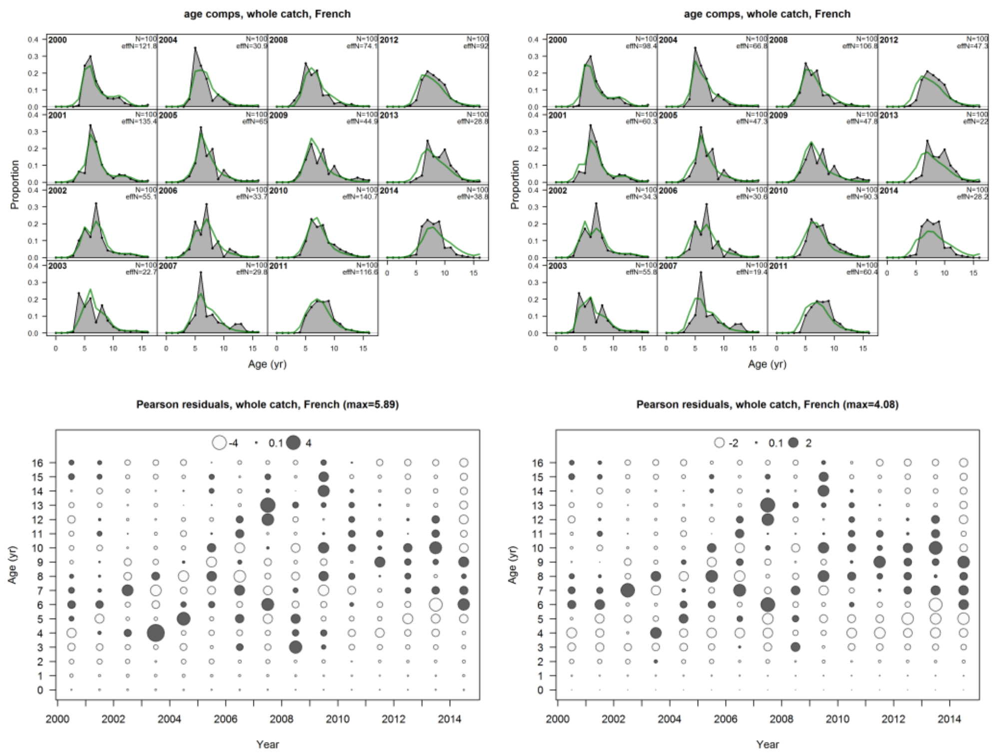



**Figure 4.2.2. Top: fit to annual length compositions; bottom: Residuals of length composition fit. Left run 1 and right run 2.**

<u>Run 3:</u> addition of UK length distribution data for commercial fleets

Raised length composition data are available for all UK fleets with variable sample sizes by year and fleet. WGCSE 2015 and earlier assessments have used only the total landings at age for UK fleets, although in some cases the midwater trawl length compositions were used rather than age data. Where age data were used, age-based selectivity was fitted. This resulted in stock weights at age being applied as proxies for catch weights at age for those fleets, as the model cannot adjust the catch weights to reflect length-based selection. IBPBass2 explored the addition of length composition data together with the age compositions for the two UK fleets (otter trawls/nets/lines, and midwater trawls). The combined UK otter trawl/nets/lines fleet compositions were fitted assuming a six-parameter double-normal length-based selectivity curve, and the midwater trawl compositions were fitted using an asymptotic length based selectivity. These selection models were of the same form as used for fitting age-based selectivity for these fleets in previous assessments.

The addition of the length composition data and fitting selectivity as a function of length for the two UK fleets have little impact on the relative trends over time (Figure 4.2.3). Residuals of the age compositions however indicate an improved fit to the combined otter trawl/nets/lines fleet age compositions, but similar fit to the midwater trawl age compositions (Figure 4.2.3). IBPBass2 concluded that the inclusion of the length data and selectivity as a function of length improves the fit of the model with little impact on the relative stock trends, and that this change should be retained for further model development.

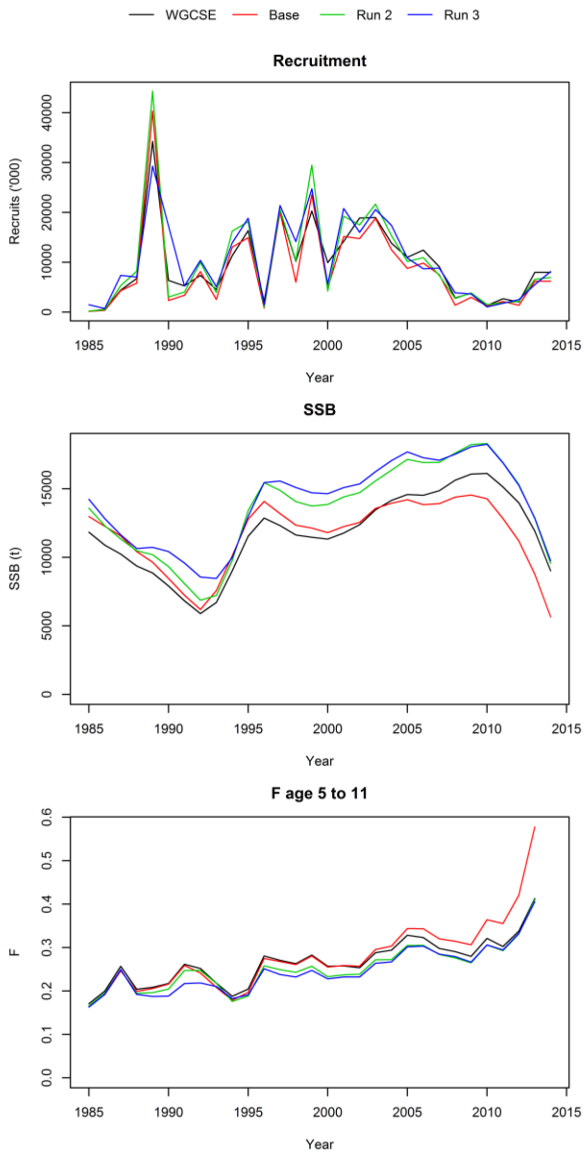



**Figure 4.2.3. Run 3: Effect on assessment of including both age and length frequency distributions for UK landings, and fitting selectivity as a function of length, compared with Run 2 which used only age compositions and fitted age based selectivity for UK fleets.**

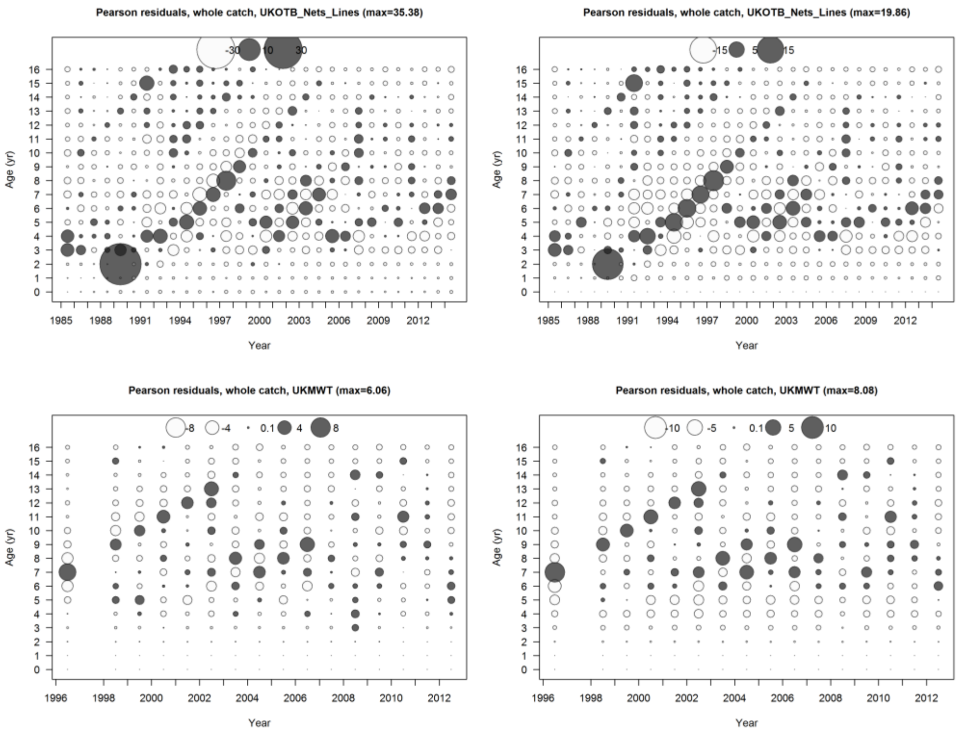



**Figure 4.2.4. <u>Run 3:</u> Residuals of age composition fit: Top: UK otter trawl/nets/lines; bottom: UK midwater trawl. Left: run 2 and right: run 3.**

<u>Run 4:</u> Autumn Solent bass survey: combination of age classes 2–4 into one single survey series.

The Solent survey data have previously been split in to 3 separate indices for ages 2, 3 and 4 to avoid the difficulties encountered in a previous benchmark (ICES IBP-New, 2012) in estimating selectivity parameters. IBPBass2 combined the abundance indices for these age classes and added the annual indices for each age as age composition data for the fleet in order to regain the covariance information provided by year-effects in the survey. Length composition data were not available for this inter-benchmark process. Selection was however fitted as a function of length using a double normal model, with minimum and maximum ages specified as 2 and 4 in the age selection function.

This change to the model had very little effect on the stock trends (Figure 4.2.5), but caused a slight reduction in uncertainty in the recruitment estimates (Figure 4.2.6).

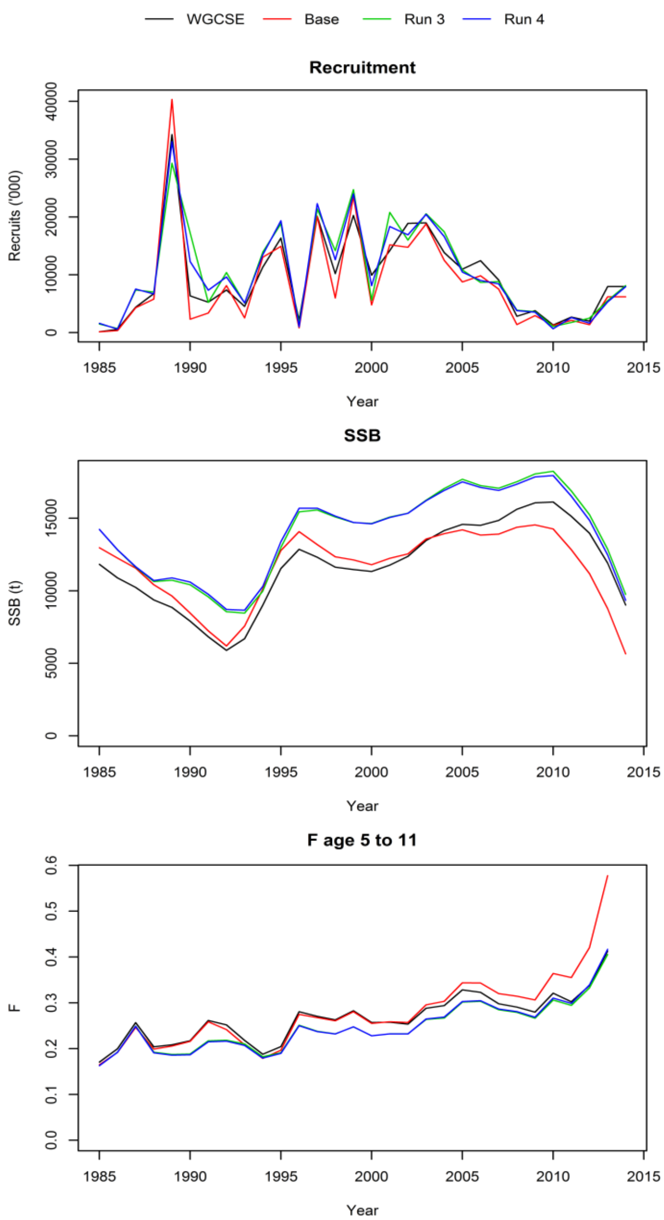



**Figure 4.2.5. <u>Run 4:</u> Effect of combining Autumn Solent bass survey into one survey index.**

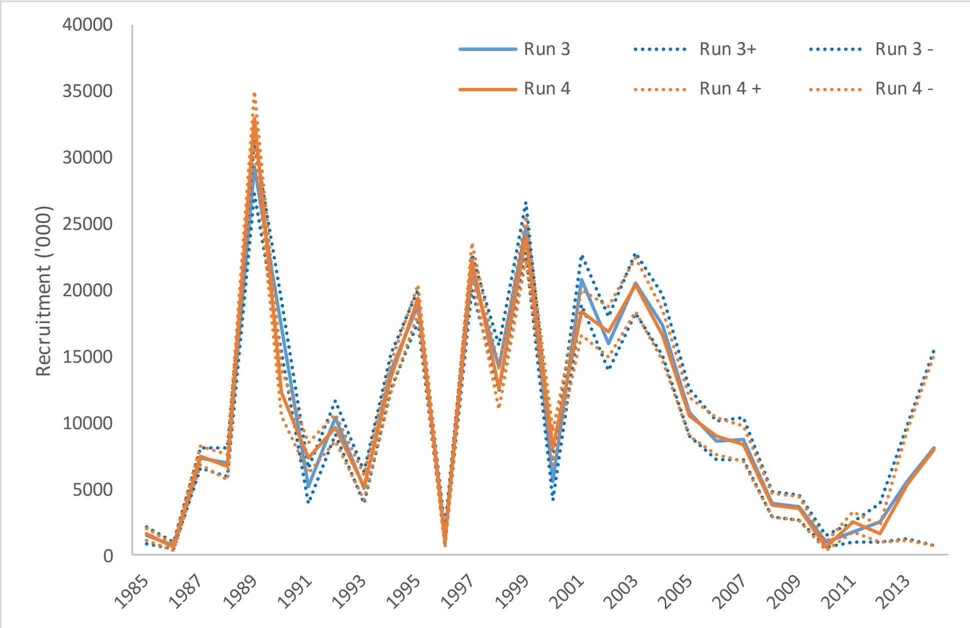



**Figure 4.2.6. Run 4: recruitment estimates and their standard deviations using the combined Solent survey index compared with the estimates from Run 3 with separate Solent indices for ages 2 – 4 treated as three separate surveys.**

Run 5: Incorporation of recreational catches as separate fleet rather than as a component of M.

Data from recreational fishery surveys in England, France, Netherlands and Belgium between 2009 and 2013, reported in WGCSE 2015 and previous assessments, indicate that the total recreational fishery landings could be around a quarter of the combined commercial and recreational fishery removals. If the recreational catch is not incorporated in the assessment and forecasts, it represents an unaccounted for mortality which is a problem when forecasting stock size. The fishing mortality estimated in the model is largely driven by the commercial fishery length and age compositions, and previous benchmarks have noted that excluding recreational catches does not alter the absolute estimates of F, but these become attributed completely to the commercial fishery. A major problem is that recreational catch estimates are only available for a few recent years, and are poorly aligned temporally between countries. IBPBass1 (ICES, 2012) used the available estimates to infer recreational removals of 1,500t in 2012. In the absence of a time-series of estimates, the same philosophy was adopted as for assuming a constant natural mortality rate in the absence of a time-series of estimates. This was implemented by adding a vector of F at age (with same selectivity as the UK commercial line fishery) to the natural mortality value, and adjusting this iteratively until the calculated recreational landing in 2012 was 1,500t. This has some undesirable consequences - for example the SS3 estimates of unexploited population size are incorrect because the recreational F is included in the M vector.

IBPBass2 developed an alternative (though equivalent) approach in which a recreational fishing fleet is specified in the model, and a time-series of landings for this fleet is reconstructed based on the assumption of a constant recreational fishing mortality over time, and conditional upon the 2012 recreational landings being 1,500t. This approach represents the landings as a fishing fleet and avoids having a fishing mortality component in the natural mortality value. The recreational fishery is predominantly rod-and-line, and the limited length–frequency data for retained fish from the recreational fishery surveys indicate a rough similarity with the length frequency distribution of retained sea bass in the UK commercial line fishery. It was therefore necessary to separate the UK line fishery catches and length and age composition data from the combined UK otter trawl/nets/lines fleet and estimate selectivity separately for this fleet. Based on analyses in previous benchmarks, selectivity for the UK line fleet was estimated using the 2-parameter asymptotic model as a function of length, and the selectivity of the recreational fishery was mirrored with this fishery.

The estimated time-series of international recreational landings, and the associated time-invariant recreational F, are shown in Figure 4.2.7. As in previous assessments, the recreational F is around 0.1, i.e. around a quarter of the total F in 2012. The stock trends for this run are given in Figure 4.2.8, and show higher SSB and lower F than Run 4 until 2010. Since both runs fit a constant recreational F, the differences must be due to the disaggregation of the UK commercial fishery into an additional lines component with the need to estimate an additional two selectivity parameters.

IBPBass2 proposed the retention of this approach for development of the final SS3 model configuration, as it represents the recreational fishery correctly as a fleet and not a component of M, thereby avoiding confusion and problems with interpreting model outputs such as fishing mortality and unexploited biomass. It must however be seen as a temporary solution, as there continue to be major uncertainties related to the accuracy of the recreational catch estimates and the assumption of constant recreational F, which will become increasingly violated in future due to management measures currently being applied separately to the commercial and recreational fisheries.

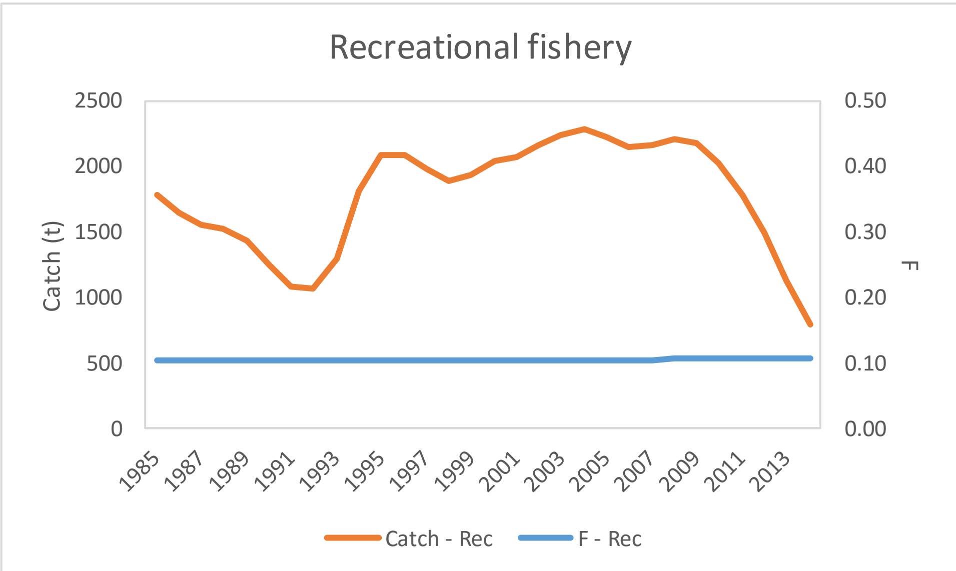



**Figure 4.2.7. Run 5: Estimated annual recreational landings and associated year-invariant fishing mortality resulting in recreational landings in 2012 of 1,500t, the figure inferred from recreational fishery surveys in years around 2012.**

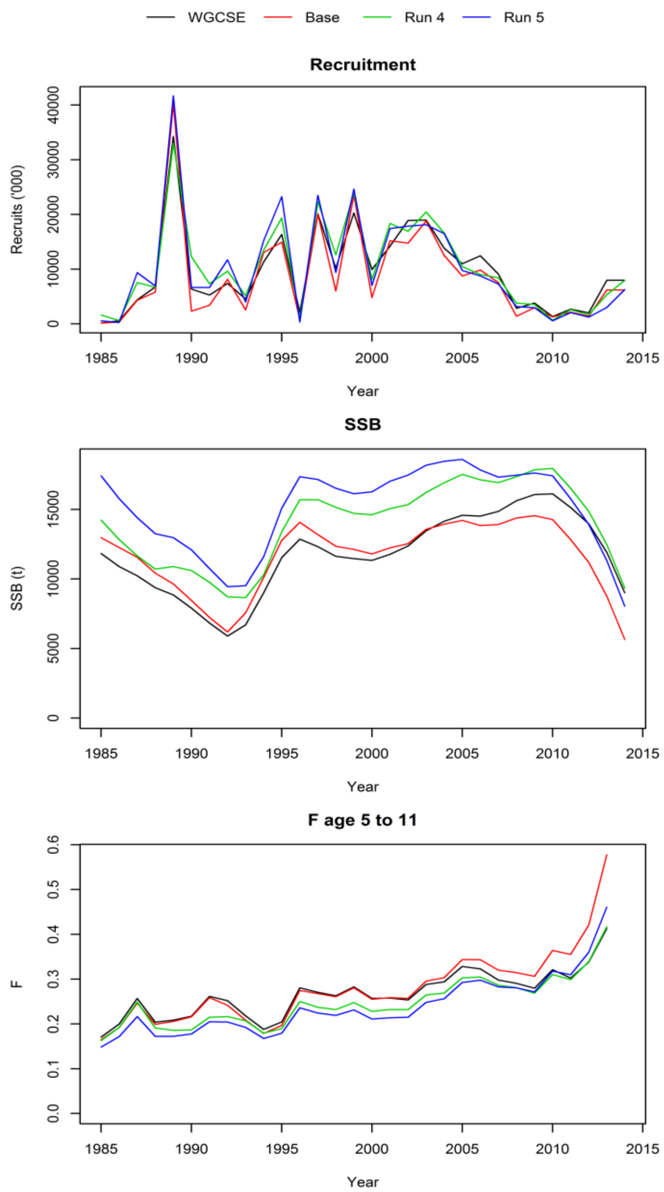



**Figure 4.2.8. Run 5. Effect on assessment of including the recreational fishery and UK commercial line fleet as separate fleets, with asymptotic length-based selectivity, compared with Run 4 in which recreational fishing mortality is included in the M vector, and UK commercial lines are included with otter trawl and nets as a single fleet.**

Run 6. Effective sample size weighting (Francis method).

Effective sample size for the fleets and survey age and length compositions were adjusted to equal the sample sizes (numbers of fishing trips sampled) as concluded in IBPbass1 (ICES 2014). IPBBass2 revisited the sample sizes and where information was available used the number of trips per year for each of the datasets. Sample sizes were adjusted using the Francis method of weighting. This was carried out using an iterative re-weighting process of compositional data using the input sample sizes and the effective sample sizes based on model fit. This method reduces the disproportionate effect of the different dataset used. Table 4.2.1 provides the multiplier by fleet for each of the age and length composition data sources.

**Table 4.2.1. Effective sample size multiplier for age and length compositions by fleet.**

| FLEET | DATA TYPE | MULTIPLIER |
|---|---|---|
| UK otter trawl/nets | Length compositions | 0.2625 |
| | Age compositions | 0.2376 |
| UK Lines | Length compositions | 0.1539 |
| | Age compositions | 0.1591 |
| UK midwater trawl | Length compositions | 0.1601 |
| | Age compositions | 0.7251 |
| French – all gears | Length compositions | 0.2023 |
| | Age compositions | 0.3362 |
| Autumn Bass survey | Age compositions | 0.8443 |
| French channel groundfish survey (CGFS) | Length compositions | 0.3562 |

Applying the above multipliers to the sample sizes for age and length composition combinations for each of the fleet resulted in a reduction in the residuals for the age and length compositions. SSB is estimated to be higher in recent years and lower in the early part of the time-series (Figure 4.2.9). Consequently, the negative log likelihoods for all components, with the exception of the equilibrium catch, decreased compared with run 5 (Table 4.2.2).

**Table 4.2.2. Summary of Likelihood values from SS3 runs 5 and 6**

| LIKELIHOOD COMPONENT | RUN5 | RUN6 |
|---|---|---|
| TOTAL | 3459.55 | 897.344 |
| Catch | 7.4839E-11 | 3.8935E-12 |
| Equil_catch | 0.1054 | 0.371252 |
| Survey | 3.2278 | 0.43911 |
| Length_comp | 1385.95 | 320.15 |
| Age_comp | 2030.4 | 547.626 |
| Recruitment | 39.8395 | 28.7418 |
| Parm_softbounds | 0.0182632 | 0.0158571 |
| Convergence level | 8.1053E-05 | 2.822E-05 |
| Active parameters | 83 | 83 |

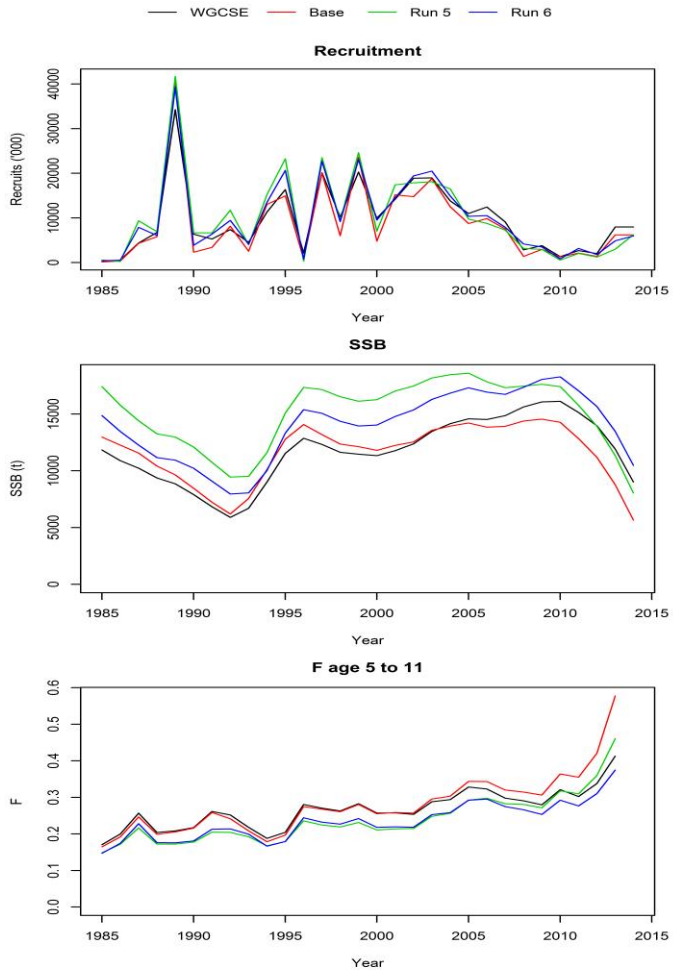



**Figure 4.2.9. Run 6: effect on stock trends of applying the Francis (2011) method to adjust the relative weighting of datasets in the assessment, compared with Run 5 where the input sample sizes are based on the actual sample sizes (numbers of trips sampled for length or age).**

## 4.3 Sensitivity and jitter analysis

IBPBass2 concluded that model Run 6 could be taken forward as the agreed approach for use in future update assessments for sea bass. However there are a number of assumptions in the model that introduce additional uncertainty to the model results. These include assumptions that relate to the biology and productivity of the stock (e.g. natural mortality and shape of the stock–recruit relationship), and assumptions related to input data and how the model is fitted. As IBPBass2 was convened primarily to review the quality and utility of French age data, it was not possible (or indeed appropriate) in the time available to comprehensively review the sensitivity of the model to all the assumptions, which should be a task for a full benchmark process. A full evaluation of uncertainty would also include Monte Carlo–Markov Chain (MCMC) or Monte Carlo–bootstrap (MCB) runs to represent uncertainty in all input data and parameters.

Using the model settings of run 6, the following sensitivity analysis were performed:

- Sensitivity to different natural mortality settings;
- Sensitivity to steepness in the stock recruitment relationship;
- Alternative lambda setting for down-weighting age and length composition data for the commercial fleets where both datasets are fitted in the model;
- Sensitivity to different levels of recreational catch.

This approach underestimates sensitivity, as it does not include sensitivity to altering these values in different possible combinations.

<u>Sensitivity to choice of natural mortality M</u>

The value (or vector) of natural mortality used in an analytical assessment is a key parameter determining the estimated productivity, abundance and MSY or other reference points (RPs). The assumed shape of the stock–recruit curve acts with the assumed M to constrain any possible biological reference points (Mangel *et al*., 2013). There are no direct estimates of natural mortality for sea bass. Armstrong (2012) in a working document to IBP-NEW (ICES 2012) used a range of life-history methods which (with the exception of a method by Beverton (1992)), gave age-invariant estimates in the range 0.15– 0.22. The Working Document recommended that the sea bass assessment uses M=0.18 as the baseline M, and to examine the sensitivity of the assessment to M= 0.15 and M = 0.22. IBP-New concluded that a value of 0.2 was appropriate given the maximum age of 28 years in historical samples, and the relatively delayed age at maturity. IBPBass1 revised the assumed value down to 0.15. Four sensitivity runs were carried out by IBPBass2:

- Allowing the model to estimate natural mortality
- A fixed value of 0.1 for natural mortality across all ages
- A fixed value of 0.2 for natural mortality across all ages
- A vector of mortality following the Gislason *et al* (2010) method identified in IBPBass1 (2014).

Natural mortality estimated by the model was 0.156 with an SD of 0.041, which is close to the fixed value used in Run 6 of 0.15. Apart from the increase in number of estimated parameters, the total likelihood and assessment results closely match the total likelihood and estimates of recruitment, SSB and $F_{5\text{-}11}$ of run 6 (Figure 4.3.1). However, the uncertainty given by the standard deviation suggests that natural mortality could be between 0.1 and 0.2.

It is expected that natural mortality will be relatively high at younger ages, and decline with increasing size and age. The Gislason *et al* (2010) method generates a natural mortality vector of this form. As expected, recruitment estimates are much higher using this method (other than compared with M=0.2 for all ages), but the relative trends in recruitment are very similar to those from the other M assumptions. Estimates of SSB and $F_{5\text{-}11}$ from the Gislason *et al* method are similar to the results from run 6 (with M=0.15) and from the sensitivity run when the model is allowed to estimate natural mortality (giving the value of 0.156). This is because the age range for mature fish, and for calculating mean F, corresponds to the age range in which the Gislason method provides estimates declining from just above 0.2 to between 0.1 and 0.2.

Sensitivity to steepness in the stock recruitment relationship

A key parameter defining a stock–recruit curve is its 'steepness'. This is defined as the ratio of recruitment from an unfished population to its recruitment when the spawning–stock biomass is at 20% of the unfished level. The stock synthesis model currently uses a Beverton–Holt (asymptotic) model with fixed stock–recruit steepness of 0.999 as there are insufficient observations to provide a possible value for steepness. IBPBass2 explored the sensitivity of the model to a steepness value of 0.7, and the results shown in Figure 4.3.2 show very little sensitivity to this value with just a minor revision downward for SSB and upward for F5-11.

Sensitivity to the lambda settings for the age and length composition data of the commercial fleets

The structure of Stock Synthesis allows the input of data closer to its raw form – for example length compositions for individual fleets together with conditional age-length data (sample data giving age compositions within length classes –i.e. age length keys). In this case, the numbers-at-age in the catches can be generated within the model taking into account weightings that relate to the sample sizes for each type of data. The inclusion of length and age data in the model allows the fitting of length-based selectivity to fishing fleets whereas retaining the year-class signals contained within age data and allowing for sample sizes in both sets of data. This approach is widely used outside Europe, whereas within ICES the conventional approach is for numbers-at-age to be estimated external to the model by applying age length keys to fleet-raised length compositions. This method (in principle) correctly accounts for the weighting factors at each stage in stratified, multistage cluster sampling schemes. Given the number of national strata in the sea bass sampling programmes, it was not feasible for IBPBass2 to generate conditional age-length input data and it was decided to look at this in more depth during a full benchmark assessment. An alternative approach used in parts of the USA, is to include fleet raised length compositions as well as the fleet-raised age compositions in the model, but to apply downweighting (emphasis factors–lamda) to each type of data to avoid the over-weighting that results from "double counting" through use of both the age and length compositions from the same sources. IBPBass2 decided to set the lambda values for the length and age compositions for fleets with both types of data to minimize overall negative log likelihood and alleviate the "double counting" concern (since lambda values are being multiplied in the model by the corresponding likelihood component).

Three sensitivities runs were carried out in which the lambda values for the length and age data in Run 6 were set as follows: lambda 0.4/0.6, 0.5/0.5 and 0.6/0.4 for the length and age data respectively.

Applying the lambda values had the expected effect of reducing the negative log likelihoods for the age and length composition data (Table 4.3.1), with very little difference to the SSB, recruitment and $F_{5.11}$ time-series estimated by each of the models (figure 4.3.3).

Sensitivity to the different levels of recreational catch

Very little information is available on the historical catch from the recreational fisheries and where data are available the precision is estimated to be around 20–30 %. With only one combined estimate the uncertainty in the time-series is unknown, IBPBass2 explored the sensitivity to an increase and decrease in the time-series of recreational catch by 20% over the time-series (figure 4.3.4).

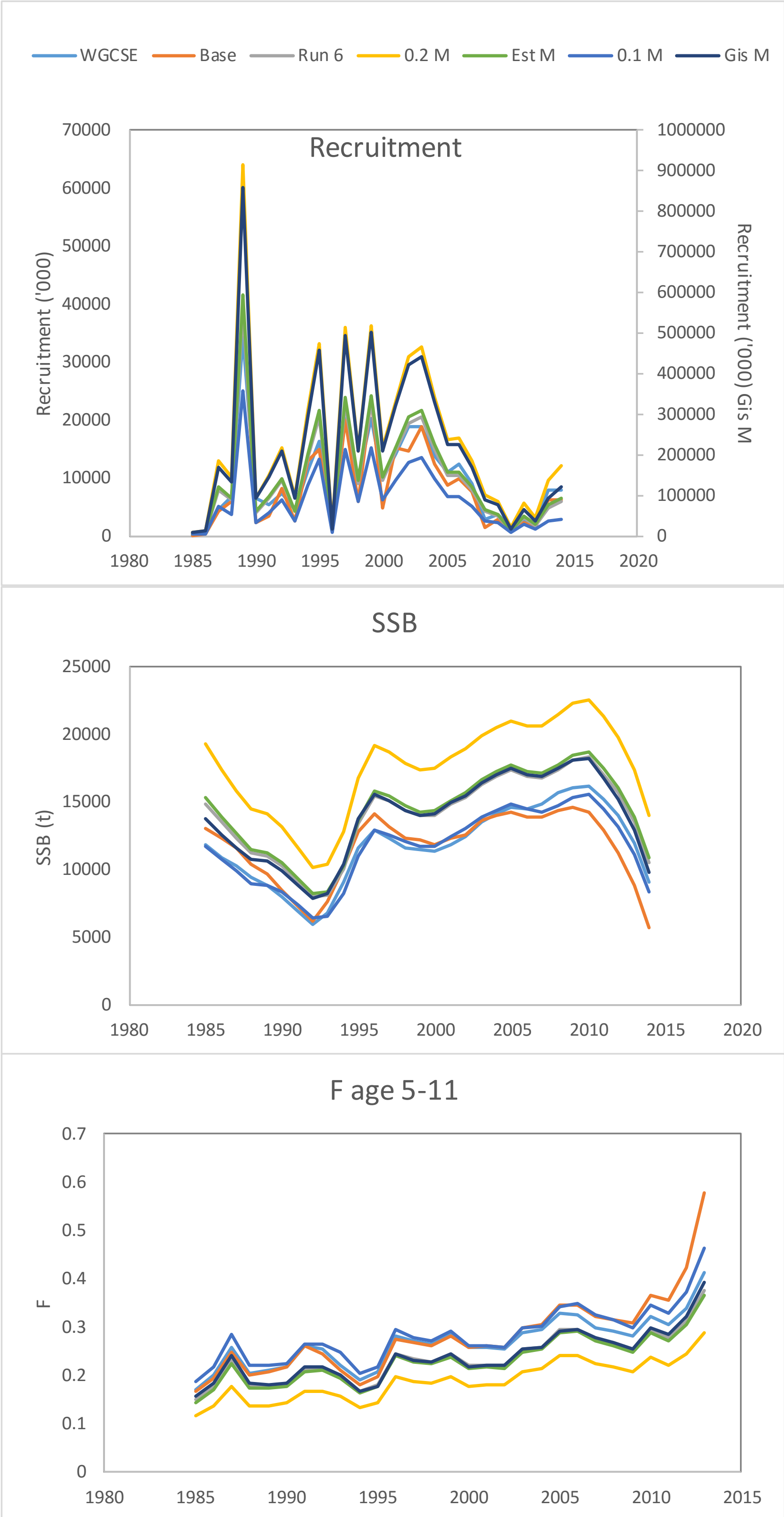



**Figure 4.3.1. Sensitivity of Run 6 model to choice of natural mortality (M). Est M = value estimated by Stock Synthesis; Gis M = Gislason method with age-dependent values; Run 6 = run with M=0.15.**


**Figure 4.3.2. Sensitivity of Run 6 model to choice of stock recruit steepness**

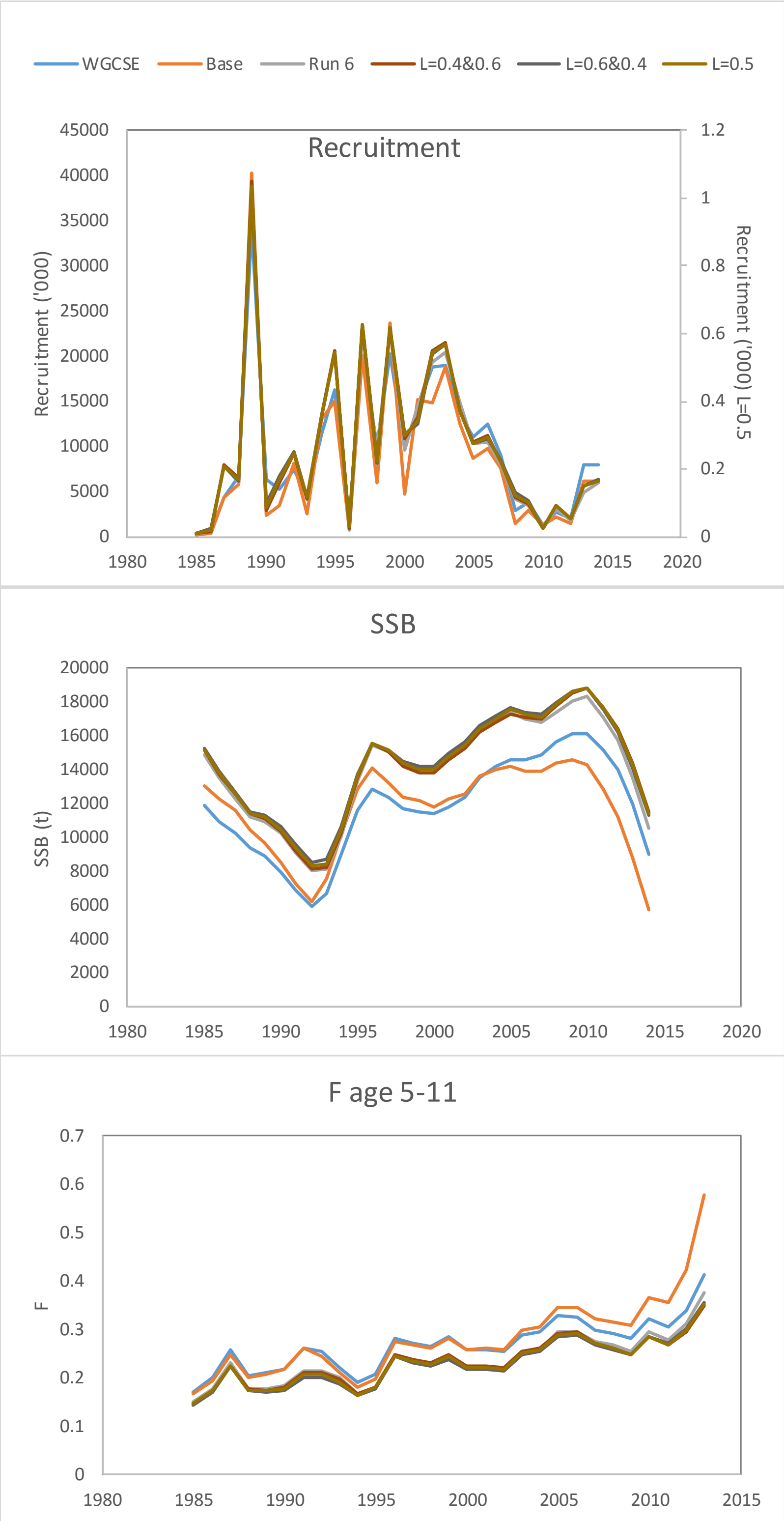



**Figure 4.3.3. Sensitivity of stock trends from run 6 to choice of lambda values for the age and length compositions of the commercial fleets. Lambda values e.g. L=0.4&0.6 refer to length then age (i.e. lambda for length data = 0.4, and for age = 0.6).**

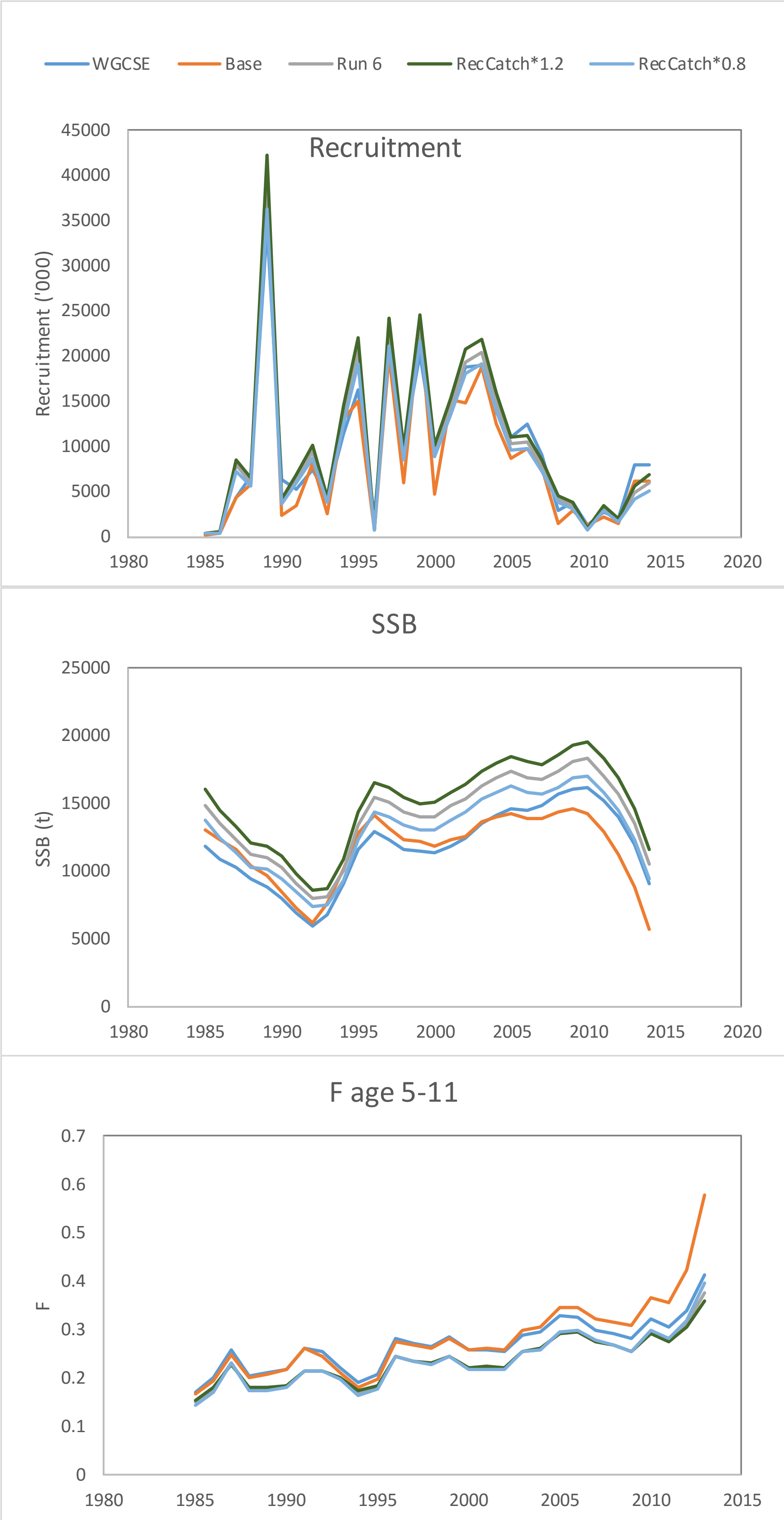



**Figure 4.3.4. Sensitivity of stock trends from run 6 to different levels of recreational catch.**

**Table 4.3.1 Summary of Likelihood values from SS3 sensitivity runs adjusting natural mortality M, stock–recruit steepness, Lamda values for weighting age and length composition data, and increasing or decreasing the annual recreational catch.**

| | M=0.2 | M=0.1 | SS3 est M | Gislason M | 0.7 SR steepness |
|---|---|---|---|---|---|
| TOTAL | 897.928 | 897.92 | 897.334 | 914.236 | 903.958 |
| Catch | 6.21E-13 | 9.46E-11 | 2.79E-12 | 7.10E-12 | 2.01E-11 |
| Equil_catch | 0.0187 | 1.8447 | 0.2863 | 0.8168 | 0.8211 |
| Survey | 0.6929 | 0.3021 | 0.4607 | 0.1803 | 1.0018 |
| Length_comp | 320.9570 | 319.3770 | 320.2320 | 328.5960 | 320.9090 |
| Age_comp | 549.9440 | 544.9420 | 547.9310 | 555.9080 | 545.8130 |
| Recruitment | 26.2996 | 31.4377 | 28.4075 | 28.7199 | 35.3965 |
| Forecast_Recruitment | 0 | 0 | 0 | 0 | 0 |
| Parm_priors | 0 | 0 | 0 | 0 | 0 |
| Parm_softbounds | 0.0160 | 0.0158 | 0.0159 | 0.0156 | 0.0160 |
| Parm_devs | 0 | 0 | 0 | 0 | 0 |
| Crash_Pen | 0 | 0 | 0 | 0 | 0 |
| Convergence level | 3.73E-05 | 9.2E-05 | 3.67E-05 | 8.96E-05 | 7.28E-05 |
| Active parameters | 83 | 83 | 84 | 83 | 83 |
| | Lamda= 0.4&0.6 | Lamda= 0.6&0.4 | Lamda= 0.5&0.5 | RecCatch *1.2 | RecCatch *0.8 |
| TOTAL | 538.574 | 487.373 | 514.574 | 896.682 | 898.34 |
| Catch | 1.94E-12 | 2.00E-12 | 2.20E-12 | 2.41E-12 | 7.16E-12 |
| Equil_catch | 0.2886 | 0.3688 | 0.2803 | 0.2478 | 0.5230 |
| Survey | 0.1979 | -0.0297 | -0.0553 | 0.5333 | 0.3458 |
| Length_comp | 168.1220 | 208.7110 | 189.0840 | 319.989 | 320.368 |
| Age_comp | 342.6960 | 254.0320 | 298.9560 | 547.950 | 547.285 |
| Recruitment | 27.2557 | 24.2768 | 26.2950 | 27.9463 | 29.8027 |
| Forecast_Recruitment | 0 | 0 | 0 | 0 | 0 |
| Parm_priors | 0 | 0 | 0 | 0 | 0 |
| Parm_softbounds | 0.0134 | 0.0139 | 0.0136 | 0.0159 | 0.0159 |
| Parm_devs | 0 | 0 | 0 | 0 | 0 |
| Crash_Pen | 0 | 0 | 0 | 0 | 0 |
| Convergence level | 6.16E-05 | 4.59E-05 | 3.27E-05 | 7.9E-05 | 1E-05 |
| Active parameters | 83 | 83 | 83 | 83 | 83 |

## 4.4 Jitter analysis

An analysis was run using the jitter function within SS3 which added 10% variation on the 83 parameters to be estimated. This was to check whether the model would be able to converge and provide similar results for each run with similar negative log likelihood values. 25 runs were carried out on Run 6 with a lambda value of 0.5 for both the age and length composition data for the commercial fleets. Of the 25 runs, 9 were unable to converge. All other model runs converged at the same point giving the same negative log likelihood values for each of the input datasets.

## 4.5 Conclusion from model development process

The model considered by IBPBass2 as suitable for future update assessments by ICES differs in several important respects from the model presented by ICES WGCSE in 2015. Key changes include:

- Fixing all growth parameters of the von Bertalanffy growth equation
- Inclusion of French age data (run1 and 2)
- Inclusion of UK length data (run 3)
- Combining the UK Autumn Solent bass survey into one index (run 4)
- Separation of the UK trawls/Nets and lines in to two fleets and Inclusion of the recreational catch at a separate fleet (run 5)
- Revision of input effective sample sizes using the Francis method (run 6)
- Using an emphasis factor (lamda) of 0.5 each for length and age composition data (sensitivity run)

In combination, these changes improve the model and alter the absolute values of SSB and fishing mortality compared with the WGCSE 2015 assessment, but have little effect on the relative trends (Figure 4.3.3–comparing the run with Lambda=0.5 with the WGCSE 2015 run).

## 4.6 Final assessment and diagnostics

The data incorporated in the assessment and fleet landings are shown graphically in Figure 4.6.1. and the input files are given in Annex 1, Appendix 1–4. A range of model outputs are shown in Figures 4.6.2–4.6.20. Standard summary tables, and tables of output stock numbers and commercial fishery F are given in Tables 4.6.1–4.6.3.

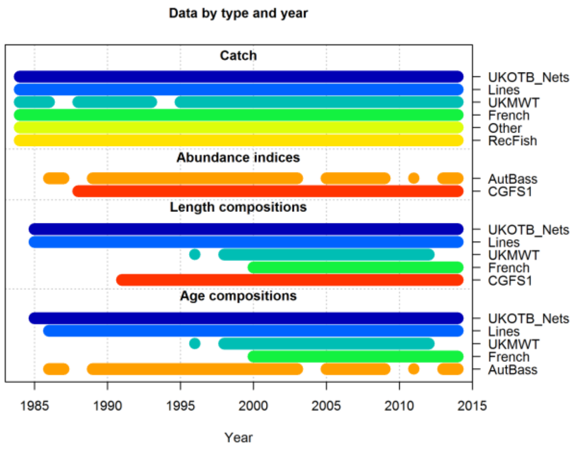
Good correspondence was found between the observed and fitted length compositions for each fleet (figure 4.6.2-9), particularly for the period after 1990. However, the observed and fitted age compositions (figures 4.6.10–15) for each fleet were less well fitted with some diagonal residual patterns indicating some problems in fitting extreme variations in recruitment.

Both the UK Solent Autumn bass and the channel groundfish abundance indices given in figures 4.6.16–17, fit reasonably well with good fits to both the age and length compositions, respectively.

With the additional of advanced options for recruitment deviation the model gives reasonable precision back to the 1976-year class (figure 4.6.18). This allows a longer term perception of recruitment dynamic. Recruitment is highly variable with no evidence of a reduction in average recruitment at the lower SSB values (figure 4.6.19) mainly affected by the imposition of a steepness value of 0.999 for the fitted Beverton–

Holt stock–recruit curve. As in IBP-Bass the likelihoods progressively worsened as the steepness value reduced.

The Retrospective analysis was carried out, for runs with data up to 2012 and 2013, it was necessary to re-estimate the recreational landings to give constant recreational F corresponding to landings of 1 500 t in 2012. For runs with final data year 2011 or earlier, the recreational landings for the run ending 2012 was adopted. There is evidence of a retrospective bias (Figure 4.6.20) given by a Mohn's Rho value of 0.265 for fishing mortality and -0.15 for SSB from a 7-year peel. A Mohn's Rho value of greater than 0.2 for fishing mortality is above the reference criteria identified by ICES in relation to the frequency of assessment.



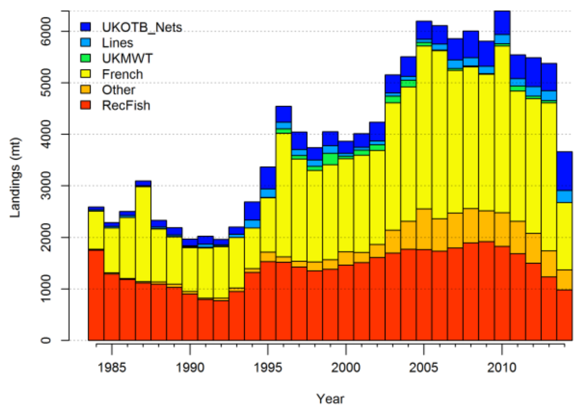
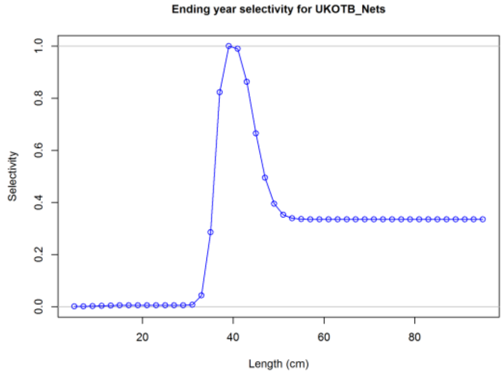
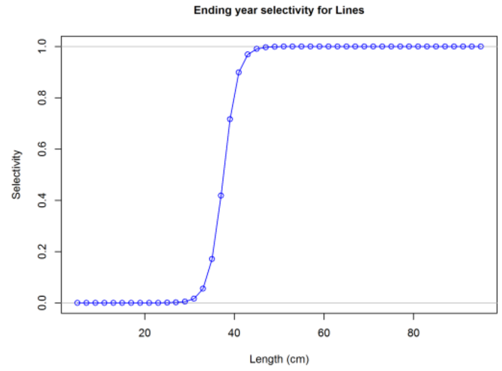
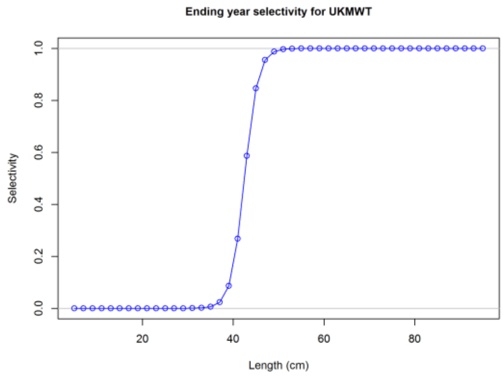
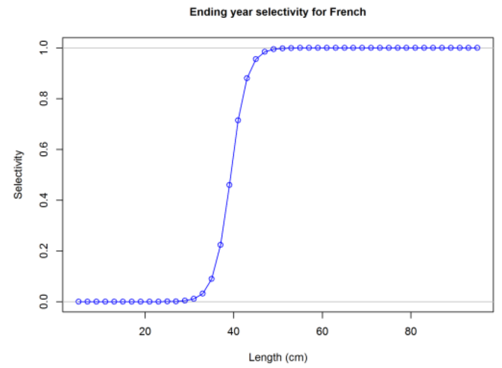




**Figure 4.6.1. Left: Datasets used in the final assessment. Right: Landings series for the six fleets.**


Ending year selectivity for UKOTB_Nets
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
20
40
60
80
Length (cm)


Ending year selectivity for Lines
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
20
40
60
80
Length (cm)


Ending year selectivity for UKMWT
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
20
40
60
80
Length (cm)


Ending year selectivity for French
Selectivity
0.0
0.2
0.4
0.6
0.8
1.0
20
40
60
80
Length (cm)

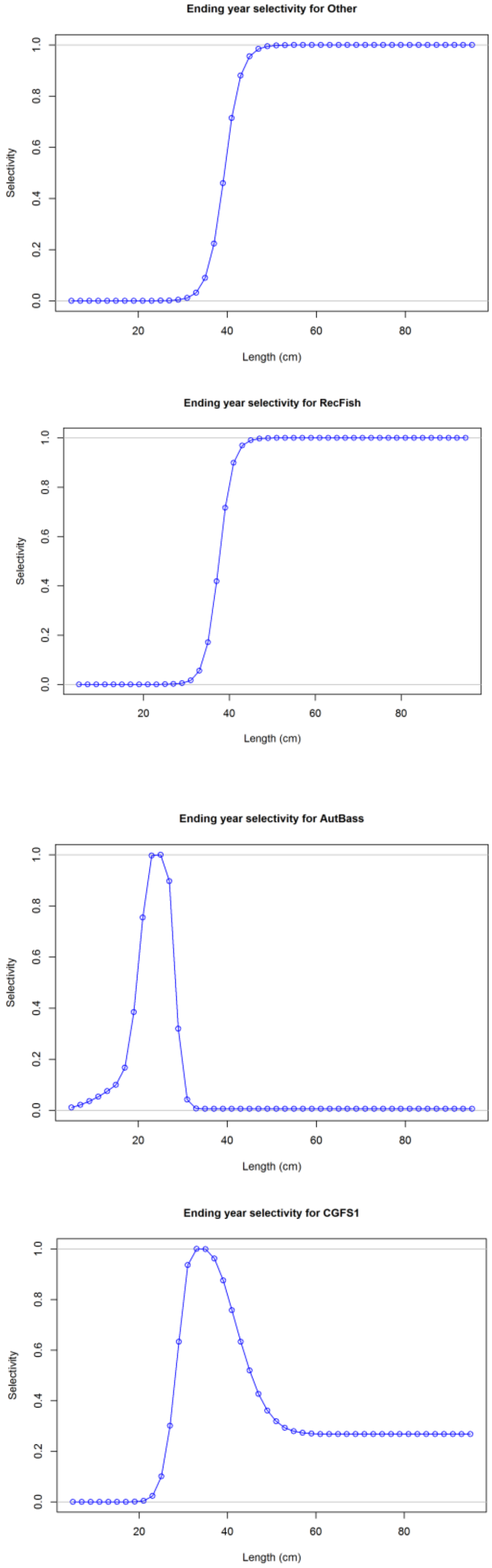



**Figure 4.6.2. Final sea bass assessment: fitted length-based selectivity curves.**

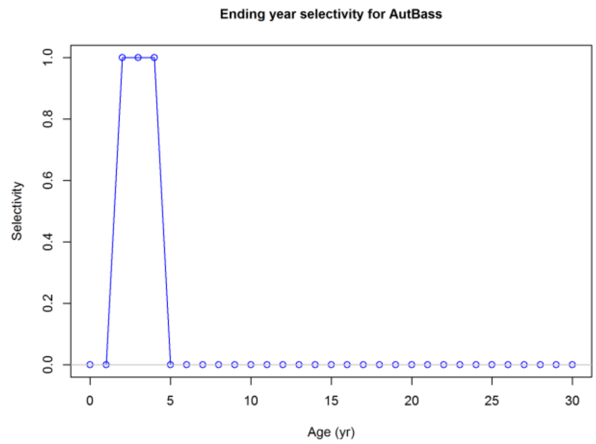



**Figure 4.6.3. Final sea bass assessment: fitted age-based selectivity curves.**

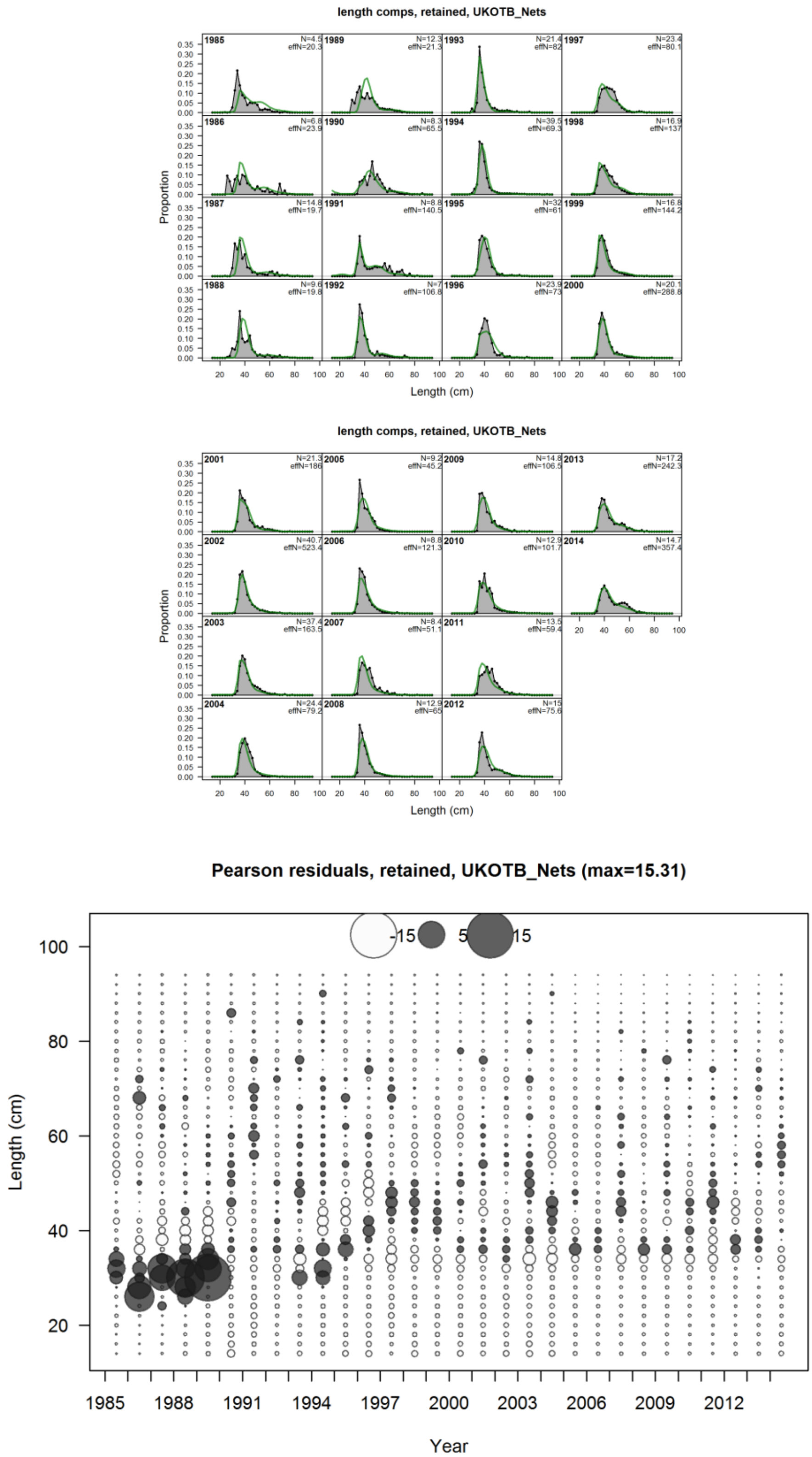



**Figure 4.6.4. Final sea bass assessment: fit to UK trawls and nets fishery length composition data.**

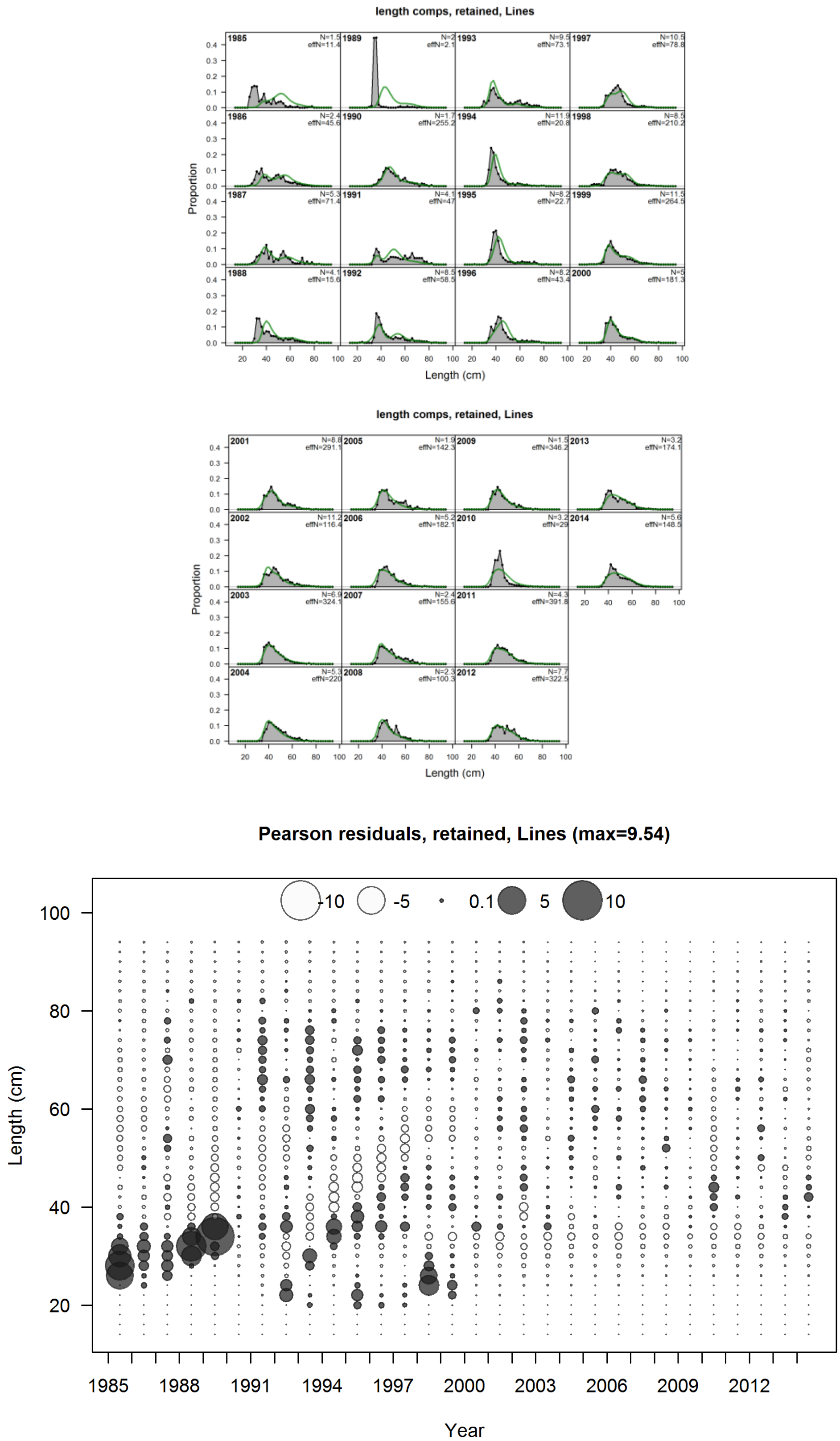



**Figure 4.6.5. Final sea bass assessment: fit to UK Lines fishery length composition data.**

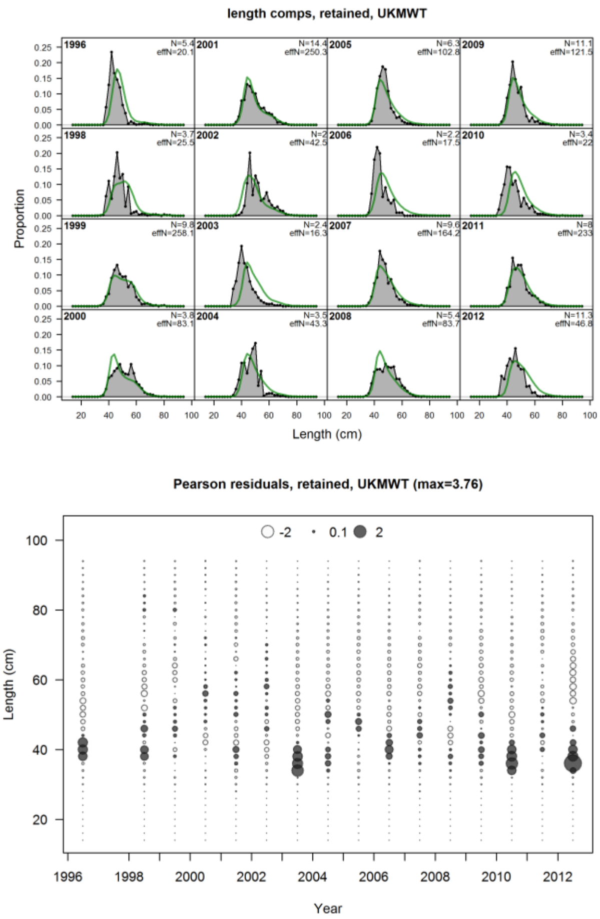



**Figure 4.6.6. Final sea bass assessment: fit to UK midwater trawl fishery length composition data.**

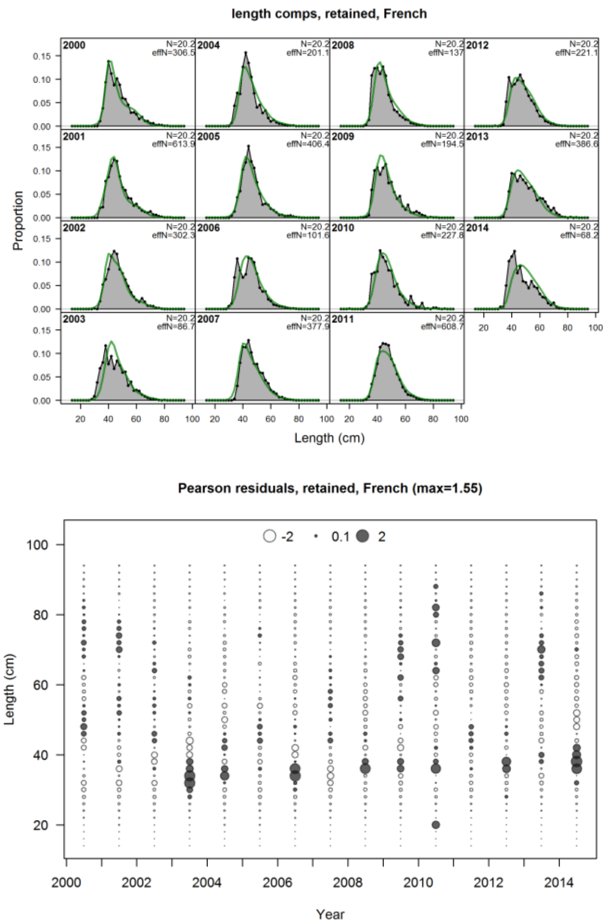



**Figure 4.6.7. Final sea bass assessment: fit to french fishery length composition data.**

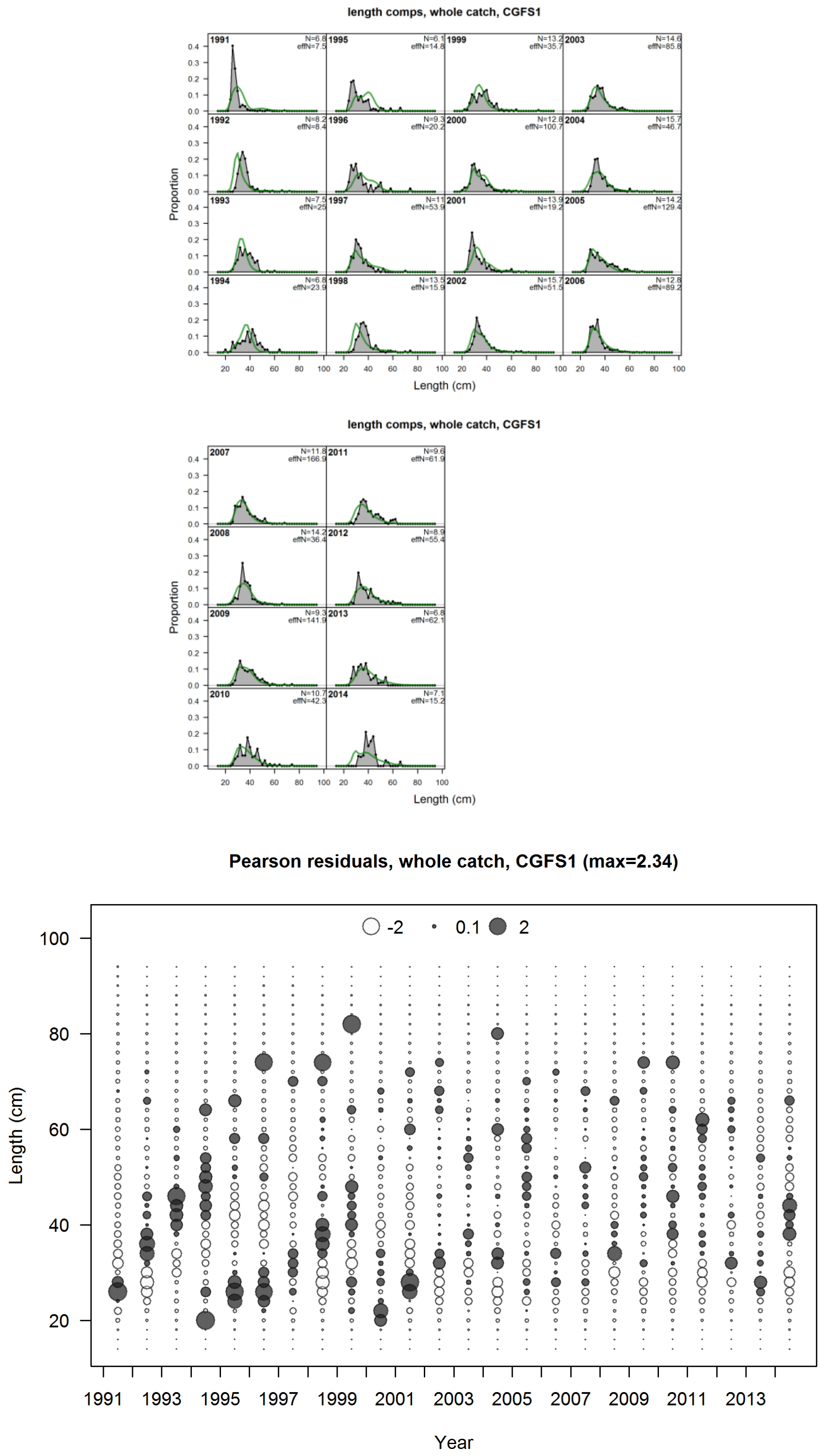
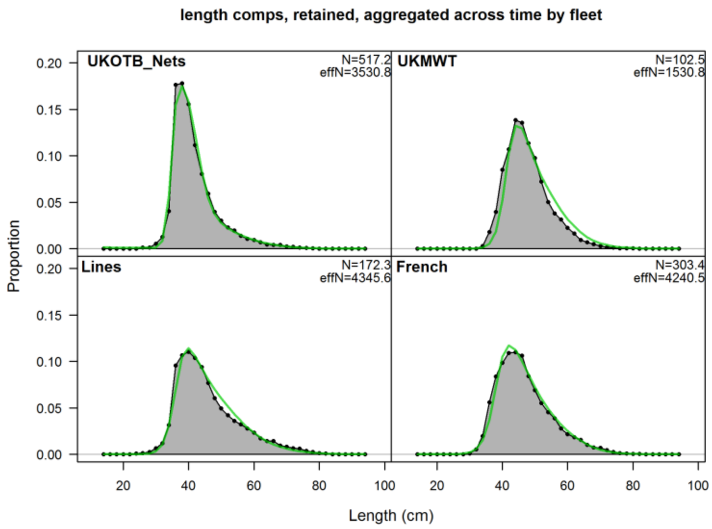



**Figure 4.6.8. Final sea bass assessment: fit to French Channel groundfish survey length composition data.**



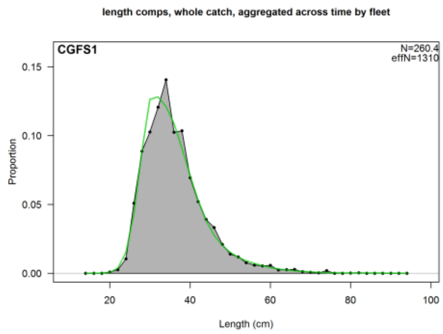




**Figure 4.6.9. Final sea bass assessment: fit to length composition data by fishery and survey, aggregated across time.**

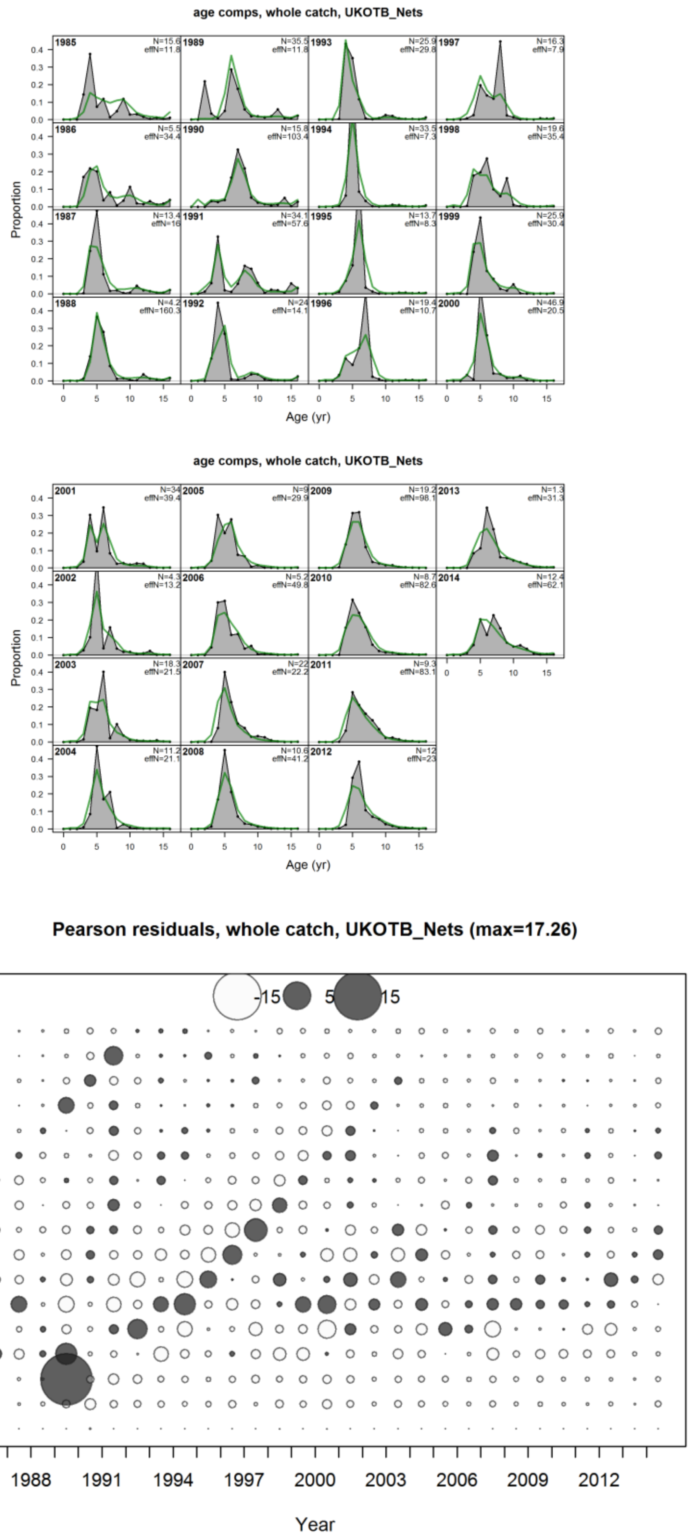



**Figure 4.6.10. Final sea bass assessment: fit to UK trawls and nets age composition data.**

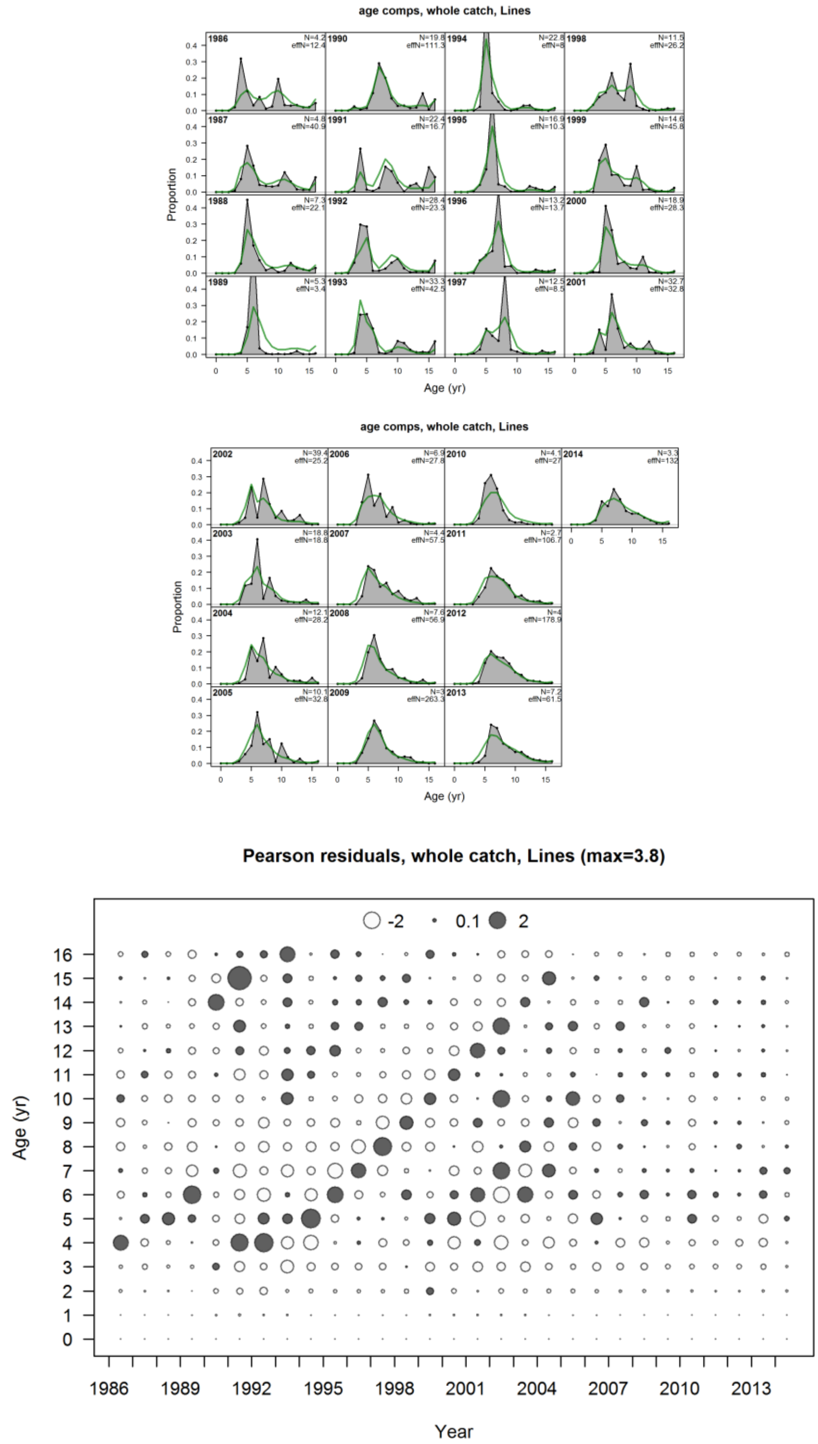



**Figure 4.6.11. Final sea bass assessment: fit to UK lines age composition data.**

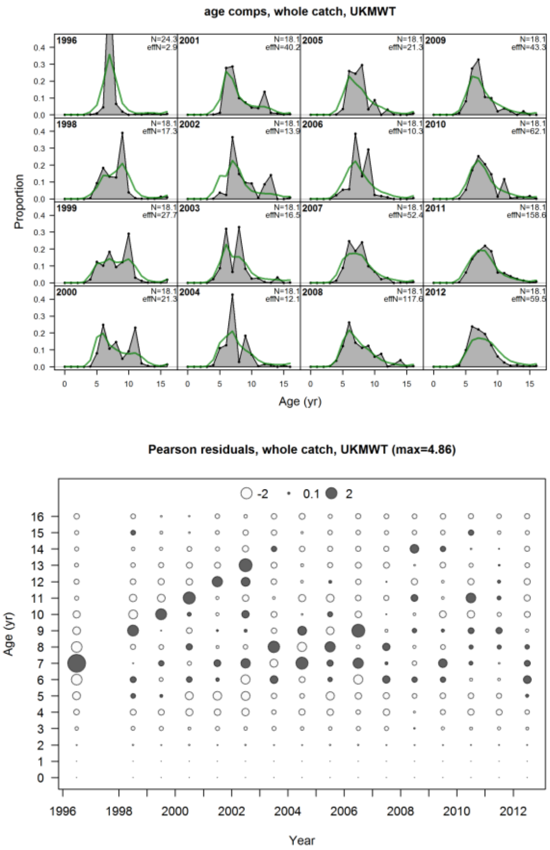



**Figure 4.6.12. Final sea bass assessment: fit to UK midwater trawl age composition data.**

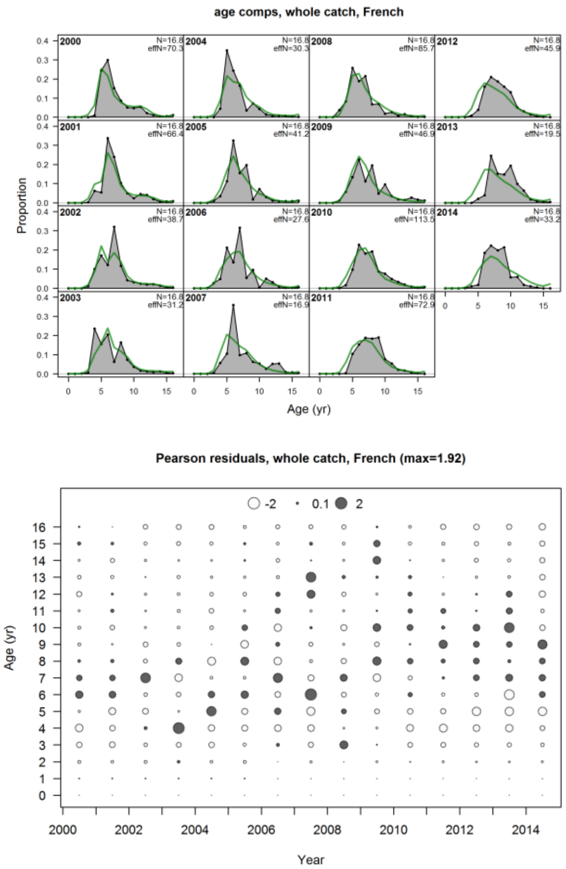



**Figure 4.6.13. Final sea bass assessment: fit to french fishery age composition data.**

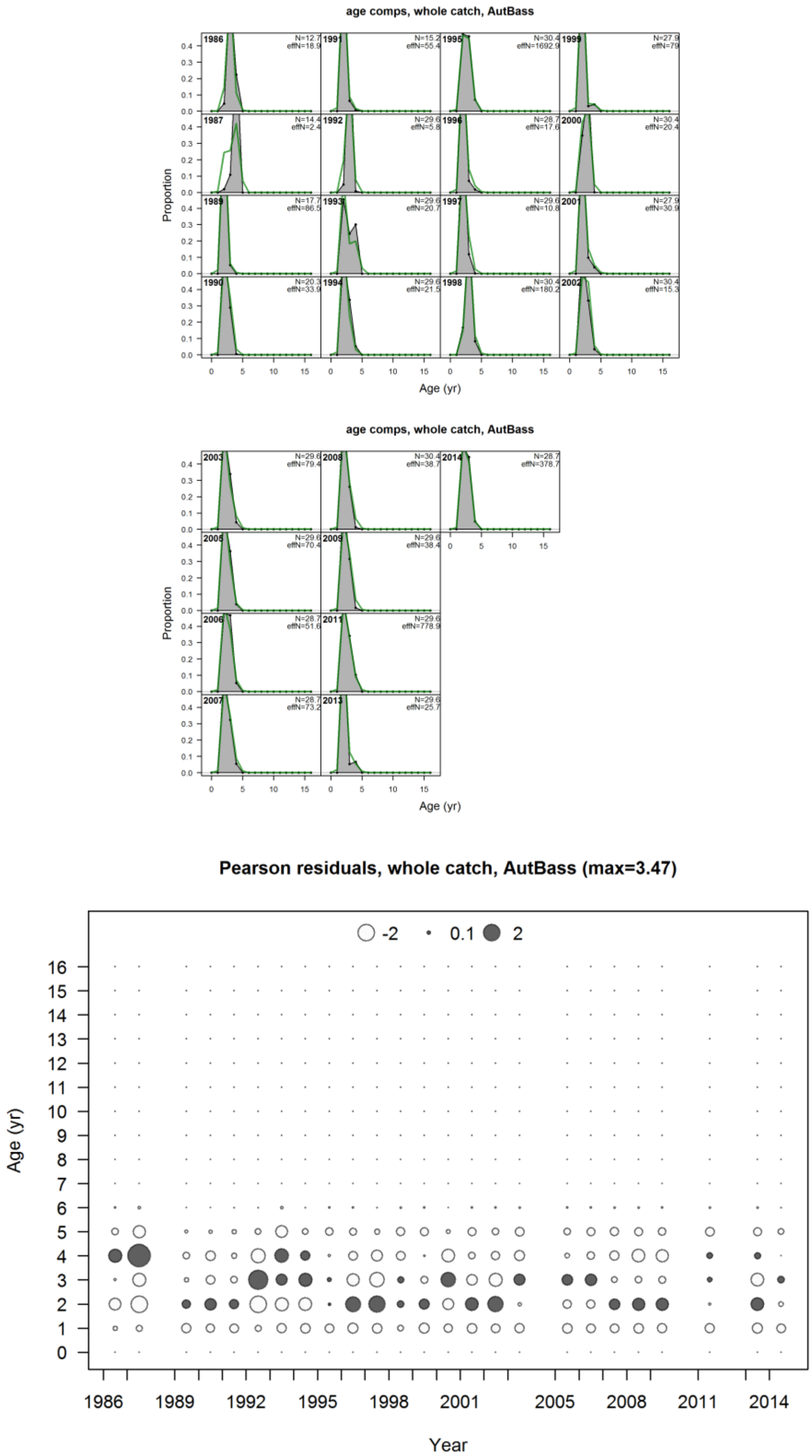



**Figure 4.6.14. Final sea bass assessment: fit to UK Solent Autumn bass survey age composition data.**

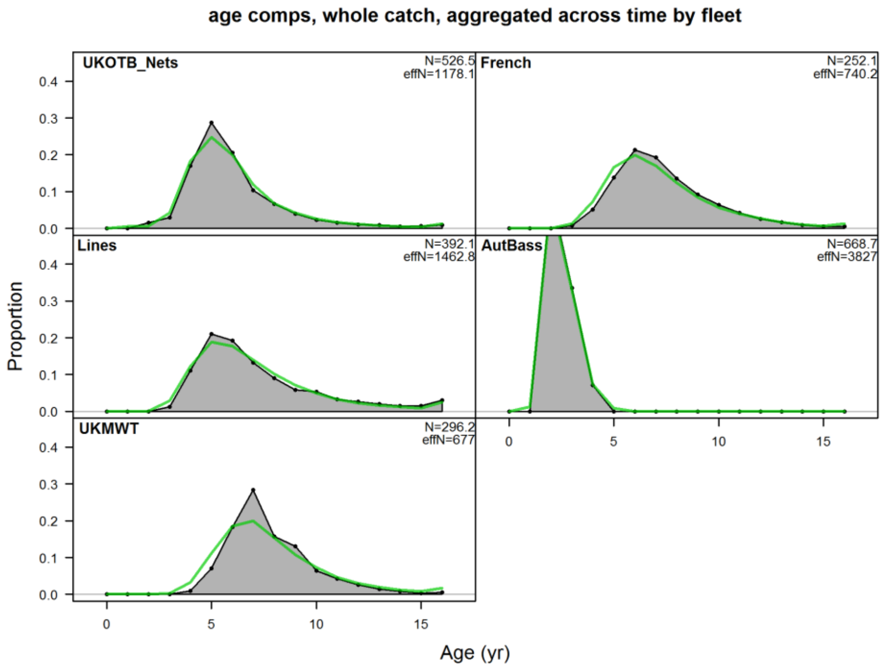



**Figure 4.6.15. Final sea bass assessment: fit to age composition data by fishery and survey, aggregated across time.**

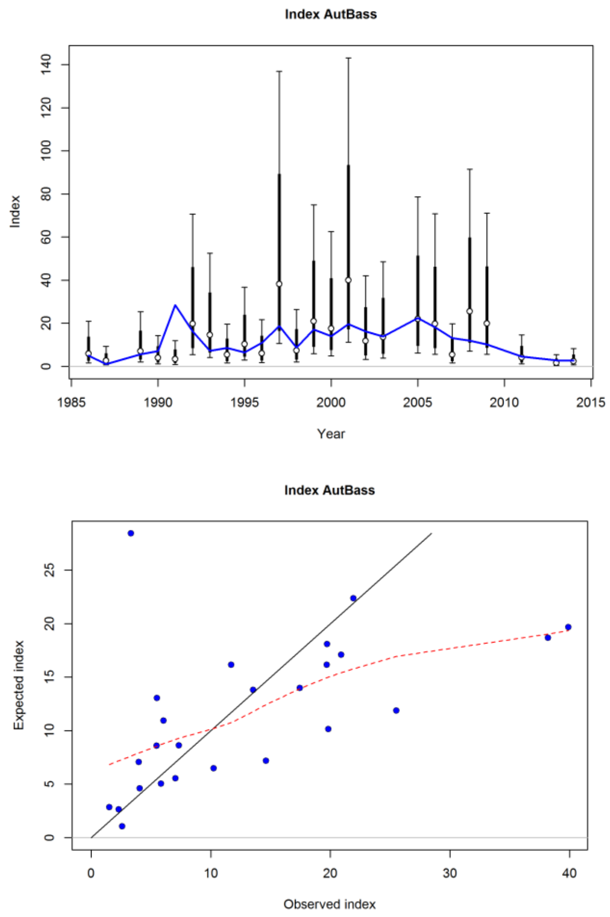



**Figure 4.6.16. Final sea bass assessment: fit to UK Solent Autumn bass survey, according to length and age based selectivity.**

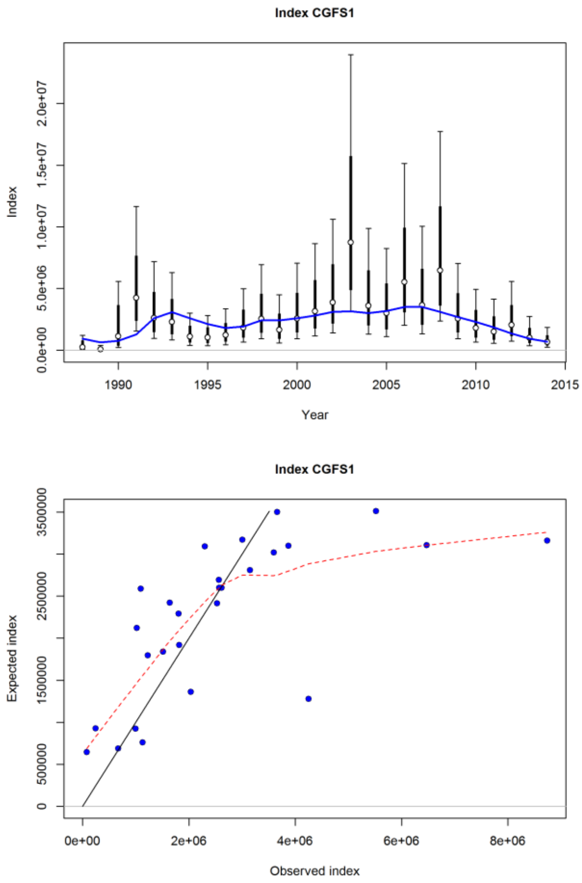



**Figure 4.6.17. Final sea bass assessment: fit to French channel groundfish survey, according to length based selectivity.**

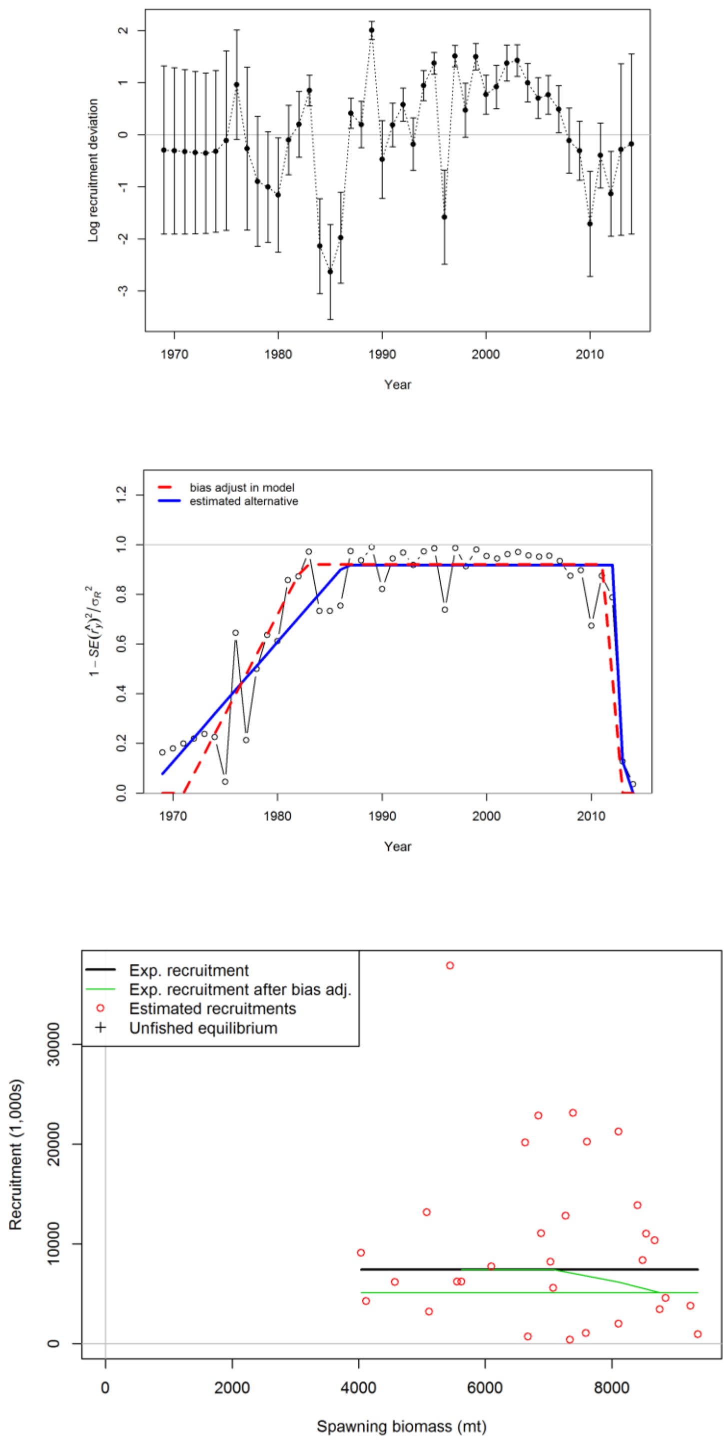



**Figure 4.6.18. Final sea bass assessment: Top left: time-series of log recruitment deviations (deviations for 1969–1984 precede the period of input catch data). Top right: Adjustment for bias due to variability of estimated recruitments in fishery. Red line shows current settings for bias adjustment. Blue line shows least squares estimate of alternative bias adjustment relationship for recruitment deviations. Bottom: Stock–recruitment scatter (model is fitted assuming Beverton–Holt stock–recruitment model and steepness = 0.999).**

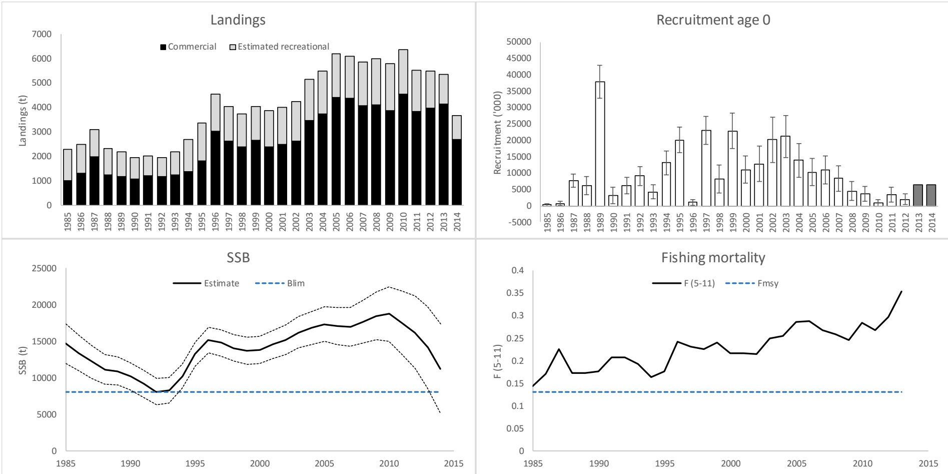



**Figure 4.6.19. Stock trends from the final assessment, based on Stock Synthesis. Recruitment in 2013 and 2014 is the long-term geometric mean. The $F_{MSY}$ proxy is $F_{35\%SPR}$ = 0.13. Error bars on Recruitment plot and dotted lines on SSB plot are ±2 standard errors.**

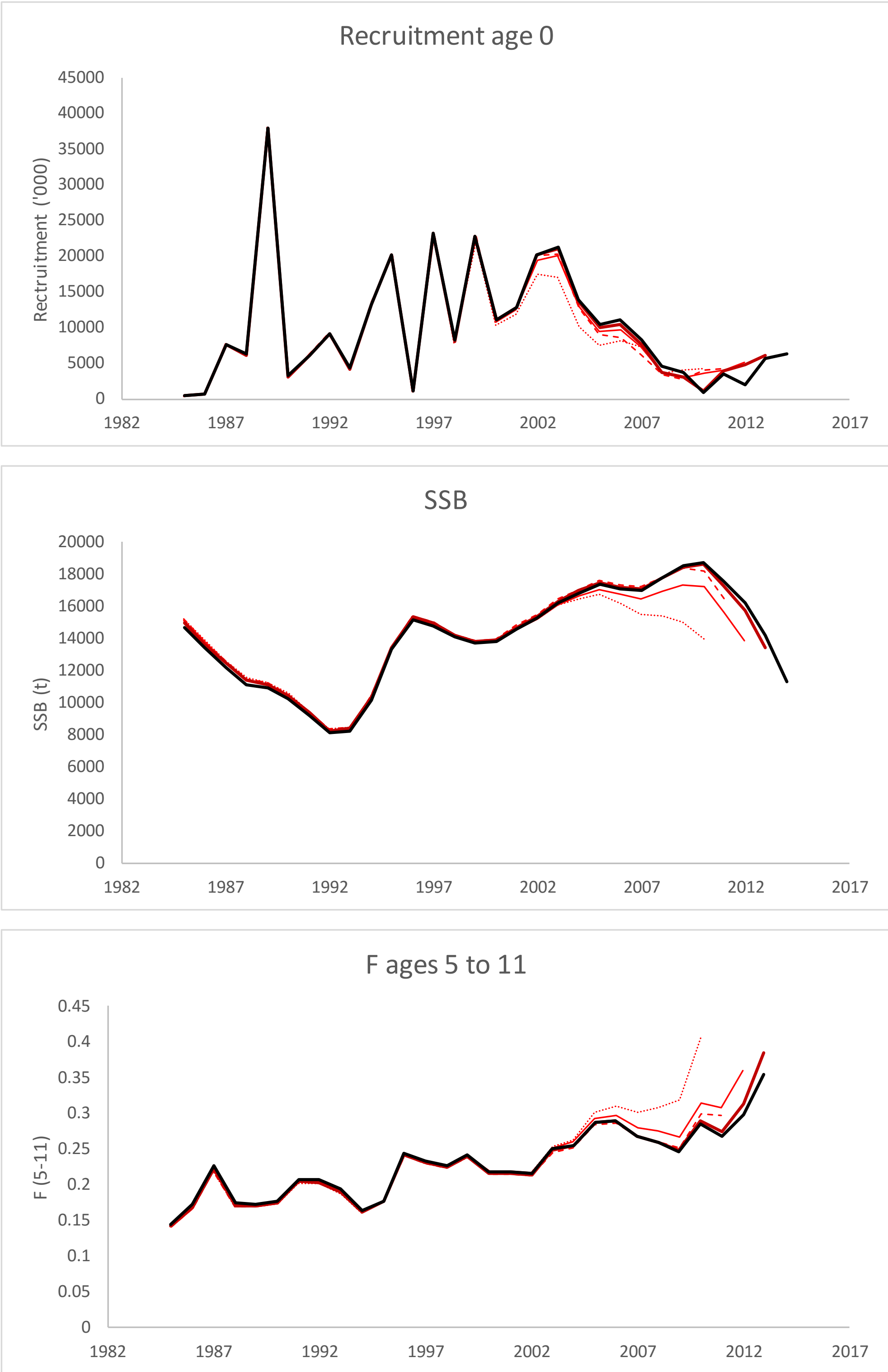



**Figure 4.6.20. Retrospective analysis of stock trends from final proposed assessment, based on Stock Synthesis run final year set to 2014 and peeling back five years.**

**Table 4.6.1. Estimated numbers-at-age in the population, at the start of the year.**

| YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 367 | 519 | 8 847 | 4 045 | 2 659 | 824 | 854 | 844 | 1 412 | 4 267 | 1 302 | 941 | 804 | 725 | 656 | 574 | 4 663 |
| 1986 | 708 | 316 | 447 | 7 615 | 3 482 | 2 289 | 709 | 735 | 726 | 1 215 | 3 672 | 1 121 | 810 | 692 | 624 | 565 | 4 507 |
| 1987 | 7 714 | 609 | 272 | 384 | 6 554 | 2 997 | 1 970 | 610 | 633 | 625 | 1 046 | 3 161 | 965 | 697 | 596 | 537 | 4 365 |
| 1988 | 6 211 | 6 639 | 524 | 234 | 331 | 5 641 | 2 579 | 1 696 | 525 | 545 | 538 | 900 | 2 721 | 830 | 600 | 513 | 4 219 |
| 1989 | 37 912 | 5 346 | 5 715 | 451 | 201 | 285 | 4 856 | 2 220 | 1 460 | 452 | 469 | 463 | 775 | 2 342 | 715 | 516 | 4 073 |
| 1990 | 3 184 | 32 631 | 4 601 | 4 919 | 388 | 173 | 245 | 4 179 | 1 911 | 1 256 | 389 | 403 | 399 | 667 | 2 015 | 615 | 3 950 |
| 1991 | 6 168 | 2 740 | 28 086 | 3 961 | 4 234 | 334 | 149 | 211 | 3 597 | 1 645 | 1 081 | 335 | 347 | 343 | 574 | 1 735 | 3 929 |
| 1992 | 9 104 | 5 309 | 2 359 | 24 174 | 3 409 | 3 644 | 288 | 128 | 182 | 3 096 | 1 416 | 931 | 288 | 299 | 295 | 494 | 4 875 |
| 1993 | 4 259 | 7 836 | 4 570 | 2 030 | 20 806 | 2 934 | 3 136 | 248 | 110 | 156 | 2 665 | 1 218 | 801 | 248 | 257 | 254 | 4 621 |
| 1994 | 13 164 | 3 666 | 6 744 | 3 933 | 1 747 | 17 908 | 2 525 | 2 699 | 213 | 95 | 135 | 2 294 | 1 049 | 689 | 214 | 221 | 4 196 |
| 1995 | 20 145 | 11 331 | 3 155 | 5 805 | 3 385 | 1 504 | 15 414 | 2 174 | 2 323 | 183 | 82 | 116 | 1 974 | 903 | 593 | 184 | 3 802 |
| 1996 | 1 052 | 17 339 | 9 752 | 2 716 | 4 996 | 2 914 | 1 294 | 13 267 | 1 871 | 2 000 | 158 | 70 | 100 | 1 699 | 777 | 511 | 3 431 |
| 1997 | 23 124 | 905 | 14 924 | 8 394 | 2 337 | 4 300 | 2 508 | 1 114 | 11 419 | 1 610 | 1 721 | 136 | 61 | 86 | 1 462 | 669 | 3 393 |
| 1998 | 8 202 | 19 903 | 779 | 12 845 | 7 225 | 2 012 | 3 701 | 2 158 | 959 | 9 828 | 1 386 | 1 481 | 117 | 52 | 74 | 1 259 | 3 496 |
| 1999 | 22 876 | 7 060 | 17 131 | 671 | 11 056 | 6 218 | 1 732 | 3 186 | 1 858 | 825 | 8 459 | 1 193 | 1 275 | 101 | 45 | 64 | 4 092 |
| 2000 | 11 038 | 19 690 | 6 077 | 14 744 | 577 | 9 516 | 5 352 | 1 490 | 2 742 | 1 599 | 710 | 7 281 | 1 027 | 1 097 | 87 | 39 | 3 577 |
| 2001 | 12 807 | 9 501 | 16 947 | 5 230 | 12 691 | 497 | 8 190 | 4 607 | 1 283 | 2 360 | 1 376 | 611 | 6 267 | 884 | 945 | 75 | 3 112 |
| 2002 | 20 237 | 11 023 | 8 177 | 14 587 | 4 502 | 10 923 | 428 | 7 050 | 3 965 | 1 104 | 2 031 | 1 185 | 526 | 5 394 | 761 | 813 | 2 743 |
| 2003 | 21 249 | 17 418 | 9 488 | 7 038 | 12 555 | 3 875 | 9 401 | 368 | 6 068 | 3 413 | 950 | 1 748 | 1 020 | 453 | 4 643 | 655 | 3 060 |
| 2004 | 13 884 | 18 289 | 14 992 | 8 166 | 6 058 | 10 806 | 3 335 | 8 092 | 317 | 5 222 | 2 937 | 818 | 1 505 | 878 | 390 | 3 996 | 3 198 |
| 2005 | 10 329 | 11 950 | 15 742 | 12 904 | 7 029 | 5 214 | 9 301 | 2 870 | 6 965 | 273 | 4 495 | 2 528 | 704 | 1 295 | 755 | 336 | 6 191 |
| 2006 | 11 005 | 8 891 | 10 285 | 13 549 | 11 106 | 6 050 | 4 488 | 8 005 | 2 471 | 5 995 | 235 | 3 869 | 2 176 | 606 | 1 115 | 650 | 5 618 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | 8 357 | 9 472 | 7 652 | 8 853 | 11 662 | 9 559 | 5 207 | 3 863 | 6 890 | 2 126 | 5 160 | 202 | 3 330 | 1 873 | 522 | 960 | 5 395 |
| 2008 | 4 563 | 7 193 | 8 153 | 6 586 | 7 619 | 10 037 | 8 228 | 4 482 | 3 325 | 5 930 | 1 830 | 4 441 | 174 | 2 866 | 1 612 | 449 | 5 469 |
| 2009 | 3 764 | 3 927 | 6 191 | 7 017 | 5 669 | 6 558 | 8 639 | 7 082 | 3 857 | 2 862 | 5 104 | 1 575 | 3 822 | 150 | 2 467 | 1 388 | 5 094 |
| 2010 | 921 | 3 240 | 3 380 | 5 329 | 6 040 | 4 879 | 5 645 | 7 436 | 6 095 | 3 320 | 2 463 | 4 393 | 1 356 | 3 290 | 129 | 2 123 | 5 579 |
| 2011 | 3 432 | 793 | 2 788 | 2 909 | 4 586 | 5 198 | 4 200 | 4 858 | 6 400 | 5 246 | 2 858 | 2 120 | 3 781 | 1 167 | 2 832 | 111 | 6 629 |
| 2012 | 1 980 | 2 954 | 682 | 2 400 | 2 504 | 3 947 | 4 474 | 3 615 | 4 182 | 5 509 | 4 515 | 2 460 | 1 825 | 3 255 | 1 004 | 2 437 | 5 801 |
| 2013 | 5 578 | 1 704 | 2 543 | 587 | 2 066 | 2 155 | 3 398 | 3 851 | 3 111 | 3 599 | 4 741 | 3 886 | 2 117 | 1 570 | 2 801 | 865 | 7 091 |
| 2014 | 6 211 | 4 801 | 1 467 | 2 189 | 506 | 1 778 | 1 855 | 2 924 | 3 315 | 2 678 | 3 098 | 4 081 | 3 345 | 1 822 | 1 352 | 2 411 | 6 847 |

**Table 4.6.2. Fishing mortality-at-age.**

| YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 0.000 | 0.000 | 0.000 | 0.003 | 0.030 | 0.090 | 0.135 | 0.152 | 0.155 | 0.156 | 0.156 | 0.156 | 0.156 | 0.156 | 0.156 | 0.156 | 0.156 |
| 1986 | 0.000 | 0.000 | 0.000 | 0.003 | 0.034 | 0.105 | 0.160 | 0.181 | 0.186 | 0.187 | 0.187 | 0.187 | 0.187 | 0.187 | 0.187 | 0.187 | 0.187 |
| 1987 | 0.000 | 0.000 | 0.000 | 0.004 | 0.042 | 0.133 | 0.208 | 0.238 | 0.247 | 0.249 | 0.249 | 0.249 | 0.249 | 0.249 | 0.249 | 0.249 | 0.249 |
| 1988 | 0.000 | 0.000 | 0.000 | 0.003 | 0.036 | 0.108 | 0.163 | 0.183 | 0.188 | 0.189 | 0.189 | 0.189 | 0.189 | 0.189 | 0.189 | 0.189 | 0.189 |
| 1989 | 0.000 | 0.000 | 0.000 | 0.004 | 0.037 | 0.110 | 0.164 | 0.183 | 0.186 | 0.186 | 0.186 | 0.186 | 0.186 | 0.186 | 0.186 | 0.186 | 0.186 |
| 1990 | 0.000 | 0.000 | 0.000 | 0.004 | 0.038 | 0.115 | 0.169 | 0.188 | 0.191 | 0.191 | 0.190 | 0.190 | 0.190 | 0.190 | 0.190 | 0.190 | 0.190 |
| 1991 | 0.000 | 0.000 | 0.000 | 0.004 | 0.045 | 0.135 | 0.199 | 0.220 | 0.224 | 0.224 | 0.223 | 0.223 | 0.223 | 0.223 | 0.223 | 0.223 | 0.223 |
| 1992 | 0.000 | 0.000 | 0.000 | 0.004 | 0.041 | 0.127 | 0.194 | 0.220 | 0.226 | 0.227 | 0.227 | 0.227 | 0.227 | 0.227 | 0.227 | 0.227 | 0.227 |
| 1993 | 0.000 | 0.000 | 0.000 | 0.004 | 0.039 | 0.118 | 0.181 | 0.204 | 0.210 | 0.211 | 0.211 | 0.211 | 0.211 | 0.211 | 0.211 | 0.211 | 0.211 |
| 1994 | 0.000 | 0.000 | 0.000 | 0.004 | 0.037 | 0.109 | 0.159 | 0.173 | 0.175 | 0.175 | 0.175 | 0.174 | 0.174 | 0.174 | 0.174 | 0.174 | 0.174 |
| 1995 | 0.000 | 0.000 | 0.000 | 0.004 | 0.041 | 0.120 | 0.173 | 0.188 | 0.189 | 0.189 | 0.188 | 0.188 | 0.188 | 0.188 | 0.188 | 0.188 | 0.188 |
| 1996 | 0.000 | 0.000 | 0.000 | 0.005 | 0.049 | 0.150 | 0.228 | 0.258 | 0.265 | 0.266 | 0.266 | 0.266 | 0.266 | 0.266 | 0.266 | 0.266 | 0.266 |
| 1997 | 0.000 | 0.000 | 0.000 | 0.005 | 0.049 | 0.148 | 0.221 | 0.246 | 0.251 | 0.251 | 0.251 | 0.251 | 0.251 | 0.251 | 0.251 | 0.251 | 0.251 |
| 1998 | 0.000 | 0.000 | 0.000 | 0.004 | 0.046 | 0.140 | 0.212 | 0.240 | 0.246 | 0.247 | 0.247 | 0.247 | 0.247 | 0.247 | 0.247 | 0.247 | 0.247 |
| 1999 | 0.000 | 0.000 | 0.000 | 0.005 | 0.047 | 0.145 | 0.224 | 0.256 | 0.264 | 0.265 | 0.265 | 0.265 | 0.265 | 0.265 | 0.265 | 0.265 | 0.265 |
| 2000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.043 | 0.132 | 0.203 | 0.230 | 0.237 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 |
| 2001 | 0.000 | 0.000 | 0.000 | 0.004 | 0.043 | 0.132 | 0.203 | 0.230 | 0.237 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 | 0.238 |
| 2002 | 0.000 | 0.000 | 0.000 | 0.004 | 0.044 | 0.134 | 0.203 | 0.228 | 0.233 | 0.234 | 0.234 | 0.234 | 0.234 | 0.234 | 0.234 | 0.234 | 0.234 |
| 2003 | 0.000 | 0.000 | 0.000 | 0.005 | 0.048 | 0.150 | 0.232 | 0.264 | 0.272 | 0.274 | 0.274 | 0.274 | 0.274 | 0.274 | 0.274 | 0.274 | 0.274 |
| 2004 | 0.000 | 0.000 | 0.000 | 0.005 | 0.049 | 0.153 | 0.237 | 0.270 | 0.278 | 0.280 | 0.280 | 0.280 | 0.280 | 0.280 | 0.280 | 0.280 | 0.280 |
| 2005 | 0.000 | 0.000 | 0.000 | 0.005 | 0.054 | 0.170 | 0.266 | 0.305 | 0.315 | 0.317 | 0.317 | 0.317 | 0.317 | 0.317 | 0.317 | 0.317 | 0.317 |
| 2006 | 0.000 | 0.000 | 0.000 | 0.005 | 0.055 | 0.173 | 0.269 | 0.307 | 0.316 | 0.318 | 0.318 | 0.319 | 0.319 | 0.319 | 0.319 | 0.319 | 0.319 |

| Year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2007 | 0.000 | 0.000 | 0.000 | 0.005 | 0.052 | 0.163 | 0.251 | 0.285 | 0.293 | 0.294 | 0.294 | 0.294 | 0.294 | 0.294 | 0.294 | 0.294 | 0.294 |
| 2008 | 0.000 | 0.000 | 0.000 | 0.005 | 0.052 | 0.161 | 0.244 | 0.275 | 0.281 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 | 0.282 |
| 2009 | 0.000 | 0.000 | 0.000 | 0.005 | 0.051 | 0.154 | 0.233 | 0.261 | 0.267 | 0.268 | 0.268 | 0.268 | 0.268 | 0.268 | 0.268 | 0.268 | 0.268 |
| 2010 | 0.000 | 0.000 | 0.000 | 0.005 | 0.056 | 0.175 | 0.267 | 0.302 | 0.310 | 0.311 | 0.311 | 0.311 | 0.311 | 0.311 | 0.311 | 0.311 | 0.311 |
| 2011 | 0.000 | 0.000 | 0.000 | 0.005 | 0.055 | 0.168 | 0.254 | 0.285 | 0.291 | 0.292 | 0.291 | 0.291 | 0.291 | 0.291 | 0.291 | 0.291 | 0.291 |
| 2012 | 0.000 | 0.000 | 0.000 | 0.006 | 0.064 | 0.193 | 0.287 | 0.317 | 0.322 | 0.321 | 0.321 | 0.321 | 0.321 | 0.321 | 0.321 | 0.321 | 0.321 |
| 2013 | 0.000 | 0.000 | 0.001 | 0.007 | 0.076 | 0.229 | 0.341 | 0.378 | 0.384 | 0.383 | 0.383 | 0.382 | 0.382 | 0.382 | 0.382 | 0.382 | 0.382 |

**Table 4.6.3. Assessment summary. Recruitment, SSB, total-stock biomass (TSB), F age 5-11 and Landings.**

| | Recruitment | | | | Landings | |
|---|---|---|---|---|---|---|
| Year | (Age 0) | SSB | TSB | F (5-11) | Commercial | Recreational1 |
| 1985 | 367 | 14 671 | 18 307 | 0.143 | 994 | 1 291 |
| 1986 | 707 | 13 351 | 17 567 | 0.170 | 1 318 | 1 186 |
| 1987 | 7 708 | 12 192 | 16 490 | 0.225 | 1 979 | 1 117 |
| 1988 | 6 206 | 11 105 | 14 738 | 0.173 | 1 239 | 1 092 |
| 1989 | 37 878 | 10 895 | 13 838 | 0.172 | 1 161 | 1 028 |
| 1990 | 3 181 | 10 220 | 13 571 | 0.176 | 1 064 | 904 |
| 1991 | 6 161 | 9 149 | 14 683 | 0.207 | 1 226 | 794 |
| 1992 | 9 092 | 8 075 | 16 255 | 0.207 | 1 186 | 772 |
| 1993 | 4 254 | 8 229 | 18 347 | 0.192 | 1 256 | 948 |
| 1994 | 13 152 | 10 149 | 20 399 | 0.163 | 1 370 | 1 318 |
| 1995 | 20 132 | 13 260 | 21 830 | 0.176 | 1 835 | 1 532 |
| 1996 | 1 051 | 15 177 | 22 525 | 0.243 | 3 022 | 1 519 |
| 1997 | 23 110 | 14 769 | 22 131 | 0.231 | 2 620 | 1 422 |
| 1998 | 8 197 | 14 058 | 22 156 | 0.225 | 2 390 | 1 353 |
| 1999 | 22 860 | 13 684 | 22 932 | 0.241 | 2 670 | 1 380 |
| 2000 | 11 030 | 13 767 | 23 704 | 0.216 | 2 407 | 1 460 |
| 2001 | 12 798 | 14 544 | 25 103 | 0.216 | 2 500 | 1 511 |
| 2002 | 20 224 | 15 211 | 26 516 | 0.214 | 2 622 | 1 610 |
| 2003 | 21 236 | 16 214 | 27 953 | 0.249 | 3 459 | 1 696 |
| 2004 | 13 876 | 16 816 | 28 845 | 0.254 | 3 731 | 1 771 |
| 2005 | 10 324 | 17 350 | 29 646 | 0.287 | 4 430 | 1 766 |
| 2006 | 10 999 | 17 086 | 29 732 | 0.288 | 4 377 | 1 732 |
| 2007 | 8 352 | 16 978 | 29 697 | 0.268 | 4 064 | 1 794 |
| 2008 | 4 560 | 17 701 | 29 566 | 0.258 | 4 107 | 1 894 |
| 2009 | 3 762 | 18 482 | 28 676 | 0.246 | 3 889 | 1 919 |
| 2010 | 921 | 18 723 | 27 145 | 0.284 | 4 562 | 1 828 |
| 2011 | 3 430 | 17 520 | 24 206 | 0.267 | 3 858 | 1 682 |
| 2012 | 1 978 | 16 218 | 21 275 | 0.297 | 3 987 | 1 500 |
| 2013 | 5 574 | 14 147 | 17 749 | 0.354 | 4 137 | 1 236 |
| 2014 | 6 204 | 11 242 | 13 860 | | 2 682 | 979 |

[1.] **Estimated**

# 5 Evaluation of existing reference points and estimate new if necessary based on conclusions form WKMSYREF3 and 4

During IBPbass2, it was not possible to update the reference points. There is currently no tool available to carry out, from the results of the SS model output, a reference point analysis based on the framework suggested by WKMSYREF4, and time constraints did not allow the development of such a tool.

# 6 External Reviewers Report

The second Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea (IBPbass2) was conducted via several Skype conferences and by correspondence between December 2015 and March 2016. The main goal of the IBPbass2 was to review quality of a new age composition dataset for French fishery landings that was recently provided by Ifremer (France) as well as evaluate performance of the stock assessment model with the new dataset included. The IBPbass2 was also intended to examine overall model structure, including various input data configurations, fleet definition and other features. It was also needed to evaluate the appropriateness of existing reference points.

## 6.1 Issues addressed at the benchmark

Review of age composition data of the French fishery landings

Age estimates for the French fleet fishery have been generated from sea bass scales and otoliths. Age estimates from scales are considered to be more reliable for this species. The uncertainty (bias and impressions) in age estimates provided was evaluated via exchange workshops conducted in 2011, 2013 and 2015, when agreement among sea bass multiple age reads, produces by age readers from different labs/countries, were examined. The evaluation of uncertainty in age estimates was primarily focused on estimates derived from scales although estimates from otolith were also included in the 2011 workshop. No significant bias was identified in age estimates from different labs, standard deviation of age readings increase with age (which is common especially long lived species). There was no indication that new data from French fishery are inferior to age data from UK fleet already used in the assessment. It was agreed to that new data are adequate for use in stock assessment.

Numbers-at-age from the new age data were calculated using the French annual age-length key applied to the length distributions of the French fleet. This fleet includes pelagic trawlers, bottom trawlers, netters, liners, Danish seiners and purse-seiners. French fleet length distributions are available from 2000 onwards. However, raising procedure used to generate these distributions changed in 2011. Between 2000–2010 raw length data by sub-fleet (gear type) have been first raised to the landings in subareas (division 4.b,c, 7.e,h, 7.d). Then numbers at length in different subareas have been summed to produce numbers at length for the entire fleet and the entire area. From 2011 forward, raw data by sub-fleet have been raised directly to the entire area (and not to subarea first as done prior to 2011). During IBPbass2 it was discussed whether the comparison can be done between the length distributions produced using old and new raising procedures, to explore whether raising to the entire area (bypassing subareas) has an effect on resultant length distributions, since sea bass size classes are not evenly distributed among subareas. However, at present, there is no overlap in time for length distributions produced from old and new raising procedures; therefore, such a comparison is not possible. In was agreed to use the numbers-at-age produced by two different raising procedures for different time periods, but recommended to pursue a comparison between length distributions produced by different raising procedures in the future.

It was also noted that primarily fish caught by liners and pelagic trawlers in subdivision 7.e,h and 7.d have been sampled for age. At present, it is not clear how representative these samples are of the entire fleet, given that substantial catches come from other gear types, including bottom trawl. This issue should also be explored in the future.

Development/update of input data for the stock assessment

The sea bass stock assessment model was developed using Stock Synthesis (Methot and Wetzel 2013), a flexible modelling platform that allows incorporating wide range of data and includes variety of modelling options. During the IBPbass2 several updates have been done to the assessment model that included changes to data inputs in SS data file and model settings in SS control file. The changes are described in detail below.

Treatment of composition data in the model

Prior to IBPbass2 the assessment model included either age or length compositional data associated with each individual fleet, even in cases when two types of compositional data were available. It is common to avoid mixing length and age compositional data because age structures are generally collected as a subset of the fish that have been measured, and if the marginal age compositions are used in the assessment along with the length compositions, the information content on sex ratio and year-class strength is largely double-counted as the same fish are contributing to likelihood components that are assumed to be independent.

It is now a common practice in SS to use conditional age-at-length approach to incorporate age data along with length compositions. In the conditional age-at-length approach individual length and age observations can be thought of as entries in an age-length key (matrix), with age across the columns and length down the rows. The approach consists of tabulating the sums within rows as the standard length frequency distribution, but instead of also tabulating the sums to the age margin, the distribution of ages in each row of the age–length key is treated as a separate observation, conditioned on the row (length) from which it came. Using conditional age distributions for each length bin allows only the additional information from age data to be captured, without creating a “double-counting” of the data in the total likelihood.

However, the development of conditional age-at-length distributions require significant amount of effort, and due to time constraints could not be accomplished during this inter-benchmark. It was, therefore, agreed for the time being, to include in the model marginal length and age compositional data for fleets when both types of data are available (including new age compositions for French fleet), but set the emphasis factors (lambda) for the length and age compositions for fleets with both types of data to 0.5 (instead of 1) to minimize overall negative log likelihood and alleviate a “double counting” concern (since lambda values are being multiplied in the model by the corresponding likelihood component). However, in the next sea bass assessment model, it is strongly recommended to include all compositional data available for each fleet and employ conditional age-at-length approach to input age compositional data.

Input sample sizes for length and age compositions have been updated to the number of fishing trips sampled. Input sample sizes for compositional data have an influence on assessment results and it has also become generally accepted practice to use the number of sampled fishing trips, rather than the number of fish measured, for input sample sizes.

Finally, it was recommended to follow the Francis method in the iterative re-weighting of compositional data. The iterative re-weighting approach attempts to develop consistency between the input sample sizes and the effective sample sizes based on model fit, and reduce the potential for particular data sources to have a disproportionate effect of total model fit. Relative data weighting in stock assessments for composition data has been the subject of recent research in the US West Coast, and the subject of a Center for the Advancement of Population Assessment Methodology (CAPAM) workshop in La Jolla, CA in October of 2015 (http://www.capamresearch.org/data-weighting/workshop). It has been recognized that it is not currently possible to recommend default procedures for composition and conditional age-at-length data. However, there is agreement that the Francis weighting approach is more appropriate in cases where the model might be miss-specified as it takes into account autocorrelation among compositional data. It is also agreed that for a correctly specified model, the McAllister-Ianelli harmonic mean weighting method works well.

Treatment of growth parameters

Prior to the IBPbass2, all but L_at_Amax growth parameters were fixed in the model. Current model settings do not allow reliable estimation of growth parameters (note that CV of length at young and old ages are currently estimated); therefore, it was recommended to fix L_at_Amax as well at the value calculated outside the assessment model. For the future, it was recommended to fully estimate growth parameters in the model and do so for females and males separately since it was shown that sea bass exhibits sexual dimorphism in growth (the model is currently specified as one sex model, although $L_\infty$ female ~70cm male ~60cm, maturity female ~40cm male ~35cm).

For the model to reliable estimate growth parameters, it is again strongly recommended to input age data as conditional age-at-length compositions. This approach normally allows estimation of all growth parameters within the stock assessment model, including the CV of length at young age and the CV at old age (which is only possible to do based on marginal age-composition observations when very strong and well-separated cohorts exist). Estimation of growth within the model allows for uncertainty associated with growth parameters estimates to be propagated to the assessment results.

Treatment of recreational catches

The IBPbass2 also addressed an issue of how to best include recreational catch into the assessment model. Prior to the IBPbass2, the approach to incorporate recreational catch in the model was to derive an age-based selectivity pattern and weights-at-age based on commercial line fishery data as a proxy for recreational catches, and add a vector of "additional recreational F at age" to the input natural mortality (M) across all ages. The recreational F vector was re-scaled in a series of SS runs until the calculated recreational landings were 1500t in 2012 (the only reliable recreational catch estimate currently available). The same recreational F was applied to all years.

This approach is ad hoc, not transparent and, thus, difficult to reproduce. Non-transparency here refers mainly to the fact that the actual recreational catch series used by the model is not explicitly provided by standard model output, and is therefore less available for scrutiny. Also, integration of recreational F with natural mortality, prevents exploration of uncertainty in M itself (which is one of the most uncertain parameters in an assessment model), by conducting sensitivity and profile analyses on M. It was, therefore, recommended to incorporate recreational catch time-series as a separate fleet, assuming the same selectivity as of commercial line fishery (for this reason, commercial line fishery was separated from the combined UK fleet). Recreational catch time-series were generated using similar iteration procedure as the one used to derive recreational F at age. Although the recreational catch stream is highly uncertain, assumptions regarding specific catch estimates are very transparent. It is also easy to explore model sensitivity to alternative assumptions about year specific values of recreation catch, via series of sensitivity runs. Also, the sensitivity of model output to alternative assumptions regarding M can also be easily explored, when M and recreational F are separated.

In future assessment, it is recommended to further explore time-series of recreational catch and conduct a thorough sensitivity analysis to evaluate impact of assumptions regarding recreational catch stream to model output. It is also recommended to include existing length compositional data for the recreational fleet in the assessment model, to more accurately describe selectivity of this fleet (instead of "mirroring" it to the selectivity of commercial line fishery).

An additional alternative approach to modelling recreational catch was also investigated during IBPBass2 that allows the recreational fleet catch to be estimated by the model, given a recreational fleet selectivity pattern, a vector of assumed annual F values, and the absolute recreational catch value for 2012. This was somewhat successful, but the resulting model had some problems with convergence that may be resolved on investigation of the estimated parameters leading to those problems (e.g. via alternative phasing of highly correlated or poorly estimated parameters). It is recommended that this form of approach also be investigated further for future assessments as it avoids the manual iteration necessary to produce the recreational catch series, and works directly from initial assumptions about recreational fishery F.

<u>Other model specifications</u>

During the IBPbass2 recruitment deviations settings were updated to include advanced options for recruitment bias adjustment. Recruitment bias adjustment settings were selected based on Methot and Taylor (2011).

Age reading was investigated during IBPbass2, allowing an improved vector of age reading imprecision to be included in the model.

Juvenile survey from Solent nursery area was originally included into the model as three separate indices (one for each age class), mostly because a suitable selectivity pattern could not be found to operate very specifically on those three age classes. During inter-benchmark it was found that a combination of age (age selectivity pattern 11 to select ages 2–4 only) and double-normal length selectivity provided a good fit to combined Solent survey age composition data, so it was recommended to re-combine the three separate indices back to one. This removed the necessity for special treatment of the Solent survey compared with others in the model. For the future it was recommended to include length composition data from Solent survey in the model, to estimate length-based selectivity using survey data (currently length data are not included in the assessment and length-based selectivity are estimated via conversion of the age compositions into length compositions via growth parameters).

The extra standard deviations for survey indices were also added to the model during the IBPBass2, and are now being estimated internally for each survey index. Use of this option has become accepted practice, and is used in many recent SS assessments to account for sources of variability of survey that are not captured in abundance index estimate.

<u>Evaluation of existing reference points</u>

Reference points were revised during WKMSYREF4 based on yield-per-recruit analysis. During the IBPbass2, it was not possible to update reference points since SS model output does not include quantities necessary for the analysis within the framework suggested by the WKMSYREF4.

According to WKMSYREF4 the default $B_{lim}$ is the lowest observed spawning-stock biomass, $B_{pa}$ is $B_{lim}$ x exp(1.645 x σ), $F_{MSY}$ is a proxy based on F35%SPR and the $MSYB_{trigger}$ is $B_{pa}$. At face value, these reference points seem sensible, and do take into account the uncertainty of the assessment for this stock, assuming that reference points would also be calculated for sensitivity assessments that bound the uncertainty of the base case. The majority of the assessment uncertainty is likely to be encompassed by alternative plausible values for M, steepness, and the historical magnitude of the recreational catch.

## 6.2 Use of final stock annex as basis for providing advice

Output for a version of the final model was examined using r4ss (Taylor *et al.* 2012) that did not reveal any major outstanding concerns regarding the model fit to all available data.

Retrospective patterns for a final model were also examined, and Mohn's ρ was calculated. Recently there has been some research on a "rule of thumb" for values for Mohn's ρ that require further investigation (Hurtado-Ferro *et al*. 2014) that says that "values of Mohn's ρ higher than 0.20 or lower than -0.15 for longer-lived species (upper and lower bounds of the 90% simulation intervals for the flatfish base case), or higher than 0.30 or lower than -0.22 for shorter-lived species (upper and lower bounds of the 90% simulation intervals for the sardine base case) should be cause for concern and taken as indicators of retrospective patterns." The biomass Mohn's ρ for the most recent base model examined at was -0.25, so outside the "rule of thumb" range. We have some advice on how corrections might be made to projections in those circumstances, but those procedures are by no means generally agreed. Means for correction or adjustment according to retrospective bias were beyond the scope of this inter-benchmark assessment and should be more fully explored during the next full benchmark.

Additional evidence of model convergence and stability is provided by so-called "jitter" analysis, where the starting values for estimated model parameters are varied according to the pre-set parameter bounds and a chosen random normal deviation, and the model re-run a number of times using the new starting values. Jitter analysis for a version of the final model did not reveal any convergence at total likelihood greater than the tested model, but did result in a considerable portion of runs that failed to converge at all. This does indicate an issue within the current model configuration that should be addressed – through investigation of which estimated parameters are causing the problem.

## 6.3 Suggestions for future work and next benchmark

During the IBPBass2 the model has been updated to include several important improvements. However, not all the suggested changes were included in the model due to time constrains. The following features are recommended for the next sea bass assessment.

Suggestion regarding data used in the assessment:

- Explore potential differences in length compositions used for calculate numbers-at-age (via age–length key) for French fishery using old and new raising procedures;
- Evaluate how representative ages sampled from liners and pelagic trawlers in subdivision 7.e,h and 7.d are of the entire French fishery.

- Evaluate if ages sampled from the French Channel Groundfish survey, currently included in the ALK applied to fishery length compositions, are representative of the French fishery
- Suggestion regarding the model structure:
- Include all available compositional data in the model;
- Incorporate age data as conditional age-at-length compositions;
- Specify model as two-sex model and estimate growth parameters for females and males separately;
- Further explore recreational catch time-series and evaluate model sensitivity to alternative assumptions about catch time-series;
- Include available length composition data for the recreational fishery to estimate length-based selectivity parameters for recreational fleet;
- Include available length composition data for juvenile survey from Solent nursery area to estimate length-based selectivity parameters for the survey;
- Explicitly incorporate discard data in the assessment model. Currently, discard is not included in the model. It is estimated to be around 5% of the total catch for commercial fleets.

# 7 References:

Armstrong, M.J. 2012. Life history estimates of natural mortality of sea bass around the UK. Working Document, IBP-NEW meeting 2012.

Armstrong, M.J. and Drogou, M. 2016. Characteristics of ageing error in sea bass. Working Document to IBPBass-2, January 2016.

Francis, RIC. 2011. Data weighting in statistical fisheries stock assessment models. Canadian Journal of Fisheries and Aquatic Sciences 68: 1124–1138.

Gislason, H., Daan, N., Rice, J.C. and Pope, J.G. 2010. Size, growth, temperature and the natural mortality of marine fish. Fish and Fisheries, 11(2): 149–158.

Hurtado-Ferro, F., Szuwalski, C. S., Valero, J. L., Anderson, S. C., Cunningham, C. J., Johnson, K. F., Licandeo, R., McGilliard, C. R., Monnahan, C. C., Muradian, M. L., Ono, K., Vert-Pre, K. A., Whitten, A. R., and Punt, A. E. 2014. Looking in the rear-view mirror: bias and retrospective patterns in integrated, age-structured stock assessment models. ICES J. Mar. Sci. doi: 10.1093/icesjms/fsu198

ICES. 2012. Report of the Inter-Benchmark Protocol on New Species (Turbot and Sea bass; IBPNew 2012), 1–5 October 2012, Copenhagen, Denmark. ICES CM 2012/ACOM:45. 239 pp.

ICES 2014. Report of the Inter-Benchmark Protocol for Sea Bass in the Irish Sea, Celtic Sea, English Channel and Southern North Sea (IBP Bass). ICES CM 2014/ACOM:45

ICES 2015a. Report of the Working Group for the Celtic Seas Ecoregion (WGCSE). ICES CM 2015:/ACOM:12

ICES 2015b. Report of the Workshop on Age Reading of Sea Bass (Dicentrarchus labrax) (WKARDL). ICES CM 2015/SSGEIOM:13

Laurec, A., Drogou, M., Huet, J. and Martin, S. 2012. Analysis of French length distributions in sea bass for a given age. Working Document to IBP-New, June 2012.

Mahé, K., Holmes, A., Huet, J., Sévin, K. and Elleboode, R. 2012. Report of the Sea bass (Dicentrachus labrax) Otolith and Scale Exchange Scheme 2011, 16 pp.

Mahé, K., Sévin, K., Moerman, M. and Holmes, A. 2014. Report of the Sea bass (Dicentrachus labrax) Otolith and Scale Exchange Scheme 2013, 14pp.

Methot, R.D., Taylor, I.G. 2011. Adjusting for bias due to variability of estimated recruitments in fishery assessment models. Can. J. Fish. Aquat. Sci. 68:1744–1760

Methot, R.D., Wetzel, C. 2013. Stock Synthesis: providing a biological and statistical framework for fishery management forecasts across a data-poor to data-rich continuum. Fish. Res. 142: 86–99.

Taylor, I., Stewart, I., Hicks, A., Garrison, T., Punt, A., Wallace, J., Wetzel, C. 2012. r4ss: R code for Stock Synthesis

## Appendix 1: French raw age composition data

**2000–2014 annual numbers-at-age by 2-cm length class and age classes 2–22+, using combined fishery and survey data. (Areas covered each year are indicated)**

| YEAR 2000_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 2 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 3 | 27 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 37 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 1 | 32 | 27 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 2 | 16 | 31 | 9 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 11 | 44 | 12 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 4 | 32 | 17 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 4 | 24 | 10 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 1 | 9 | 21 | 11 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 1 | 4 | 12 | 9 | 8 | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 1 | 10 | 9 | 9 | 6 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 9 | 11 | 6 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 8 | 14 | 12 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8 | 13 | 21 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 5 | 10 | 11 | 5 | 4 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 10 | 10 | 3 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 9 | 3 | 7 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 9 | 3 | 6 | 1 | 2 | 1 | 1 | 2 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 5 | 4 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 1 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 2 | 2 | 2 | 0 | 4 | 0 | 0 | 1 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 2 | 4 | 1 | 1 | 1 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 1 | 2 | 1 | 0 | 1 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 1 | 2 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2001_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 2 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 1 | 8 | 4 | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 4 | 23 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 2 | 1 | 20 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 1 | 2 | 15 | 11 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 1 | 3 | 16 | 15 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 0 | 16 | 19 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 5 | 15 | 8 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 0 | 13 | 15 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 1 | 1 | 8 | 6 | 8 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 6 | 8 | 5 | 7 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 8 | 5 | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 5 | 3 | 11 | 7 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 10 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 6 | 9 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 10 | 7 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 6 | 9 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 5 | 4 | 10 | 3 | 4 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 3 | 0 | 5 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 3 | 4 | 0 | 2 | 1 | 1 | 0 | 1 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 1 | 1 | 3 | 6 | 0 | 1 | 1 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2002_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 3 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 2 | 18 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 21 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 6 | 23 | 8 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 2 | 17 | 14 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 1 | 7 | 9 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 3 | 6 | 26 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 3 | 6 | 24 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 1 | 4 | 19 | 12 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 1 | 2 | 20 | 9 | 5 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 2 | 7 | 11 | 8 | 2 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 4 | 19 | 2 | 3 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 1 | 4 | 7 | 11 | 5 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 9 | 7 | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2 | 7 | 7 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 7 | 3 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 4 | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 12 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 2 | 7 | 3 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 8 | 9 | 5 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 3 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2003_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 12 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 1 | 13 | 13 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 9 | 14 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 7 | 9 | 22 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 4 | 7 | 24 | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 1 | 1 | 20 | 6 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 2 | 2 | 9 | 9 | 18 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 5 | 9 | 22 | 9 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 3 | 1 | 23 | 14 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 1 | 2 | 13 | 19 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 3 | 17 | 12 | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 8 | 12 | 5 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 15 | 11 | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 10 | 4 | 9 | 1 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 6 | 3 | 9 | 7 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 5 | 4 | 8 | 11 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 6 | 11 | 9 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 11 | 8 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 8 | 12 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 5 | 9 | 6 | 1 | 0 | 2 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2004_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 4 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 9 | 29 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 4 | 40 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 5 | 47 | 16 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 25 | 26 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 26 | 20 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 8 | 35 | 18 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 3 | 17 | 23 | 5 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 3 | 11 | 18 | 9 | 13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 3 | 11 | 10 | 29 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 9 | 6 | 27 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 14 | 22 | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 14 | 16 | 7 | 5 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 25 | 7 | 3 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 16 | 7 | 5 | 7 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 15 | 9 | 5 | 7 | 1 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 9 | 6 | 7 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 5 | 5 | 11 | 4 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 5 | 10 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 9 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2005_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 3 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 1 | 8 | 13 | 16 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 1 | 4 | 12 | 32 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 1 | 13 | 33 | 10 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 1 | 3 | 32 | 15 | 12 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 4 | 20 | 17 | 20 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 2 | 17 | 17 | 23 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 1 | 14 | 14 | 32 | 2 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 2 | 7 | 11 | 23 | 2 | 13 | 4 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 2 | 4 | 8 | 19 | 4 | 18 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 5 | 2 | 12 | 3 | 22 | 8 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 4 | 23 | 12 | 2 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 19 | 15 | 4 | 3 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 14 | 13 | 8 | 3 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 10 | 12 | 4 | 2 | 5 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 4 | 8 | 4 | 6 | 4 | 5 | 0 | 3 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 5 | 6 | 2 | 5 | 7 | 0 | 2 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 0 | 4 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 2 | 2 | 4 | 4 | 2 | 1 | 0 | 0 | 1 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 1 | 4 | 8 | 1 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 1 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2006_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 2 | 1 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 1 | 2 | 8 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 6 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 5 | 1 | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 1 | 3 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 0 | 3 | 10 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 1 | 3 | 11 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 1 | 9 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 2 | 5 | 1 | 3 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 6 | 1 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 7 | 1 | 4 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 6 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 6 | 6 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 6 | 8 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 7 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 5 | 1 | 5 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 2 | 2 | 2 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 2 | 1 | 3 | 5 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 4 | 2 | 5 | 5 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 4 | 8 | 1 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 0 | 0 | 1 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2007_AREA7EH | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 2 | 11 | 4 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 1 | 21 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 1 | 7 | 8 | 11 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 4 | 9 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 2 | 19 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 5 | 19 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 3 | 21 | 3 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 1 | 5 | 3 | 13 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 1 | 5 | 5 | 7 | 7 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 2 | 2 | 8 | 5 | 6 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 2 | 5 | 4 | 2 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 1 | 4 | 2 | 10 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 2 | 4 | 3 | 9 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 6 | 4 | 6 | 8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 8 | 9 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 10 | 14 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 8 | 12 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 9 | 6 | 4 | 2 | 1 | 3 | 1 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 5 | 5 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 1 | 3 | 4 | 3 | 4 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 2 | 1 | 3 | 0 | 5 | 0 | 1 | 0 | 2 | 1 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 3 | 6 | 0 | 2 | 1 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 0 | 3 | 1 | 1 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2008 AREA 7EH7D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 4 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 1 | 5 | 8 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 6 | 9 | 10 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 2 | 8 | 18 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 1 | 2 | 17 | 8 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 1 | 1 | 14 | 9 | 13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 2 | 9 | 12 | 9 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 1 | 8 | 10 | 13 | 3 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 5 | 4 | 19 | 7 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 9 | 12 | 6 | 5 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 1 | 2 | 8 | 6 | 11 | 2 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 1 | 5 | 5 | 5 | 13 | 2 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 4 | 9 | 10 | 6 | 5 | 1 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 12 | 8 | 5 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 9 | 2 | 12 | 2 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 9 | 1 | 9 | 2 | 7 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 4 | 5 | 2 | 10 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 1 | 5 | 5 | 6 | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 3 | 11 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 5 | 3 | 8 | 6 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 1 | 5 | 5 | 3 | 3 | 6 | 0 | 1 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 6 | 6 | 0 | 3 | 5 | 1 | 2 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 3 | 3 | 2 | 2 | 2 | 3 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 3 | 2 | 1 | 1 | 1 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2009 AREA 7EH7D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 6 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 2 | 4 | 8 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 4 | 8 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 5 | 10 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 2 | 4 | 16 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 0 | 8 | 6 | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 4 | 6 | 4 | 11 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 1 | 3 | 6 | 11 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 3 | 4 | 9 | 4 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 2 | 2 | 8 | 3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 7 | 6 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 10 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 6 | 3 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 2 | 4 | 3 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 4 | 3 | 2 | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 3 | 4 | 3 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 1 | 2 | 5 | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 2 | 6 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 4 | 1 | 3 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 4 | 5 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 1 | 2 | 1 | 2 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 2 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2010 AREA 7EH7D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 2 | 1 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 1 | 9 | 3 | 7 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 7 | 15 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 8 | 21 | 8 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 0 | 22 | 17 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 1 | 7 | 18 | 18 | 8 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 0 | 5 | 18 | 24 | 12 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 1 | 7 | 23 | 16 | 13 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 0 | 11 | 12 | 11 | 12 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 2 | 0 | 6 | 10 | 11 | 12 | 3 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 1 | 10 | 5 | 8 | 8 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 1 | 0 | 6 | 3 | 17 | 6 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 7 | 9 | 10 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 5 | 8 | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 7 | 7 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 4 | 5 | 7 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 1 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 4 | 7 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 4 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 2 | 8 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 88 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2011 AREA 7EH7D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 4 | 19 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 5 | 26 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 1 | 32 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 4 | 28 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 17 | 12 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 11 | 14 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 4 | 17 | 17 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 3 | 9 | 13 | 8 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 0 | 4 | 14 | 8 | 6 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 0 | 1 | 6 | 11 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 1 | 6 | 7 | 12 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 8 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 11 | 8 | 3 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 7 | 7 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 5 | 8 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 9 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 9 | 3 | 3 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 5 | 5 | 4 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 7 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 4 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 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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| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 16 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 30 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 17 | 9 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 4 | 8 | 24 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 7 | 20 | 21 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 4 | 18 | 24 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 2 | 12 | 26 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 1 | 7 | 14 | 26 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 0 | 2 | 7 | 21 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 0 | 3 | 7 | 18 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 1 | 1 | 5 | 24 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 10 | 13 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 20 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 11 | 11 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 9 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 5 | 8 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 7 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 | 7 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 8 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 8 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 4 | 1 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2013<br>AREA<br>7EH7D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
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| 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 1 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 0 | 5 | 9 | 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 0 | 9 | 17 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 5 | 7 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 1 | 4 | 30 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 2 | 3 | 20 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 0 | 0 | 14 | 7 | 7 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 0 | 0 | 3 | 14 | 12 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 12 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 9 | 13 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8 | 21 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 8 | 9 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 11 | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 19 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 12 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 12 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 10 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 8 | 6 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 7 | 5 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 5 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 4 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 5 | 2 | 1 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| YEAR 2014 AREA 7EH7D | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
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| 16 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 8 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 6 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 0 | 1 | 1 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 36 | 0 | 0 | 2 | 2 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 38 | 0 | 0 | 0 | 2 | 21 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 40 | 0 | 0 | 0 | 0 | 9 | 20 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 42 | 0 | 0 | 0 | 0 | 8 | 16 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 44 | 0 | 0 | 0 | 0 | 3 | 12 | 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 46 | 0 | 0 | 0 | 0 | 2 | 10 | 14 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 48 | 0 | 0 | 0 | 0 | 0 | 1 | 12 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 50 | 0 | 0 | 0 | 0 | 0 | 1 | 13 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 52 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 19 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 54 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 20 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 56 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 58 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 6 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 60 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 68 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 78 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 82 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# Annex 1: List of Participants

| Name | Address | Phone/Fax | E-mail |
|---|---|---|---|
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| Name | Address | Phone/Fax | E-mail |
| --- | --- | --- | --- |
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| Scott Large | International Council for the Exploration of the Seas<br>H. C. Andersens Boulevard 44-46<br>1553<br>Copenhagen<br>Denamark | +45 33 38 67 86 | scott.large@ices.dk |
| Vladlena Gertseva (External Chair) | National Oceanic and Atmospheric Administration<br>Northwest Fisheries Science Center<br>(NOAA Fisheries)<br>2725 Montlake Boulevard East<br>Seattle<br>WA 98112<br>USA | +1 206-860-3457 | vladlena.gertseva@noaa.gov |

# Annex 2: Terms of Reference

**IBPBass2 – Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea**

2015/2/ACOM32 **The second Inter-Benchmark Protocol for sea bass in the Irish Sea, Celtic Sea, English Channel, and southern North Sea (IBPBass2)** that will serve as in Inter-Benchmark Protocol, chaired by Michel Bertignac, France, and Vladlena Gertseva, USA (external chair), will meet by correspondence (1 December 2015–31 March 2016) to:

a ) Review quality and performance of age composition data for French fishery landings in the Stock Synthesis model formulated by IBP-bass;

b ) Develop input data are for stock assessment including empirical weights at age;

c ) Develop age compositions for the Channel groundfish survey and test in SS3 model.

d ) Evaluate the appropriateness of existing reference points and estimate new if necessary based on conclusions form WKMSYREF3 and 4.

| STOCK | STOCK LEADER | |
|---|---|---|
| Sea bass in IVbc and VIIa,d–h | Mike Armstrong | mike.armstrong@cefas.co.uk |

The Inter-Benchmark Workshop will report by 1 April 2016 for the attention of ACOM.

# Annex 3: Stock Annex for Sea bass in 4.b,c and 7.a, d–h

Stock-specific documentation of standard assessment procedures used by ICES.

| | |
|---|---|
| Stock | European sea bass (*Dicentrarchus labrax*) in Subarea 4b,c and 7a, d–h (BSS-47) |
| Working Group | WGCSE |
| Date | April 2016 |
| Revised by | IBPBass2, April 2016 |

## A. General

### A.1. Stock definition

Bass *Dicentrarchus labrax* is a widely distributed species in Northeast Atlantic shelf waters with a range from southern Norway, through the North Sea, the Irish Sea, the Bay of Biscay, the Mediterranean and the Black Sea to Northwest Africa. The species is at the northern limits of its range around the British Isles and southern Scandinavia.

Stock structure of sea bass in the Northeast Atlantic has been reviewed by WGNEW 2012 and IBP-NEW 2012 based on evidence from genetics studies, tagging studies, distribution of commercial catches and similarities in stock trends between areas, drawing also on extensive information contained in previous WGNEW and ICES SGBASS reports.

IBP-NEW and WGCSE considers that stock structure remains uncertain, and recommends further studies on sea bass stock identity, using conventional and electronic tagging, genetics and other individual and population markers (e.g. otolith microchemistry and shape), together with data on spawning distribution, larval transport and VMS data for vessels tracking migrating bass shoals, to confirm and quantify the exchange rate of sea bass between sea areas that could form management units for this stock. Such information is critical to support development of models to describe the spatial dynamic of the species under environmental drivers (e.g. temperature and food). Such a modelling work is being carried out in France in the framework of a PhD study (R. Lopez), and in the UK.

The pragmatic view of IBP-NEW 2012 was to structure the baseline stock assessments into four units:

- <u>Assessment area 1</u>. Sea bass in ICES Areas 4.b,c, 7.d, 7e,h and 7.a,f,g (lack of clear genetic evidence; concentration of Area 4 bass fisheries in the southern North Sea; seasonal movements of bass across ICES divisions). Relatively data-rich area with data on fishery landings and length/age composition; discards estimates and lengths; growth and maturity parameters; juvenile surveys, fishery lpue trends. [Bass-47].
- <u>Assessment area 2</u>. Sea bass in Biscay (ICES Subarea 8a,b). Available data are fishery landings, with length compositions from 2000; discards from 2009; some fishery lpue.
- <u>Assessment area 3</u>. Sea bass in 8.c and 9.a (landings, effort).

- Assessment area 4. Sea bass in Irish coastal waters (6.a, 7.b, 7.j). Available data: Recreational fishery catch rates; no commercial fishery operating. [Bass-wosi].

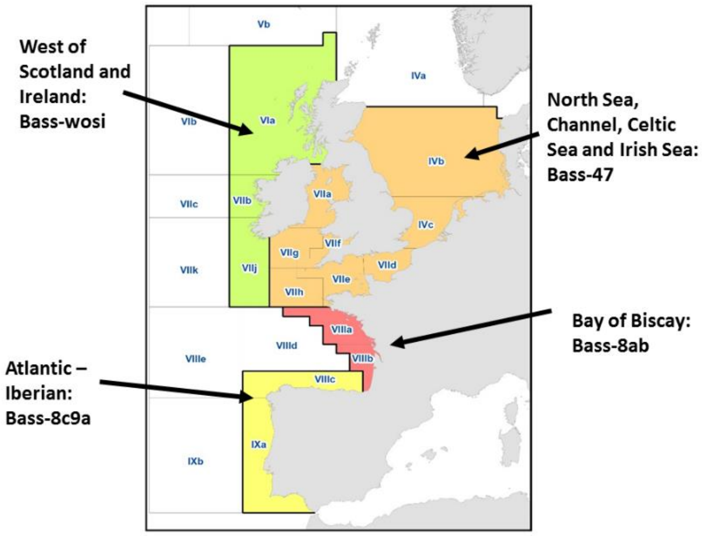



**Figure A1.1. Current stock definitions for sea bass.**

Fishery landings of sea bass are extremely small in Irish coastal waters of 7.a and 7.g and the stock assessment for assessment area 1will not reflect the sea bass populations around the Irish coast, which may be more strongly affiliated to the population in area 4 off southern, western and Northern Ireland.

At IBP-New (ICES, 2012a), it was agreed that sea bass in the North Sea (4b&c) and in the Irish Sea, Channel and Celtic Sea (7.a,d,e,f,g&h) would be treated as a functional stock unit as there is no clear basis from fishery data, tagging and genetics studies to subdivide the populations in the Irish Sea, Celtic Sea, Channel and North Sea into independent stock units. Supporting information can be found in the IBP-New report. The other stock units defined for sea bass are: west of Scotland and Ireland (6.a and 7.b,j; Bay Of Biscay (8.a,b); and the more southerly population in 8.c and 9.a.

In the absence of new information the pragmatic view of WGCSE 2015 is to continue to assume the presence of discrete sea bass stocks off southern Ireland and in the Bay of Biscay (8.a,b) and Iberian waters (8.c, 9.a).

## A.2. Fishery

### General description

The commercial sea bass fisheries in Areas 4 and 7 have two distinct components: an offshore fishery on pre-spawning and spawning bass during November to April, predominantly by pelagic trawlers from France and the UK, and small-scale fisheries catching mature fish returning to coastal areas following spawning and in some cases immature sea bass. The inshore fisheries include many small (10 m and under) vessels using a variety of fishing methods (e.g. trawl, handline, longline, nets, rod and line). The fishery may be either targeting sea bass or taking sea bass as a bycatch with other species. Historical landings data for the small-scale fisheries have often been poorly recorded. Although sea bass can occur as target or bycatch of many vessels, the bulk of the catch can be taken by relatively few vessels. For example in the UK in 2010, sea bass landings were reported by 1480 vessels (including 1207 of 10 m and under), 10% of which were responsible for over 70% of the total landings of 719 t (Walmsley and Armstrong, 2012). For France, in 2009 sea bass landings were reported by 2226 vessels including 976 of 10 m and under. Three main métiers were responsible for over 83% of the total landings. Pelagic trawlers (31.5% of total landings, for 58 vessels and 276 seamen) and "liners+handliners" (21.7% of total landings for 416 vessels and 634 seamen) are very economically dependent of this species (Drogou *et al*., 2011). French bottom trawlers often do not target sea bass, but this gear does represent 30.1% of the total landings (for 832 vessels and 2769 seamen). (Drogou *et al*., 2011).

In 2014 a large decrease in French midwater landings has been observed due to the very bad weather conditions, and the vessels switched effort to hake. Seabass landings have also moved from 1591 tons in 2013 to 242 tons in 2014, and this métier accounted in 2014 for only 9% of the total international landings. A decrease was also observed in French bottom trawlers for the same reason to a lesser extent.

According to the CHARM 3 Atlas of the Channel Fisheries, sea bass production in value represented €31 937 in 2008. It's the third most valuable species caught in the Channel (source: Agrimer) in 2008 behind sole and monkfish (tuna is not included in statistics). The market value sea bass depends greatly on how it's caught, giving added value to certain métiers: in 2013 according to the database SACROIS (Ifremer-DPMA), mean price of sea bass sold in France by liners was €17 per Kg compared with €7 per Kg for pelagic trawl, reflecting differences in volume and fish condition.

Sea bass are a popular target for recreational fishing in Europe, particularly for angling in the UK, Ireland and France, and increasingly in parts of southern Norway, the Netherlands and Belgium. Relatively little historical data are available on recreational fisheries although several European countries are now carrying out surveys to meet the requirements of the EU Data Collection Framework and for other purposes (ICES 2009; 2010; 2011, 2012c; Herfault *et al*., 2010; Rocklin *et al*., 2014; Van der Hammen and De Graaf, 2012,205; Armstrong *et al*., 2013.).

More detailed descriptions of national fisheries can be found in ICES WGCSE 2015 (ICES 2015) and in Armstrong and Drogou (2014).

#### Fishery management regulations

Sea bass are not subject to EU TACs and quotas. Commercial vessels catching bass within cod recovery zones are subject to days-at-sea limits according to gear, mesh and species composition. Under EU regulation, the MLS of bass in the Northeast Atlantic is 36 cm total length, and there is effectively a banned range for enmeshing nets of 70–89 mm stretched mesh in Regions 1 and 2 of Community waters[1]. Emergency measures were introduced by the EU banning pelagic / midwater trawling for bass from January

[1] Region 1: All waters which lie to the north and west of a line running from a point at latitude 48°N, longitude 18°W; thence due north to latitude 60°N; thence due east to longitude 5°W; thence due north to latitude 60°30'N; thence due east to longitude 4°W; thence due north to latitude 64°N; thence due east to the coast of Norway.

Region 2: All waters situated north of latitude 48°N, but excluding the waters in Region 1 and ICES Divisions IIIb, IIIc and IIId.

to end of April 2015. A bag limit of 3 fish per day was introduced in 2015 for recreational fishing (EU Regulation 2015/523 of 25 March 2015).

A variety of national restrictions on commercial bass fishing are also in place. These include:

- a landings limit of 5 t/boat/week for all French and UK trawlers landing bass;
- closure of 37 bass nursery areas in England and Wales to specified fishing methods;
- UK regional byelaws in Cornwall and South Wales stipulating a 37.5 cm MLS;
- a minimum gillnet mesh size of 100 mm in South Wales;
- a variety of control measures in Ireland that effectively ban commercial fishing for bass in Irish waters; plus MLS of 40cm;
- a licensing system from 2012 in France for commercial gears targeting sea bass.
- voluntary closed season from February to mid-March for longline and handline bass fisheries in Brittany.

Depending on country, measures affecting recreational fisheries include minimum landing sizes, restrictions on sale of catch, bag limits (Ireland), and gear restrictions (France; Netherlands).

#### Management applicable to 2015

In 4.b,c and 7.a,d–h (North Sea, Channel, Celtic Sea and Irish Sea) the European Council has adopted emergency measures to help sea bass recover (Recent scientific analyses have reinforced previous concerns about the state of the stock and advised urgently to reduce fishing by 80%). Effective emergency measures in January 2015 placed a ban on targeting the fish stock by pair-trawling while it is reproducing, during the spawning season, which runs until the end of April 2015. Bag limit of 3 fish per day was introduced for recreational fishing in 2015. The European Commission is consulting with Member States and stakeholders during 2013–2015 to establish a broader, balanced package of measures to control fishing mortality and rebuild the stock.

### A.3. Ecosystem aspects

Temperature appears to be a major driver for bass production and distribution (Pawson, 1992). Reynolds *et al.* (2003) observed a positive relationship between annual seawater temperature during the development phases of eggs and larvae of sea bass and the timing and (possibly) abundance of post-larval recruitment to nursery areas. In addition, early growth is related to summer temperature and survival of 0-groups through the first winter is affected by body size (and fat reserves) and water temperature (Lancaster, 1991; Pawson, 1992). Prolonged periods of temperatures below 5–6°C may lead to high levels of mortality in 0-groups in estuaries during cold winters. As a result, any SSB–recruit relationships may be obscured by temperature effects (Pawson *et al.*, 2007a). WGCSE 2014 presented time series of UK inshore coastal temperatures during January to March and examined correlations with bass recruitment (Figure A.3.1).

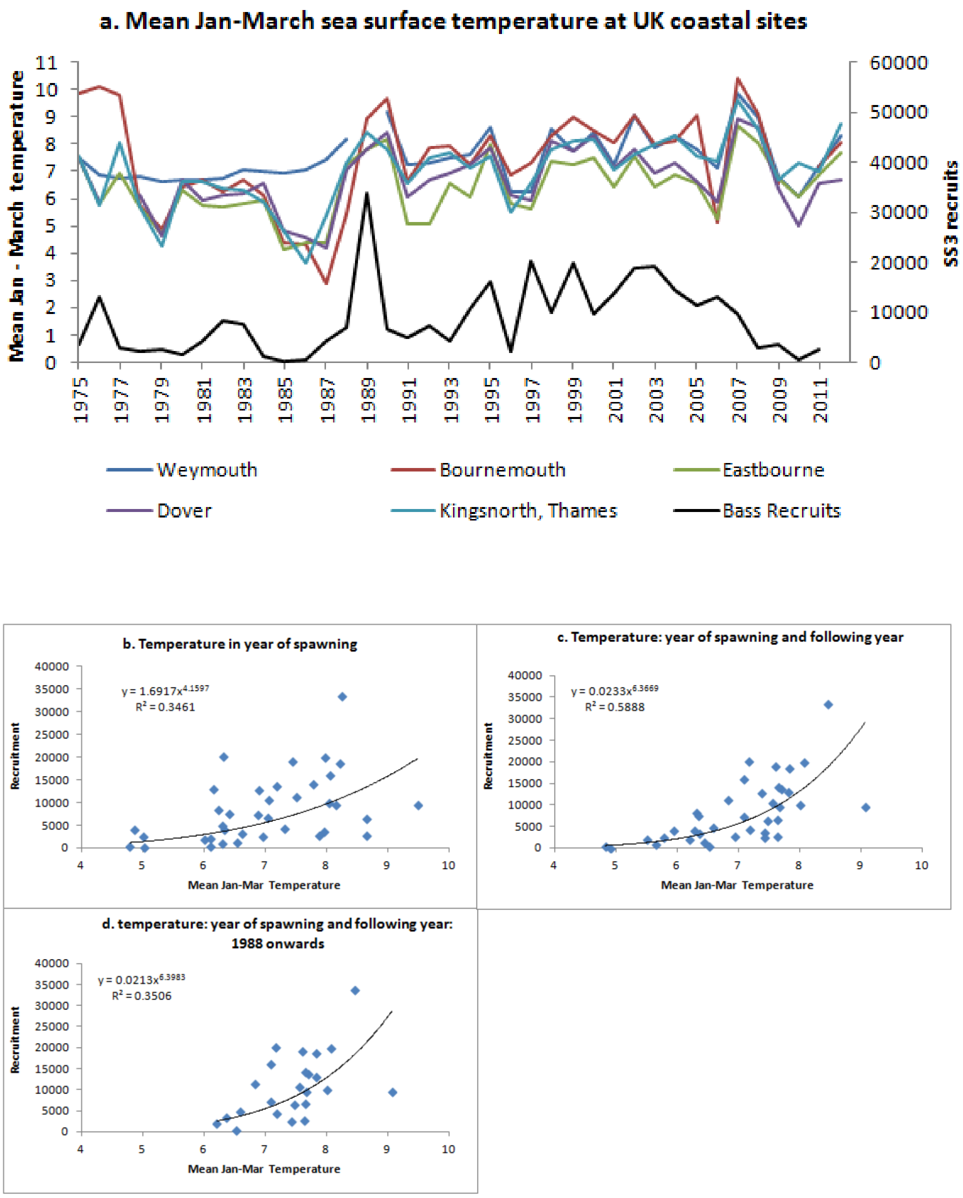



**Figure A.3.1. (a) Mean January–March coastal sea temperatures at five sites along the south coast of England, compared with the time-series of sea bass recruitment estimates from the update WGCSE assessment, including pre-1985 values from estimated recruit deviations back to 1975. (b)–(d): correlation between sea bass recruitment and (b) mean temperature for the five sites in the year of spawning; (c) mean temperature in the year of spawning and the following spring; and (d) the same as (c) but restricting the series to 1988 onwards (From ICES WGCSE 2014).**

# B. Data

## B.1. Commercial catch

### B1.1 Landings data

#### Data available

Landings series for use in the assessment are available from three sources:

i ) Official statistics recorded in the ICES FishStat database since around the mid-1970s.

ii ) French landings for 1999–2014 from a separate analysis by Ifremer of logbook, auction and VMS data, with earlier official data adjusted as described below.

iii ) Survey estimates of landings from the UK fleet of 10 m and under vessels (which are not obliged to provide EU logbooks), carried out by Cefas.

Total international landings of sea bass in European waters from sources (i) and (ii) combined increased from around 2000 t in the late 1970s to over 8000 t by 2006, the bulk coming from Areas 4.b,c, 7.e and 8. An important driver of the increase in landings since the 1990s was the increased landings in Divisions 4.b,c, 7.d and 7.e,h, coinciding with the large 1989 year class and a northward expansion of the sea bass population in the North Sea during a period of increasing sea temperatures.

#### Quality of official landings data

The official landings data for sea bass available to WGCSE 2015 are subject to several uncertainties that can affect the accuracy of assessments:

- Incomplete reporting of landings in the 1970s and early 1980s when the fisheries were developing (the assessment uses only data from 1985 onwards);
- Reporting of official French data by port rather than fishing ground before 2000. (The best landings estimates are from auctions for this period. During WGCSE, no fishing grounds could be identified for these landings).
- Poor reporting accuracy for small vessels that do not supply EU logbooks.

From 2000 onwards, Ifremer has provided revised French landings from a separate analysis of logbook and auction data which allocates landings correctly by fishing ground. To generate a consistent series of French landings from 1985 onwards for the Area 4&7 assessment, IBP-New 2012 adjusted pre-2000 official landings from the ICES database by the average of the Ifremer correction factors by area from 2000–2010:

- 4.bc+7.d: 1.04; 7.e,h: 1.6; 7.a,f,g: 0.62.

The accuracy of UK landings statistics is expected to have improved since the introduction of the Registration of Buyers and Sellers scheme in 2005/2006, particularly for recording of marketed landings of small vessels that do not have to supply EU logbooks. However, the official reported landings of sea bass in the UK are known to underestimate the true total landings, particularly for small-scale inshore fisheries where there has been no requirement to submit EC logbooks. Prior to the introduction of Buyers and Sellers requiring sales documentation, local fishery inspectors estimated landings of the under-10 m fleet using whatever information they had available from auctions, and frequently entered aggregated estimates for multiple vessels into the fishery landings database. Unfortunately, the Buyers and Sellers regulations do not cover all landings. The EU Control Regulation allows landings of less than 30 kg to be disposed of for personal consumption without providing sales slips or other documents. This is ostensibly to reduce the administrative burden for a skipper disposing of small quantities for personal use. However, for small-scale fisheries where there are very large numbers of small vessels often catching small quantities, the cumulative catch of unrecorded small landings can be relatively high. This is likely to be an issue over the full time-series.

The UK (England) has previously carried out independent surveys to estimate historical landings data for sea bass, particularly for smaller vessels not supplying EU logbooks. A voluntary logbook scheme was carried out in conjunction with a biennial census of vessels catching sea bass. The census covers different segments of coast in different years (Pickett, 1990). The scheme was stratified by area, gear and vessel characteristics. Selected vessels from the strata kept logbooks for periods ranging from one to 25 years, and comprised what could be described as a "reference" fleet as opposed to a randomised selection of vessels each year. The scheme was terminated in 2007 and 2008, and reinstated for a further two years (2009 and 2010) before being terminated again. The scheme has now been suspended permanently. The landings tables in some earlier ACOM advice included "unallocated" landings which were the difference between the voluntary logbook estimates and the official UK statistics in each ICES area.

A review of the Cefas logbook scheme in 2012 (Armstrong and Walmsley, 2012a) showed that the previous estimates included recreational charter boats. After removal of these landings, the Cefas logbook estimates for nets and lines still showed substantial differences with official estimates (Figure B1.1). For fixed/driftnets, the landings including the Cefas logbook estimates for under 10 m vessels results in a landings series that is on average around three times higher than the official statistics. For lines, the ratio fluctuates around 3.0 for a large part of the series but was larger from 2000–2005. Insufficient logbooks were available for trawls to allow estimation of fleet-wide landings.

The Armstrong and Walmsley (2012a) review concluded that the survey is sensibly spread over a range of vessel types and gears, but is over-stratified and has insufficient (and declining) coverage of the many survey strata while using *adhoc*, judgment-based vessel selection schemes rather than randomized selection. Despite the potential biases, the survey results for commercial vessels confirm that the historical official reported landings of sea bass are likely to be underestimates. Neither data source for UK 10m and under vessels is considered accurate over the historical time series but ICES WGNEW (ICES, 2008) and IBPBass (ICES, 2014) found that the stock trends from a statistical assessment model were relatively insensitive to the choice of these two catch histories. The main effect of including the additional landings is to scale biomass estimates up without altering the trend. Total fishing mortality estimates are not affected, as the age profiles of the catches remains more-or-less the same, but the proportion of total F attributable to recreational fisheries in the final stock assessment is reduced slightly by the additional commercial landings. Given the small contribution of UK reported landings of under-10m fleets to total international landings of bass, the uncertainties concerning the level of bias in the Cefas logbook estimates, and the lack of such estimates after 2011, the official statistics have been retained in the current assessment. Of more concern would be any change in reporting accuracy over time, as this would lead to biased assessment trends using reported landings figures.

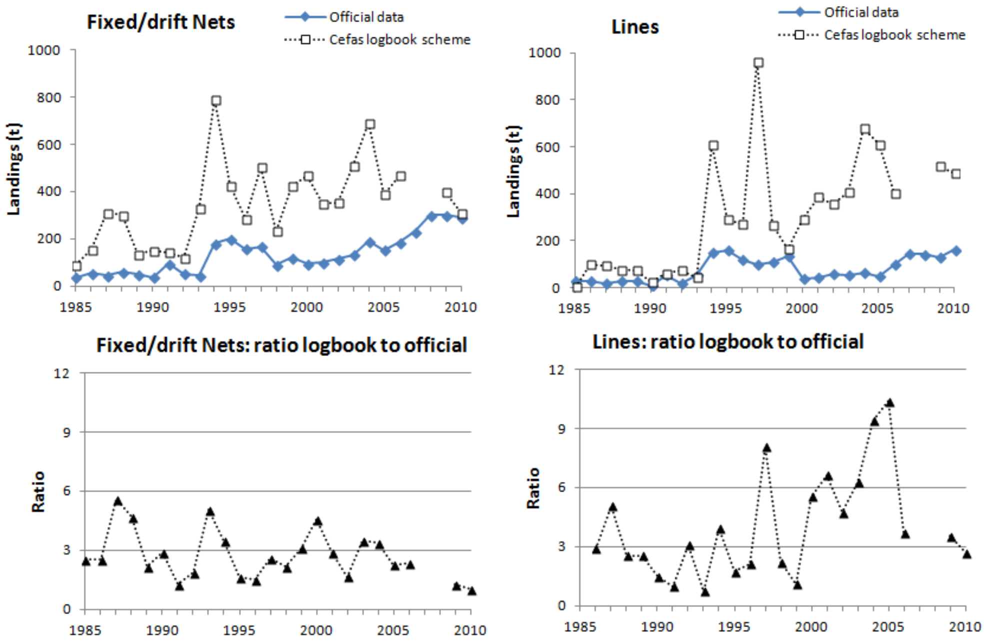



**Figure B1.1. Top: estimates of sea bass landings for under-10 m UK netters and liners based on the Cefas logbook and port survey scheme. Bottom: ratio of landings of these gears including the Cefas logbook estimates for <10 m commercial vessels, and the total official reported landings of all UK vessels using these gears.**

### Dutch landings

Landings and effort data from the commercial fleet are available from the EU logbooks; market category composition of landings is available from the auction data (sale slips); and size and age data are available through market sampling. The fisheries were described in detail in van der Hammen *et al.* (2013).

### EU logbook data

Official EU logbook data of the entire Dutch fleet are maintained by the NVWA (formerly known as the General Inspection Service, AID). IMARES has access to these logbooks and stores the data in a database (VISSTAT). EU logbook data contain information on:

- landings (kg): by vessel, trip, ICES statistical rectangle and species;
- effort (days absent from port): by vessel, trip and ICES statistical rectangle;
- vessel information: length, engine power and gear used.

Logbook data are available from the entire Dutch fishing fleet and from foreign vessels landing their catches in the Netherlands.

### Auction data: landings by market category

Auction data cover both the total Dutch fishing fleet and foreign vessels landing their catches on Dutch auctions. These data are also stored in VISSTAT and contain information on:

- landings by market category (kg): by vessel, trip (landing date) and species.

Further information on availability and quality of landings data by country is provided by IBPBass (ICES, 2014).

### B1.2 Discards estimates

#### UK data

##### Survey design and analysis

Estimation of bass discards is problematic because the observer scheme covers all vessel trips in a stratum without reference to target species, and overall it samples less than 1% of all fishing trips. As bass are absent or at very low numbers in a large fraction of fishing trips throughout the year, particularly in winter, the amount of sample data on bass is very low and the estimates are likely to have poor precision and variable biases related to inclusion of under 10 m vessels. Vessels under 10 m, that are responsible for a large fraction of bass catches, were excluded until recent years on health and safety and other logistical grounds, and although under 10 m vessels are now included since 2007, the fleet of vessels under 7 m remains excluded.

Raising of UK discards data to the fleet level is currently performed using a ratio estimator using the ratio of reported landings in a stratum to the computed retained weight of sea bass in sampled trips. This assumes that the retention curve for sampled vessels is representative of all vessels in the stratum.

##### Data coverage and quality

UK discards data are available for métiers associated with trawls and fixed/driftnets only. Discards from commercial line boats are expected to be relatively low and have high survival, so this fleet sector is excluded from the scheme for sea bass. As sampling is targeted at all species, annual coverage of the bass fisheries is relatively limited.

Numerically, the largest numbers of bass discarded from UK fisheries are from the bottom trawl fleet, with much smaller numbers from nets and even less from beam trawls. Only eleven midwater pair trawl trips were observed up to 2013, and discarding of bass was negligible as the fishery targets mainly adult bass. No bass discards were observed in the eight longline trips observed. The raised length frequencies of discarded and retained bass, aggregated overall years, are available along with the retention ogives. It is clear that discarding is driven primarily by the minimum landing size of 36 cm (see IBPBass 2014 report).

Sampling levels for UK and French discard sampling, and discards estimates, are given in the WGCSE report and updated annually.

#### French data

##### Survey design and analysis

The French sampling schemes also utilise vessel-list sampling frames and random selection of vessels within strata defined by area and fleet sector.  From the activity calendars of French vessels for year n-1, vessels are grouped by the métiers practiced. Thus, a vessel may belong to multiple groups if practicing several métiers in the period. If the métier has to be sampled in priority No. 1, the vessel to be boarded is chosen randomly within this group of vessels. The observer then chooses to go on board for a trip. During the trip, the fishing operations corresponding to métier No. 1 are sampled. Optionally, if the vessel practices several métier during the trip, fishing operation of the métier No 2 will also be sampled if the métier No.2 is included in the annual sampling plan. If the métier is not part of the plan, it is requested to sample at least one fishing operation of this métier in the trip. (complete document on sampling protocol in French :http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OB-SMER_V2_2_2012.pdf)

#### Data coverage and quality

Discards data are only available for French fleets from 2009 onwards. For 2012, results are described in the annual French report on:" http://archimer.ifremer.fr/doc/00167/27787/25978.pdf" for 2012. Discards estimates for France are from vessel selections that for some areas and gears include relatively limited numbers of observed trips where sea bass is caught and discarded. Precision is therefore very low at current sampling rates. In France the low sampling rate observed can be explain by the low discarding rate. Length frequencies were not available at IBPbass for 2013.

#### Spain

No bass discards were observed for any métier in the 2003-2013 period. Number of sampled hauls per métier and area were presented to IBP-NEW 2012 (see assessment report).

#### Discards data from other European countries

Discards data for Dutch beam trawlers were presented to ICES IBP-NEW 2012, as annual mean numbers discarded per hour in 2004–2010. No commercial fisheries for sea bass exist in Ireland.

### B1.3 Recreational catches

Recreational marine fishery surveys covering different parts of the sea bass stock in the North Sea, Channel, Celtic Sea and Irish Sea have been developed in France, Netherlands, England and Belgium (ICES, 2012c). Survey design and methods of recreational catch estimation are described in IBPBass 2014.

#### Data from France

A survey of recreational fishers, focusing mainly on bass, was conducted between 2009 and 2011. Estimates of sea bass recreational catches were obtained from a panel of 121 recreational fishermen recruited during a random digit dialling screening survey of 15 000 households in the targeted districts. The estimated recreational catch of bass in the Bay of Biscay and in the Channel was 3170 t of which 2350 t was kept and 830 t released. The estimates for Subarea 4 and 7 were 940 t kept and 332 t released.

The precision of the combined Biscay and Channel estimate was relatively low (CV=26%; note that the figure of 51% given in IBPNEW 2012 (ICES, 2012a) was incorrect). This gives an average and 95% confidence intervals of 3170 t [1554 t; 4786 t] for the whole Subareas 4, 7 and 8. Increasing the panel from 121 to 210 fishermen would be expected to improve precision to 20% and increasing this panel to 500 would improve precision to 13%.

The main gears used, in order of total catch, were fishing rod with artificial lure, fishing rod with bait, handline, longline, net and spear fishing. Approximately 80% of the recreational catch was taken by sea angling (rod and line or handline).

A new survey was conducted from July 2011 to December 2012, based on a similar methodology to the previous study (not only on sea bass this time, but also on other marine species including crustaceans and cephalopods). A random digit dialling screening survey of 16 130 households led to the recruitment of a panel of 183 fishermen to keep logbooks. In parallel, 151 fishermen were recruited on site by the Promopeche association, and 30 more via the sea bass fishermen panel set up in 2009. This resulted in 364 panel members keeping logbooks describing their catches (species, weight, size, etc.) The focus of the survey on sea bass shows that in Atlantic (Bay of Biscay and Channel), the estimated recreational catch of bass in 2012 was 3922 t of which 3146 t was kept and 776 t released. At this time results have to be considered as provisional, (results split between Bay and Biscay and Channel are not available yet with relative standard error).

#### UK (E&W)

A new survey programme *Sea Angling 2012*, based on a statistically sound survey design started in 2012 to estimate fishing effort, catches (kept and released) and fish sizes for shore based and boat angling in England. The survey does not cover other forms of recreational fishing. Results are available in Armstrong *et al*., 2013.

The surveys adopted, where possible, statistically-sound, probability-based survey designs, building on knowledge gained through participation in the ICES Working Group on Recreational Fishery Surveys (WGRFS). Two survey approaches were adopted: firstly a stratified random survey of charter boats from a list frame covering ports in England, and secondly an on-site stratified random survey of shore anglers and private boat anglers to estimate mean catch per day, combined with annual effort estimates derived from questions added to a monthly Office of National Statistics household survey covering Great Britain.

A list of almost 400 charter boats was compiled for the charter boat survey, and 166 skippers agreed to participate. Each month over a twelve month period in 2012 and 2013, 34 randomly-selected skippers completed a diary documenting their activities, catches and sizes of fish. A diary was completed whether or not any fishing took place. Data from 5300 anglers were collected. Total annual catches were estimated by raising the monthly catches per vessel from the diaries to all vessel-month combinations in the frame, and raising this to all vessels including refusals. The estimated total annual catch of sea bass for the entire coast of England was 44 t (RSE 31%) of which 31 t was kept. The release rate by number was 37%. The charter boat survey has potential bias due to the large non-response rate, if non-respondents have different catch rates to respondents.

The Office of National Statistics (ONS) household survey covered 12 000 households during 2012, and from this it was estimated that 2.2% of adults over 16 years old went sea angling at least once in the previous year. The surveys estimated there are 884 000 sea anglers in England. Estimation of fishing effort by shore and private boat anglers proved very difficult due to the overall low number of households with sea anglers in the survey. A range of methods was explored to estimate annual and seasonal effort using the ONS data alone, and combining it with observations from on-site and on-line surveys. It has not been possible yet to agree on a best estimate of effort, and for that reason the estimates of total catch (cpue × effort) for shore and private boat angling are given as a range of plausible values.

The survey of anglers fishing from the shore and private boats to estimate cpue was carried out throughout 2012 using on-site interviews. A stratified random design was adopted to select shore sites and boat landing sites on a weekly basis from site lists stratified into low-activity and high-activity sites. The shore survey used roving-creel methods (collecting data from partial angling trips), and the private boat survey a roving access-point survey (data from completed trips). Visits were made to 1475 shore sites and 425 private boat sites, and 2440 anglers were interviewed. The mean daily catch rate of kept and released fish of each species was estimated based on the survey design, and sizes of caught fish were recorded. Cpue for shore angling was estimated using catches for the observed trip duration and estimates of expected total trip duration for that day. A length-of-stay bias correction was applied based on expected total trip duration. The catch-per-day estimates were combined with estimates of total annual fishing effort (days fished) obtained from the ONS survey to estimate total annual catches. Release rates, by number, were 82% for shore angling and 57% for private boats. Non-response rates were very low (<10%) in this survey. The range of point estimates for shore-caught bass was 98–143 t (total) and 38–56 t (kept), and for private and rented boats was 194–546 t (total) and 142–367 t (kept). The relative standard errors for the individual shore and private boat estimates were relatively high at 40–50%.

Combining the catch estimates for charter boats, private boats and shore angling, the point estimates of annual kept weights of sea bass ranged from 230 t–440 t (Table 2.4.1c), compared with total UK commercial landings of almost 900 t in 2012. The combined estimates of bass catches had precision (relative standard error) estimates of 26%–38%for the different effort estimation methods. The relatively large standard errors combined with the range of plausible methods of estimating effort for shore and private boats.

#### Netherlands

Sea bass are taken by recreational sea anglers in the Netherlands. A recent survey investigated the amount of sea bass caught by recreational fishers (van der Hammen and de Graaf, 2012, 2015; ICES, 2012c) from March 2010 to February 2011 and from March 2013 to February 2013. Estimates of recreational sea bass were obtained from a panel of 1043 recreational fishermen (in the first survey) recruited during a telephone survey of 109 293 people. Revised estimates were provided to WGCSE 2013 (ICES, 2013a). The catch weights are estimated with a limited amount of length–frequency data, and are therefore less reliable than the estimates in numbers (and may also be adjusted if more data are available). For the same reason, there are no ‘returned’ estimates by weight (yet).

The estimated total recreational catch of sea bass was 366 000 fish (RSE 30%), of which 234 000 were retained, equivalent to 138 t. These results are mainly applicable to Subarea 4.

#### Belgium

A recreational fishing survey was conducted in 2013 in Belgium by the Belgian Fisheries Institute, using a questionnaire approach, in order to meet DCF requirements. The estimated retained catch of sea bass was 60 t.

### Hooking mortality rates

The US National Marine Fisheries Service has in the past used an average hooking mortality of 9% for striped bass, estimated by Diodati and Richards (1996). Striped bass are very similar to European sea bass in terms of morphology, habitats and angling methods. A literature review of hooking mortality for a range of species compiled by the Massachusetts Division of Marine Fisheries included a total of 40 different experiments by 16 different authors where striped bass hooking mortality was estimated over two or more days (Gary A. Nelson, Massachusetts Division of Marine Fisheries, pers. comm.) The mean hooking mortality rate was 0.19 (standard deviation 0.19). Direct experiments are needed on European seabass to estimate hooking mortality for conditions and angling methods typical of European fisheries.

#### Total recreational catch

Total catches are given in the WGCSE report and updated when new estimates become available. They are also documented in the annual reports of the ICES Working Group on recreational fisheries (WGRFS).

## B.2. Biological sampling

### B2.1 Length and age compositions of landed and discarded fish in commercial fisheries

Length and age compositions of sea bass landings were available to WGCSE 2015 from sampling in the UK and France.

#### UK

#### Sampling methods and analysis

The UK (E&W) sampling programme for length compositions of sea bass covers sampling at sea and on shore. The sampling design for at-sea sampling is described above. The on-shore sampling programme uses an area list frame comprising port days, currently stratified by quarter, ICES Division and an index of “port size”. “Large” ports are sampled more intensively than “small ports”. Separate list frames of ports are established for pelagic trawlers, beam trawlers and demersal trawl, nets and lines. Sampling targets are set to achieve a specified number of port visits by stratum, taking account the need for fleet based as well as stock based data specified by the EU Data Collection Framework, although other diagnostics are monitored such as numbers of fish measures and otoliths/scales collected by species. This scheme has only been in development and operation since around 2010 when Cefas took over the sampling from the Marine and Fisheries Agency. Prior to then, the sampling targets were mainly set as numbers of fish of each species to measure or age by quarter, district, and gear groupings, with minimum numbers of sampling trips also specified to spread the sampling out.

Length compositions are first vessel-raised using ratios of landed live weight to predicted live weight of the length frequency calculated from a length–weight relationship:

$$W\ (kg) = 0.00001296\ (L+0.5)^{2.969}$$

Raised LFDs are then summed over vessels within a sampling stratum and raised to give total raised fleet LFDs per stratum, which are then combined. This procedure ensures sums-of-products ratios of 1.0, but will lead to some bias in numbers-at-length due to discrepancies between true fish weights and calculated fish weights from the length–weight relationship.

#### Data coverage and quality

Age compositions for UK commercial fishery landings of sea bass are derived from biennial (January–June and July–December) age–length keys (ALK) constructed for four areas: 4.b,c; 7.d, 7.e,h and 7.a,f,g. These are applied to fleet-raised landings length frequencies for each of four gear groups (bottom trawls; midwater trawls; fixed/drift-nets and lines) in each area. Further details are given in the ICES IBP-NEW (ICES, 2012a) and WGCSE (ICES, 2013a) reports and in the stock annex along with tables giving numbers of trips sampled for length and age and numbers of fish measured and aged.

A recommendation of WGCSE 2013 was to expand the UK age frequencies to the full recorded age range and to re-evaluate the plus-group definition (previously at 12+). Sea bass have been recorded to almost 30 years of age, and it was thought that having more true ages in the Stock Synthesis input data could allow better estimates of early recruit deviations. The necessary extractions were done for IBPBass, and the data were examined in detail by Armstrong and Readdy (IBPBass Working Document_01). Bubble plots and catch curves showed that coherent information on year classes was present well beyond the last true age (11) previously adopted. The exploratory SS3 runs show that the different choices of plus-group (12+; 16+; 18+; 20+) have relatively little impact on the results, other than (as hoped) a slightly better estimation of early recruit deviations. Expanding the age compositions may help fit domed selection curves for fleets where this is appropriate, but risks an increasing number of zero catch entries for older ages as recent weak year classes feed into future catches and become depleted. A plus-gp of 16+ was recommended for further model development and agreed by IBPBass. Sampling of midwater trawls prior to 1996, and in 1997, was considered too poor to develop age compositions. All datasets show a very strong 1989 year class and very weak 1985–1987 year classes.

### France

#### Sampling methods and analysis

The French sampling programme for length compositions of sea bass covers sampling at sea and on shore. Since 2009, both sampling types are first based on métiers composition and their relative importance per fishing harbours and month. Both are also designed to sample the whole catch following a concurrent sampling of species, potentially leading to low sea bass sample size. In order to complement this effort, specific sampling for sea bass at the market is added at times and harbours when higher landings are occurring, especially from métiers targeting sea bass. The sampling frame is based on the main harbours, gear types (or grouping of métiers) and month and is available to all samplers on a dedicated website. Real time follow-up of the plan, refusal rates and their reasons, time taken to sample, all this information is also available from the website, together with sampling protocol (in French:

http://sih.ifremer.fr/content/download/5587/40495/file/Manuel_OBSMER_V2_2_2012.pdf). Before 2009, only market specific sampling was in place, and the sampling plan was designed and followed by the stock coordinator. The French sampling programme for age compositions of sea bass is based on age–length keys with fixed allocation. For the 7.e,h area, quarterly French landings at auctions are sampled in order to collect five scales (from 2000 to 2008) or three scales (from 2009) by length class (cm). For the 8.a,b area the information is available only from 2010. For other areas the information is not available. All length samples are populated in a central database (Harmonie) and regular extracts are available in the COST format. Raising the data to the population is done using COST tools and a special forum for discussing the outcomes of the analysis is held every year in March, in order to gather all stock coordinators and prepare the datasets for the assessment working groups.

#### Data coverage and quality

Length compositions of French sea bass commercial landings are constructed from2014 for the area including 4.b,c; 7.d, 7.e,h and 7.a,f,g, for all métier. The input data for French fleets in Stock Synthesis are the fleet-aggregated length compositions in 2 cm classes (20–21.9, 22–23.9, etc.) for each year from 2000 onwards.

The statistical design of fishery sampling schemes has undergone change in recent years in the UK and France, following recommendations from ICES workshops on sampling survey design, with a move towards more representative sampling across trips within fleet segments. This can result in sampling more trips that have small catches of bass, and is one reason for the increase in numbers of sampled trips with bass since 2009 in France which does not imply an increase of the proportion in numbers of fish measured per trip.

#### Other countries

Fishery landings length or age compositions from other countries catching bass were not available to IBPBass2 2016. The Netherlands did collect age samples of sea bass every year from 2005 to 2008. From 2010 onwards, age samples are collected only once every three year. In the IMARES market sampling data on length, age, sex and weight are collected for several commercially important species. For sea bass this is done on an irregular basis and data are only available for some years. Market sampling is done since 2005. The age sampling frequency is now set triennially (2010, 2013, etc.) Every three years four samples of 15 fish (60 fish in total) are aged, and every year the lengths of 24 samples of 15 fish (360 fish in total) are taken. Otoliths and scales that are retrieved from the fish are sent to Cefas in the UK for age reading. Length samples are collected every year. All samples are collected in the auctions where most sea bass is landed, in the south of the Netherlands. The quality of the data is good enough to use them in assessments. However, both the length and age data need processing before they can be inserted in an assessment.

#### Effective sample sizes for length and age compositions

The effective sample size for annual estimates of length or age composition lie between the number of trips sampled and the number of fish measured or aged, due to cluster sampling effects. Effective sample sizes have now been computed for UK and French sampling data for sea bass. Initial sample sizes for the length compositions are first computed for the UK trawls/nets and lines fleet based using the number of trips sampled for length and the age compositions on the number of trips sampled for age. The UK midwater trawl length frequencies use the number of trips sampled for length, similar to the Other UK fleets, however the age frequency distribution uses a sample size set at 50 for each year. For the French combined-fleet LFDs, the sample size is set at 200 for each year and the age frequency distribution sample size set at 100 for each year.

Sample sizes where adjusted using the Francis method of weighting. This was carried out using an iterative re-weighting process of compositional data using the input sample sizes and the effective sample sizes based on model fit. This method reduces the disproportionate effect of the different dataset used. Table B.2.1.1 provides the multiplier by fleet for each of the age and length composition data sources.

**Table B.2.1.1 Effective sample size multiply for age and length compositions by fleet.**

| FLEET | DATA TYPE | MULTIPLIER |
|---|---|---|
| UK otter trawl/nets | Length compositions | 0.2625 |
| | Age compositions | 0.2376 |
| Lines | Length compositions | 0.1539 |
| | Age compositions | 0.1591 |
| UK midwater trawl | Length compositions | 0.1601 |
| | Age compositions | 0.7251 |
| French | Length compositions | 0.2023 |
| | Age compositions | 0.3362 |
| Autumn Bass survey | Age compositions | 0.8443 |
| French channel ground fish survey (CGFS) | Length compositions | 0.3562 |

### Accuracy and validation of age estimates

#### Age-reading consistency

Consistency in age reading of sea bass between four operators in Cefas and Ifremer was examined during a limited exchange of otolith and scale images between laboratories in 2011, organised by the ICES Planning Group on Commercial Catches, Discards and Biological Sampling (Mahé *et al*., 2012). A total of 155 fish of 17–74 cm was sampled on board French research vessels during two international surveys. The precision of ageing was similar for scales and otoliths. The coefficient of variation of age readings for individual fish was around 12% implying a standard deviation of +/- 1 year for a ten year-old fish, with relatively few fish having identical readings by all four operators. However it was noted by the operators that photographic images were more difficult to evaluate than original age material, which was likely to have a negative effect on the consistency of ageing. These results provide no indication of the validity of ages, only the consistency between operators, and cannot indicate data quality in earlier years when different operators provided the age data. A more extensive age exchange is to be carried out in 2015.

#### Age validation

WGCSE and IBPBass were not aware of specific studies to validate absolute ages of sea bass derived from otolith or scale readings. Strong and weak year classes can be followed clearly to over 20 years of age in UK sample data although it is not known to what extent the elevated numbers of sampled fish in immediately adjacent year classes is a true reflection of year-class strength or a consequence of age errors discussed in the previous section. Year-class tracking is less clear in the younger ages 3–5 although this will be affected by gear selectivity and changes in fish behaviour.

Sea bass show relatively broad length-at-age distributions, and it has been noted in French data (Laurec *et al*., 2012 WD to IBP-NEW) that the length-at-age distributions can have unusual patterns including some multiple modes that could indicate age errors. This will result in some smoothing of age data across neighbouring year classes. In the UK data, unusual patterns in length-at-age distributions for some younger ages appear related more to effects of minimum landing size on data from the fishery.

#### Inclusion of age error parameters in Stock Synthesis model

CVs for ageing error by age class can be input to Stock Synthesis. Based on the ICES sea bass scale exchange in 2002, the CVs of ~12% can be specified as increasing values per age class to give a standard error of ~1 year per age class.

### B2.2 Growth parameters

Pickett and Pawson (1994) provide plots of growth curves for female and male bass based on samples collected in the 1980s in Areas 4 and 7. The samples used by Pickett and Pawson (1994) for growth and maturity analysis were obtained from a range of fishery and other sources.

A re-analysis of UK historical age–length data including more recent samples was conducted in 2012, using data for the full UK sampling series from 1985 to 2010 (Armstrong and Walmsley, 2012b). The data are derived from sampling of UK fishery catches around England and Wales as well as from trawls surveys of young bass in the Solent and Thames estuary. More than 90 000 sea bass have been aged since 1985. The inshore surveys are mainly young sea bass up to 3–5 years of age, whereas the fishery samples include fish up to 28 years of age.

All ageing is done from scales, excluding scales considered to be re-grown. On surveys, scales are collected in a length-stratified manner from individual hauls with a view to building age–length keys. A similar approach has historically been adopted for catch sampling. This may lead to non-random sampling of individual age groups when the catch numbers are well in excess of numbers sampled from an individual catch. It will also lead to some overestimation of the standard deviation of lengths-at-age.

All ages for fitting growth curves are referred to a nominal January 1 birthdate, according to month of capture. Parameters of the von Bertalanffy growth curve were fitted in Excel Solver using non-linear minimisation of ∑(obs-exp)^2 for lengths-at-age of individual fish, by area and for all data combined.

Von Bertalanffy model parameters were as follows:

| Area | 4.b,c | 7.d | 7.e | 7.a,f,g | All areas |
|---|---|---|---|---|---|
| Linf (cm) | 82.98 | 87.22 | 92.27 | 81.87 | 84.55 |
| K | 0.1104 | 0.09298 | 0.07697 | 0.09246 | 0.09699 |
| t0 (years) | -0.608 | -0.592 | -1.693 | -1.066 | -0.730 |

Standard deviation of length-at-age distributions increases linearly with age according to:

SD (age) = 0.1166*age + 3.5609

The sampled sea bass show some sexual dimorphism of growth from about seven years of age onwards. It is currently not possible to implement a sex-disaggregated Stock Synthesis assessment, therefore a combined-sex growth curve is adopted. Mean length-at-age has not shown any trend over time, and length-at-age is also very similar in strong and weak year classes (Armstrong and Walmsley, 2012b). Hence data have been combined over the full series to estimate growth parameters.

### B2.3 Maturity

#### Spawning grounds and season

Ripe adult bass have been caught by pelagic trawling in the south of Division 8.a and in the north of Division 8.b in the Bay of Biscay during January–March (Morizur, unpublished data), and planktonic egg surveys (Thompson and Harrop, 1987; Jennings and Pawson, 1992) have shown that bass spawn offshore in the English Channel and eastern Celtic Sea from February to May. Spawning started in the Midwestern Channel when the temperature range associated with bass egg distributions was 8.5–11°C, and appeared to spread east through the Channel as the surface water temperature exceeded 9°C. Seasonal patterns of occurrence of advanced maturity stages in UK samples also indicate spawning mainly January to May in ICES Areas 4 and 7 (Armstrong and Walmsley, 2012c). Spawning and ripe bass are also found in the southern North Sea (information from commercial fisheries and angler reports in Netherlands supplied to IBP-NEW 2012 by F. Quirijns).

#### Previous estimates of maturity at length/age, and data available for re-analysis

SGBASS (ICES 2004) reported that around Britain and Ireland, male bass mature at a length of 31–35 cm, aged 4–7 years, and females at 40–45 cm, aged 5–8 years, (Kennedy and Fitzmaurice, 1972; Pawson and Pickett, 1996), and data from the southern part of the Bay of Biscay (Lam Hoai, 1970; Stequert, 1972) indicate that male matures at a length of 35 cm (age 4) and females at 42 cm (age 6). Data provided by Masski (1998) from samples taken from 7.e bottom trawlers (41 females) indicate that 40% and 82% of females were mature at-age 6 and 7 respectively, with a very small percentage mature at-age 5.

Collection of maturity data are difficult as few adult bass are caught in surveys and bass are typically landed whole and are extremely expensive to purchase. Samples collected by the UK (Cefas) during 1982–2003 and 2009 in ICES Areas 4 and 7 were re-analysed for ICES IBP-NEW 2012 (Armstrong and Walmsley, 2012c). Samples have come from all around the coast of England and Wales, though few fish have been sampled in the Irish Sea (7.a).

#### Defining a maturity marker for sea bass

Sea bass are multiple batch spawners, as indicated by size distributions of oocytes (eggs) in ovaries (Mayer *et al*., 1990). This means that the ovary will start to mature oocytes through to vitellogenic stages during the months immediately prior to the spawning season. Historical maturity staging of sea bass by the UK has used the maturity key given in Pawson and Pickett (1996; Table B2-1). In their analyses, they treated stage 2 as mature, and stage 3 as immature. Their reasoning was that stage 3 ovaries (early maturing) were found in smaller bass than later stages (4+) indicating that many of these fish may not proceed to spawning. Sea bass migrate offshore to spawning grounds, and it is likely that early maturing fish could be over-represented, and advanced maturing fish under-represented in inshore catches sampled during the period of spawning migrations. An additional spent stage (8) has been occasionally recorded.

The identification of a suitable marker to identify maturity has to take into account the probability of finding a fish at any maturity stage in different months, the duration of a stage, and the availability/catchability of fish at that stage of maturity. When the majority of mature sea bass have entered the batch spawning cycle in spring, all stages represented in batch spawning (III to 7) will be evident and should be distinct from immature fish. Hence, the best markers for maturity are the maturity stages representing different stages in the batch spawning cycle, sampled at a time when spawning is taking place (or immediately before), provided fish in all stages are equally catchable. This is the conclusion of recent ICES workshops on maturity staging of gadoids and flatfish, which recommends sampling within a month or so of the beginning and end of the spawning season. Experience with other roundfish and flatfish stocks is that it can be very difficult to distinguish between virgin females and fish that have spawned previously, when sampled in the non-spawning period. The UK data were therefore re-analysed using samples from December to April, treating all fish of maturity stages 3 to 7 as mature.

#### Re-estimation of maturity ogives from UK data

Maturity was modelled using a binomial error structure and logit link function, fitted in R to individual observations. The logistic model describing proportion mature by 1 cm length class $L$ was formulated as:

$$Pmat(L) = 1/(1+e^{-(a+bL)})$$

defined by the parameters slope $b$ and length intecept$a$. These parameters were estimated separately for females and males. This can also be expressed as:

$$Pmat(L) = 1/(1+e^{-b(L+c)}) \text{where } c = a/b$$

Stock Synthesis uses the second formulation, and the parameters required are the slope (b = 0.3335: entered as a negative value) and the length inflection, which is the estimated length at 50% maturity ($L^{50\%}$ = 40.65 cm).

The 2009 data come from a large sample of sea bass taken in spring from a few trips specifically to revisit bass maturity, but this sample dominates the time-series of sampling which is spread over very many more trips and months than in 2009 and therefore has better coverage. Maturity ogives were therefore fitted including and excluding 2009 data. The inclusion of 2009 data, which were for a relatively restricted length range of fish around 40 cm, has the effect of improving the fit of the model near the top of the ascending limb of the maturity ogive for females (Figure B2-1). However the very high weighting for these lengths compared to the data for lengths <35 cm results in the model fitting very poorly to the smaller length classes. Excluding the 2009 data allow the length classes <35 cm to carry more weight, and the ogive appears to fit the data for 30–40 cm sea bass more closely, although the fit for lengths >40 cm is poorer. Addition of the 2009 data effectively shifts the L50% from around 41 cm to 35 cm. In contrast, inclusion or exclusion of the 2009 data has less effect on the model fit for males (Figure B2-1). On balance, it was considered undesirable for a few large hauls in a recent year to have excessive leverage in the model fit, and the model excluding 2009 was considered preferable as a long-term maturity ogive for use in assessments.

**Table B2-1. Macroscopic characteristics of the maturity stages of the gonads of bass. (Pawson and Pickett, 1996)**

| Maturity Stage | | Ovary | Testis |
|---|---|---|---|
| I | Immature | Small thread-like ovary, reddish-pink | Small, colourless, thread-like; testis not practical to differentiate macroscopically <TL 20 cm |
| II | Recovering spent | Ovaries one-third length of ventral cavity, opaque, pink with thickened walls and may have atretic eggs | Testis one-third length of ventral cavity, often bloodshot with parts dark grey |
| III | Developing (early) | Ovaries up to one-half length of ventral cavity, orange-red, slight granular appearance, thin, translucent walls | Testes thickness 10–20% of length, dirty white, tinged grey or pink |
| 4 | Developing (late) | Ovaries greater than one-third length of ventral cavity, orange-red; eggs clearly visible, but none hyaline | Testes flat-oval in cross-section and thickness >20% of length, half to two-thirds of ventral cavity. White colour and milt expressed from vent if pressure applied to abdomen |
| V | Gravid (ripe) | Swollen ovaries two-thirds length of ventral cavity, pale yellow-orange; opaque eggs clearly visible with some hyaline | Testes bright white and more rounded-oval in cross-section. Only light pressure required to cause milt to flow from vent |
| 6 | Running | Ovaries very swollen; both opaque and larger hyaline eggs clearly visible beneath thin almost transparent ovary wall, and expressed freely with light pressure | Testes becoming grey-white and less turgid. Milt extruded spontaneously |
| 7 | Spent | Ovary flaccid but not empty, deep red; very thick ovary wall; dense yellow atretic eggs may be visible | Testes flattened and grey, flushed with red or pink, larger than those at stage II or III |

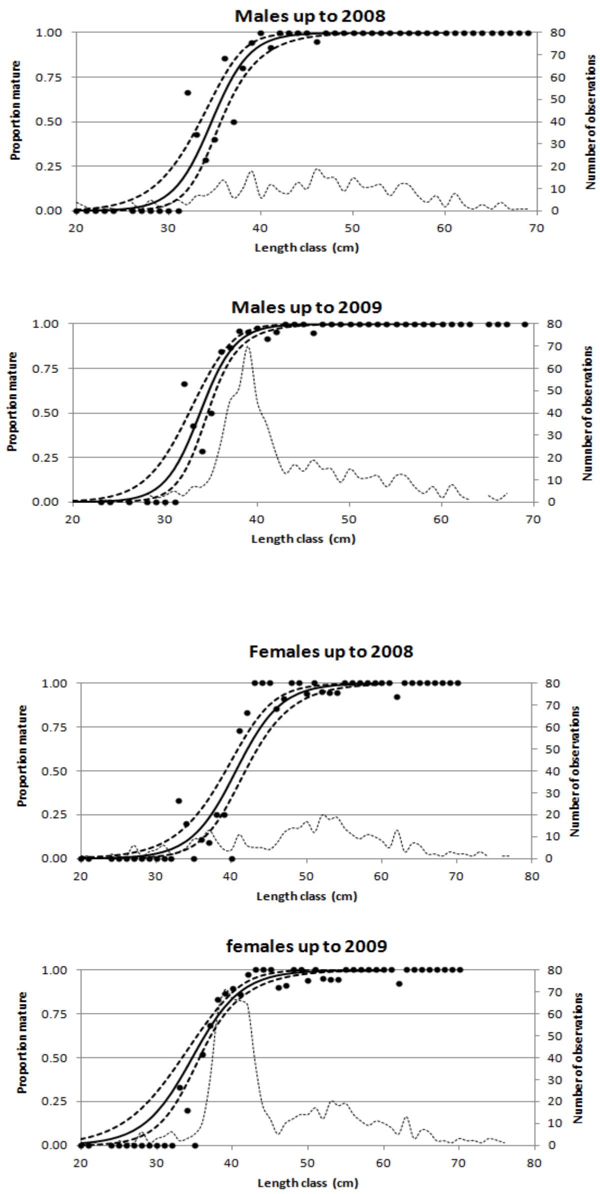



**Figure B2.1. Logistic maturity ogives (with 95% confidence intervals) fitted to individual maturity records for sea bass during December–April. Top plot: excluding 2009 data (top); bottom plot: including 2009 data. Points are proportion mature in the raw data. Dotted line is the number of observations per length class.**

The parameters of the model $Pmat(L) = 1/(1+e^{-b(L+c)})$ are given below:

| | FEMALES | MALES |
|---|---|---|
| Intercept (a) | -13.556 | -16.851 |
| Slope (b) | 0.3335 | 0.4861 |
| c = a/b | -40.6488 | -34.6652 |
| $L_{25\%}$ | 37.35 | 32.41 |
| $L_{50\%}$ | 40.65 | 34.67 |
| $L_{75\%}$ | 43.95 | 36.93 |

The logistic model for females and males is:

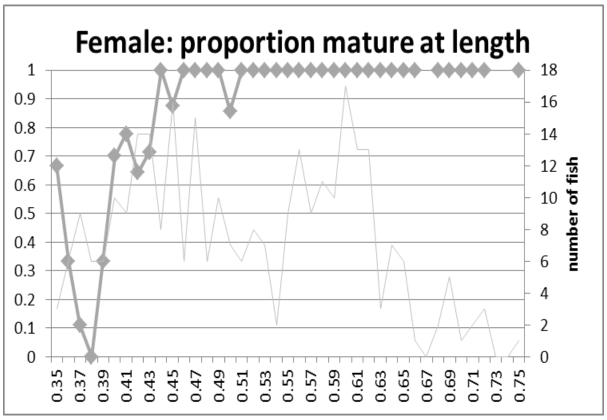
Pmat(L) = 1/(1+e-0.3335(L-40.6488)) (females)
Pmat(L) = 1/(1+e-0.4861(L-34.6652)) (males)

The maturation range for females occurs at-ages 4 to 7, and for males at ages 3–6, as shown by the proportion mature at-age in the same samples used for estimation of length-based maturity ogives (Table B2-2).

**Table B2-2. Raw proportion mature at-age in 1982–2003 UK samples from all areas.**

| | FEMALES | MALES |
|---|---|---|
| age 2 | 0.00 | 0.00 |
| age 3 | 0.00 | 0.27 |
| age 4 | 0.17 | 0.54 |
| age 5 | 0.21 | 0.61 |
| age 6 | 0.55 | 0.91 |
| age 7 | 0.95 | 0.98 |
| age 8 | 1.00 | 1.00 |
| age 9 | 0.95 | 0.98 |
| age 10+ | 1.00 | 1.00 |

Data on sea bass maturity have also been collected in the Netherlands since 2005. Methods and data are described by Quirijns and Bierman (2012). For male fish, too few specimens were measured to estimate maturity. Maturity-at-age and length are plotted in Figure B2-2. Note that only few fish were measured in the lowest age and length groups. At age 4, 50% of the females are mature. This is substantially lower than the age at 50% maturity in the Cefas 1982–2003 samples (Table B2-2), and closer to the ogive from Cefas data including the large 2009 sample (Figure B2-1), for which L50 was around 35 cm (~4 years old). This may confirm that sea bass could now be maturing earlier than in the 1980s–early 2000s, at least for the North Sea. The plot showing maturity-at-length for Netherlands samples is not based on enough measurements to show a reliable maturity ogive.



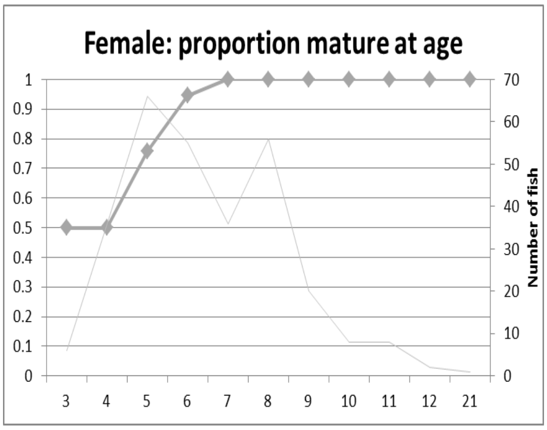




**Figure B2-2. Proportion of mature at-age and length (length in m) for female sea bass sampled in the southern North Sea by the Netherlands during 2005 (thick line). The thin line shows the number of fish measured on which the proportion of maturity is based.**

### B2.4 Larval dispersal, nursery grounds and recruitment

Bass larvae resulting from offshore spawning move steadily inshore towards the coast as they grow and, when they reach a specific developmental stage at around 11–15 mm in length (at 30–50 days old), it is thought that they respond to an environmental cue and actively swim into estuarine nursery habitats (Jennings and Pawson, 1992). From June onwards, 0-group bass in excess of 15 mm long are found almost exclusively in creeks, estuaries, backwaters, and shallow bays all along the southeast, south, and west coasts of England and Wales, where they remain through their first and second years, after which they migrate to over-wintering areas in deeper water, returning to the larger estuaries in summer. Several studies indicate the existence of similar bass nursery areas in bays and estuaries on the French coasts of the Channel and Bay of Biscay and southern Ireland.

During the winter, juvenile bass move into deeper channels or into open water, and return in spring to the larger estuaries and shallow bays on the open coast, where they remain for the next 2–3 years.

On the south and west coasts of the UK, juvenile bass emigrate from these nursery areas at around 36 cm TL (age 3–6 years, depending on growth rate), often dispersing well outside the 'home' range, and not necessarily recruiting to their specific parent spawning stock (Pawson *et al.*, 1987; Pickett and Pawson, 2004). It appears that there is substantial mixing of bass at this stage throughout large parts of the populations' distribution range. When they reach four or five years of age their movements become more wide-ranging and they eventually adopt the adult feeding/spawning migration patterns (Pawson *et al.*, 1994).

Sea temperature has a strong influence on sea bass dynamics, affecting spatial distributions, and also the growth and survival of young bass in nursery areas during the first years of life (Pawson, 1992; WGCSE, 2014).

### B2.5 Natural mortality M

There are no direct estimates of natural mortality available for Northeast Atlantic sea bass. Predation up to around age 4 will be in and near estuaries and bays. As with other fish species it is expected that M will be relatively high at the youngest ages, particularly given the slow growth rate in bass. A variety of methods are given in the literature relating natural mortality rate M to life history parameters such as von Bertalanffy growth parameters k and Linf (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. The probability of encountering very old bass is partly a function of the interaction of year class strength and sampling rates, as well as mortality, however the occurrence of sea bass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings. Age compositions of recreational fishery caught bass in southern Ireland, presented by stakeholders at IBP-NEW 2012, also show ages up to 26 years (Figure B2-3). This stock has been subject to a commercial fishery ban for many years.

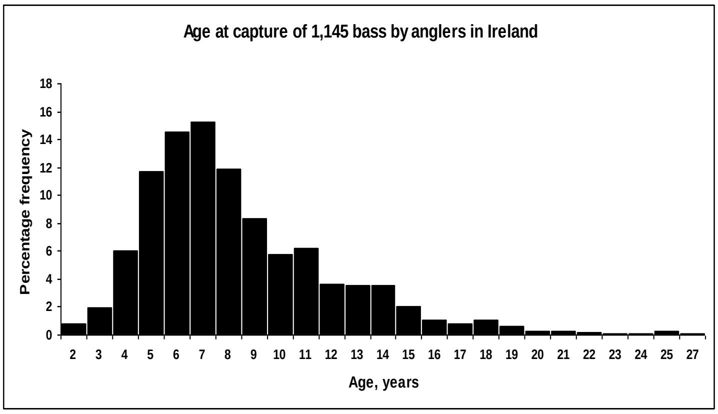



**Figure B2-3. Age composition of bass from samples collected from recreational catches in southern Ireland (data courtesy Ed Fahy, IBP-NEW 2012 meeting).**

Inferences on sea bass natural mortality based on some life-history models in the literature are given in IBP-NEW 2012 benchmark assessment section. The inferred values of M, with the exception of the Beverton method, are in the range 0.15–0.22 (Armstrong, 2012).

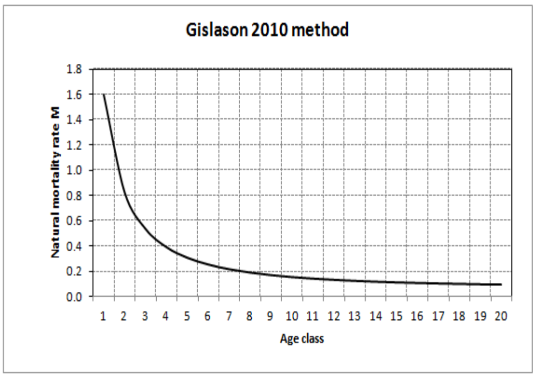
A variety of methods are given in the literature relating natural mortality rate M to life-history parameters such as von Bertalanffy growth parameters k and $L_{inf}$ (asymptotic length), length or age at 50% maturity and apparent longevity particularly in an unexploited or very lightly exploited population. The method of Gislason *et al.* (2010) generates age-varying M values. These methods were applied to the following sea bass life-history parameters by Armstrong (2012):

| LIFE-HISTORY PARAMETERS | |
|---|---|
| VBGF K (combined sex) | 0.097 |
| VBGF Linf (combined sex) | 84.55 |
| VBGF to (combined sex | -0.73 |
| Age at 50% maturity females (L50% converted to age) | 6 |
| Age at 50% maturity males (L50% converted to age) | 4 |
| | |
| Max age (combined sex) | 28 |
| Length at 50% mat females | 40.65 |
| Length at 50% mat males | 34.67 |

The probability of encountering very old bass is partly a function of the interaction of year-class strength and sampling rates, as well as mortality, however the occurrence of seabass to almost 30 years of age suggests low rates of mortality. The observed maximum age of 28 years in sea bass samples in the UK was recorded in the early 1980s, following a period of relatively low fishery landings although recreational fishing was occurring throughout this period. Age compositions of recreational fishery caught bass in southern Ireland, presented by stakeholders at IBPNew 2012, show ages up to 26 years. This stock has been subject to a commercial fishery ban for many years.

Inferences on natural mortality rates are given below:

| Source | Formulation | Combined sex M | | |
|---|---|---|---|---|
| Hoenig 1983 | variety of taxa ln(M) = 1.44-0.982*ln(tmax); | 0.160 | | |
| | teleosts ln(M) = 1.46-1.01*ln(tmax) | **0.149** | | |
| Alverson and Carney 1975 | M = 3k/(exp(0.38*tmax*k)-1) | **0.161** | | |
| Pauly 1980 | M=exp(-0.0152+0.6543*ln(k)-0.279*ln(Linf,cm)+0.4634*lnT(oC)) | 0.196 | temperature C | 12 |
| | | **0.211** | | 14 |
| | | 0.224 | | 16 |
| Ralston 1987 | M=0.0189+2.06*k | **0.219** | | |
| Beverton 1992 | M=3k/(exp(*am* *k)-1) am = age at 50% maturity | 0.369 | female *am* ; comb sex k | |
| | | 0.614 | male *am* , comb sex k | |
| Jensen (1997) | M=1.5K | **0.146** | | |
| Gislason 2010 | M = exp(0.55-1.61*Ln(L) + 1.44* Ln (Linf)+ Ln(K)) | **Age class** | Length | M |
| | | 1 | 13.1 | 1.599 |
| | | 2 | 19.7 | 0.827 |
| | | 3 | 25.7 | 0.539 |
| | | 4 | 31.1 | 0.395 |
| | | 5 | 36.1 | 0.312 |
| | | 6 | 40.5 | 0.258 |
| | | 7 | 44.6 | 0.221 |
| | | 8 | 48.3 | 0.195 |
| | | 9 | 51.6 | 0.175 |
| | | 10 | 54.7 | 0.159 |
| | | 11 | 57.5 | 0.147 |
| | | 12 | 60.0 | 0.138 |
| | | 13 | 62.2 | 0.130 |
| | | 14 | 64.3 | 0.123 |
| | | 15 | 66.2 | 0.117 |
| | | 16 | 67.9 | 0.113 |
| | | 17 | 69.4 | 0.109 |
| | | 18 | 70.8 | 0.105 |
| | | 19 | 72.1 | 0.102 |
| | | 20 | 73.2 | 0.100 |




The inferred values of M, with the exception of the Beverton method, are in the range 0.15–0.22. The average of the Gislason estimates for ages 3–20 is 0.19, and the estimates fall below 0.15 by age 11. The value M=0.2 was adopted by WGCSE 2013

## B.3 Surveys

### B3.1 UK Solent and Thames pre-recruit surveys

The UK has conducted pre-recruit trawl surveys in the Solent and the Thames Estuary since 1981 and 1997 respectively. These surveys all ended in 2009 although the Solent survey was repeated as a one-off survey in autumn 2011 to help provide recruitment indices for the bass benchmark assessment. The location of the surveys and the tow positions are shown in Figure B3-1. Both surveys use a high headline bass trawl, although in the Thames it is deployed as a twin rig and in the Solent as a single rig.

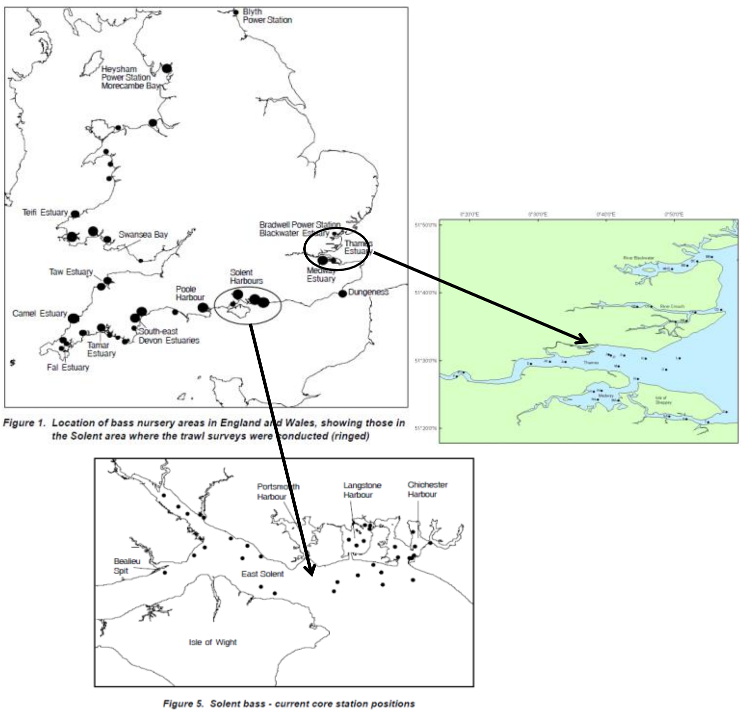



**Figure B3-1. Location and tow positions for UK (England) Solent and Thames sea bass surveys.**

The Solent survey has previously been presented to WGNEW as a combined index across ages in each year class. The index was derived by firstly rescaling the annual mean catch rate per age class to the mean for that age in the survey series, then taking the average of the rescaled values for ages 2–4 in each year class from surveys in May–July and September (i.e. up to six values represented in the annual combined index). The Thames survey data were worked up in the same way, although using a different age range for the combined index (ages 0–3). WGNEW 2012 provided the survey data in the more conventional tuning-file format, giving the standardised catch rates (arithmetic mean numbers per 10 minute tow) by year and age, separately for the two surveys (data in assessment report). These surveys have now been discontinued and will not be updated by future working groups unless new resources are allocated.

The spring and autumn Solent survey index series are updated to include the autumn 2013 survey and to amend an error in the autumn survey indices in 2000. The surveys do not show major year-effects, but as noted in previous assessments the autumn (September) survey shows a general increase in recruitment during the 1990s up to the mid-2000s, with very low indices for the 2008 onwards year classes, whilst the spring survey shows poor recruitment from around 2002 onwards. Previous Stock Synthesis runs show that the autumn survey is much better fitted than the spring survey. The spring survey is likely to be more strongly affected by weather and by temperature effects on distribution.

The Thames survey series indicates an increase in recruitment from the mid-1990s to early 2000s followed by some poor year classes, possibly a strong 2007 year class, then weak year classes in 2008 and 2009. A problem with the use of the Thames survey is that it may reflect recruitment from spawning that became established in the southern North Sea as the stock expanded in the 1990s under warmer sea conditions, and may therefore not reflect recruitment trends that influence the larger stock components in the Channel and Celtic Sea.

A justification of using the Solent survey as an index of recruitment over the full range of the stock was the results of a statistical, UK-only fleet-based separable model developed by Pawson *et al*. (2007) and updated by ICES WGNEW (Kupschus *et al*., 2008). The Pawson *et al*. model was fitted only using UK age compositions for trawls, midwater trawls, nets and lines, separately for ICES Divisions 4.b,c, 7.d, 7.e,h and 7.a,f,g, and was intended mainly to estimate fleet selection patterns. Although it excluded any tuning data, the recruitment-series for each sea area closely resembled the Solent survey indices and to an extent the shorter Thames series, and was able to provide coherent selection patterns by fleet.

The full Solent survey series was subject to a change in gear design in 1993. Some comparative trawling was carried out to develop age-varying calibration factors, but these are poorly documented and the original raw data and calibration results are currently being sought at Cefas. Pending an evaluation of this, the benchmark Stock Synthesis runs included a sensitivity run with the series split into two periods around the gear change. Some additional issues with calibration factors applied to the spring survey were detected during the benchmark, and this is considered later in the sections on model development.

A precision estimate was calculated for the Solent and Thames surveys based on the between-tow variations in catch rate of all the age classes used in the index. For the Solent spring, Solent autumn and Thames surveys, the relative standard errors were 0.42, 0.25 and 0.43 respectively.

IBP-Bass 2014 reviewed the performance of the Solent and Thames surveys and decided to exclude the Solent spring and the Thames survey for the following reasons:

- The Solent spring survey (Table B.3.1) has performed poorly in the assessment, indicating trends in recruitment not in accord with other data. This may be related to temperature or other environmental effects on distribution of small bass in spring. Unusual calibration factors noted in some years in the Solent spring data files require investigation.
- The Thames survey (Table B.3.2) may reflect recruitment from spawning that became established in the southern North Sea as the stock expanded in the 1990s under warmer sea conditions, and may therefore not reflect recruitment trends that influence the larger stock components in the Channel and Celtic Sea.

The removal of these surveys has negligible impact on the estimated stock trends.

**Table B.3.1. Time-series of relative abundance indices for seabass age groups 2, 3 and 4 from the UK Solent spring and autumn trawl surveys. A change in trawl design took place in 1993.**

| | May–July | | | September | | |
|---|---|---|---|---|---|---|
| Year | age 2 | age 3 | age 4 | age 2 | age 3 | age 4 |
| 1981 | 0.00 | 0.30 | 0.25 | | No survey | |
| 1982 | 0.51 | 2.17 | 0.16 | 3.25 | 10.10 | 0.38 |
| 1983 | | No survey | | 9.87 | 0.91 | 1.88 |
| 1984 | 0.95 | 2.66 | 0.43 | 1.38 | 0.65 | 0.09 |
| 1985 | 0.00 | 10.33 | 2.56 | | No survey | |
| 1986 | | No survey | | 0.27 | 4.26 | 1.31 |
| 1987 | 0.00 | 0.42 | 3.18 | 0.05 | 0.28 | 2.27 |
| 1988 | 0.00 | 0.02 | 0.47 | | No survey | |
| 1989 | | No survey | | 6.68 | 0.37 | 0.00 |
| 1990 | 2.84 | 2.48 | 0.00 | 2.81 | 1.15 | 0.02 |
| 1991 | 5.78 | 0.62 | 0.09 | 3.08 | 0.21 | 0.03 |
| 1992 | 0.11 | 7.04 | 0.35 | 0.95 | 18.59 | 0.16 |
| 1993 | 0.05 | 7.33 | 14.02 | 6.65 | 3.59 | 4.39 |
| 1994 | 0.04 | 1.63 | 1.14 | 3.33 | 1.84 | 0.29 |
| 1995 | 0.05 | 1.57 | 0.97 | 4.83 | 4.69 | 0.72 |
| 1996 | 1.43 | 4.09 | 3.36 | 5.52 | 0.43 | 0.11 |
| 1997 | 0.27 | 1.94 | 0.11 | 33.62 | 4.52 | 0.06 |
| 1998 | 0.00 | 6.75 | 5.79 | 1.22 | 5.50 | 0.61 |
| 1999 | 0.61 | 0.95 | 12.30 | 19.37 | 0.67 | 0.87 |
| 2000 | 0.49 | 37.03 | 1.06 | 6.07 | 11.35 | 0.03 |
| 2001 | 1.71 | 6.33 | 3.43 | 34.42 | 3.92 | 1.57 |
| 2002 | 0.63 | 1.62 | 0.29 | 7.42 | 3.87 | 0.40 |
| 2003 | 0.06 | 0.32 | 0.38 | 8.37 | 4.60 | 0.59 |
| 2004 | 0.17 | 0.28 | 0.16 | | No survey | |
| 2005 | 0.05 | 0.42 | 0.35 | 13.12 | 7.98 | 0.84 |
| 2006 | 0.44 | 2.47 | 1.03 | 9.51 | 9.21 | 1.02 |
| 2007 | 0.33 | 0.50 | 0.50 | 3.42 | 1.78 | 0.30 |
| 2008 | | No survey | | 18.52 | 6.66 | 0.34 |
| 2009 | 0.72 | 1.03 | 0.13 | 13.25 | 6.25 | 0.33 |
| 2010 | | No survey | | | No survey | |
| 2011 | | No survey | | 2.25 | 1.39 | 0.42 |
| 2012 | | No survey | | | No survey | |
| 2013 | | No survey | | 1.34 | 0.08 | 0.10 |
| 2014 | | No Survey | | 1.17 | 1.02 | 0.11 |

**Note: September 2000 data amended.**

**Table B.3.2. Time-series of relative abundance indices for seabass age groups 0–3 from the UK Thames trawl survey.**

| YEAR | AGE 0 | AGE 1 | AGE 2 | AGE 3 |
|---|---|---|---|---|
| 1997 | 7.737 | 0 | 0.048 | 0.41 |
| 1998 | | No survey | | |
| 1999 | 19.54 | 6.033 | 0.764 | 0 |
| 2000 | 4.015 | 14.74 | 0.832 | 0.089 |
| 2001 | 121.5 | 11.47 | 5.108 | 0.171 |
| 2002 | 469 | 20.71 | 2.716 | 1.093 |
| 2003 | 225.6 | 35.76 | 4.429 | 0.159 |
| 2004 | 238.92 | 44.99 | 7.32 | 1.03 |
| 2005 | 37.04 | 14.49 | 6.86 | 0.75 |
| 2006 | 245.54 | 11.26 | 3.46 | 0.94 |
| 2007 | | No survey | | |
| 2008 | 107.55 | 50.69 | 1.86 | 0.2 |
| 2009 | 95.43 | 7.79 | 13.59 | 0.91 |

### B3.2 Other 0-gp & 1-gp surveys

The UK has undertaken a seine net survey in the Tamar Estuary, since 1985. Additional data are available from the Camel estuary and power stations in the Thames and Severn Estuary. These surveys are used as supporting information and not included in the assessment. Abundance indices for these surveys are given in Table B3.1. The Tamar survey abundance indices need to be updated to include more recent surveys. Seine net surveys in the UK estuaries Fal and Helford also have data on 0-gp and 1-gp bass.

**Table B3-1. Abundance indices for 0-gp and 1-gp bass. († discontinued).**

| | ESTUARY SEINE SURVEYS | | | POWER STATION SCREEN | |
|---|---|---|---|---|---|
| | TAMAR (0-GROUP) | TAMAR (1-GROUP) | CAMEL | SEVERN | THAMES |
| | 7E | 7E | 7F | 7F | 4C |
| 1972 | | | | 3 | |
| 1973 | | | | 4 | |
| 1974 | | | | 1 | |
| 1975 | | | | 15 | 78 |
| 1976 | | | | 127 | 100 |
| 1977 | | | | - | 6 |
| 1978 | | | | - | 5 |
| 1979 | | | | - | 5 |
| 1980 | | | | 9 | 37 |
| 1981 | | | 2 | 216 | 21 |
| 1982 | | | 123 | 83 | 56 |
| 1983 | | | 30 | 226 | 83 |
| 1984 | | | 134 | 8 | 62 |
| 1985 | 0.663 | 0.385 | 22 | 11 | 76 |
| 1986 | 0.005 | 0.014 | 1 | 3 | 14 |
| 1987 | 0.032 | 0.062 | 31 | 96 | 116 |
| 1988 | 1.484 | 1.284 | 48 | 98 | 54 |
| 1989 | 2.348 | 2.389 | 112 | 446 | 610 |
| 1990 | 1.038 | 1.516 | 89 | 25 | 433 |
| 1991 | 0.076 | 0.058 | 50 | 300 | 64 |
| 1992 | 2.216 | 2.431 | 25 | 280 | 104 |
| 1993 | 1.013 | 0.913 | 22 | 202 | 131 |
| 1994 | 1.126 | 0.346 | 134 | - | 26 |
| 1995 | 2.356 | 1.294 | - | - | 27 |
| 1996 | 0.102 | 0.047 | 119 | 242 | † |
| 1997 | 1.119 | 1.299 | 102 | † | |
| 1998 | 2.082 | 3.170 | 264 | | |
| 1999 | 1.215 | 0.937 | 56 | | |
| 2000 | 0.340 | 1.185 | 133 | | |
| 2001 | 0.351 | 0.129 | † | | |
| 2002 | 2.098 | 3.179 | | | |
| 2003 | 0.965 | 1.067 | | | |
| 2004 | 1.453 | 0.261 | | | |
| 2005 | 0.522 | 0.169 | | | |
| 2006 | 0.186 | 0.203 | | | |
| 2007 | 0.475 | 1.308 | | | |
| 2008 | 1.275 | 1.229 | | | |
| 2009 | 0.460 | | | | |

### B3.3 Evhoe survey: France

Sea bass are caught in small numbers in the French Evhoe trawl survey, which extends to the shelf edge in Subareas 7 and 8 but also extends into coastal areas of the Bay of Biscay and the Celtic Sea where bass may be caught (cf the station map). Less than 10% of the stations have bass catches in most years. A mean of 0.5 sea bass per trawl has been recorded from 1987. Abundance indices are calculated as stratified means.

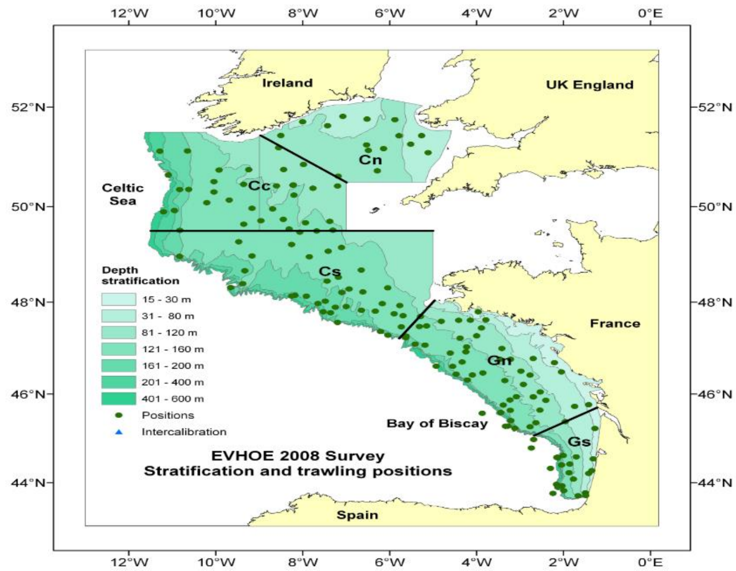



**Figure B 3-2. Station positions for French Evhoe bottom-trawl survey (not used in assessment).**

### B3.4 Channel Ground Fish Survey (CGFS): France

Raw data on sea bass from the French scientific trawl survey "Channel Ground Fish Survey - CGFS" were not available for the previous benchmark in 2012 (IBPNEW, ICES, 2012). Details of the survey are given in Coppin *et al.* (2002), which includes a full description of the GOV trawl used in October each year at the 82 stations in ICES Division 7.d shown in Figure B3.3. The majority of sea bass are caught in the coastal waters of England and France (Figure B3.3). The abundance indices from all the stations give similar trends as from a subset of stations in the main coastal areas, and trial runs with SS3 gave similar trends. Therefore, for further SS3 development, the indices calculated from all the area are used.

The abundance indices are calculated applying a stratified random swept-area based estimator. Strata correspond to ICES statistical rectangles. Swept-area is calculated using wingspread. As this is a stratified swept-area based indicator, uncertainty is based on between haul variance within a strata and summation of variances across strata. Full methodology is presented in the WD_01, available in Annex 2 of the IBPBass report 2014. The trends in both the index and in the proportion of stations with sea bass show some similarities to the trend in total biomass estimates from the ICES WGCSE 2013 update assessment using Stock Synthesis, which lent *a priori* support to the use of the index in the assessment. The swept-area indices of abundance, the percentage of stations with sea bass, and the variance of the estimates are included in the WGCSE 2014 report and will be updated annually. The length composition of the survey index is calculated and is also input to Stock Synthesis.

The precision of the swept-area indices appears unrealistically high in some years (e.g. 0.025 in 1991), which may indicate that the index trends are driven largely by the incidence of positive catches. Modelling of the data using delta lognormal models may provide more realistic precision. During trial Stock Synthesis runs, the use of the CVs resulted in an inability to fit the selection curve for the survey due to individual years being given far too much weight. Relaxing the CVs to 0.30 for all years except the first three years (set to 0.6 given the very low incidence of positive stations) allowed the model to fit the length compositions more closely over the series. The annual indices are therefore input to Stock Synthesis with a CV of 0.30 for all years. The effective sample sizes for the annual survey length composition data are set at the number of stations with sea bass length data. The length compositions for the first three years (1988–1990) are excluded from the assessment due to very small sample sizes although the aggregate indices are retained.

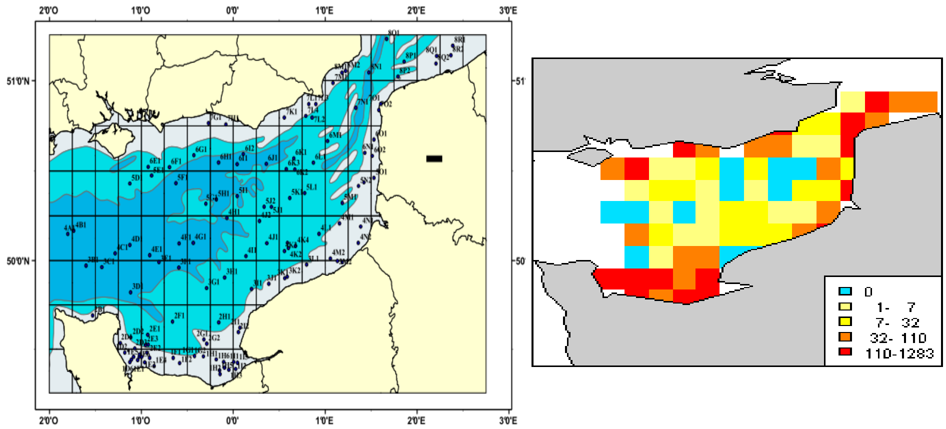



**Figure B.3.3. Left: stations fished during the Channel Groundfish Survey carried out annually by France. Right: distribution of total catches of sea bass over the survey series.**

## B.4 Commercial lpue

ICES IBPNew2012 evaluated a range of commercial fishery lpue series for French and UK fleets operating in Areas 4 and 7. The UK analysis of official catch statistics involved filtering individual trip data to include only trips in ICES rectangles where bass catches have been recorded historically. UK vessels of 10m and under, for which historical landings data are very uncertain, were found to have a wide range of lpue trends depending on gear and area fished, often showing a very steep increase since the mid-2000s (Armstrong and Maxwell, 2012). This may be partly a consequence of more accurate reporting caused by the Registration of Buyers and Sellers regulations after its introduction in 2005, but may also represent a bias caused by increased targeting of sea bass by vessels with insufficient quotas for other stocks or trying to develop track record.

With some exceptions (e.g. trawlers in 7.d), UK >10m vessels tended to show different lpue trends to 10m and under vessels. Relative trends of seabass lpue for 70–99 mm mesh UK otter trawls (1985–2011) and French otter trawlers (2000–2010) operating in 4.b,c,7.d, 7.e,h and 7.a,f,g showed a general trend of increase in the 1980s and 1990s, followed by a levelling off and a decline after 2009 (Figure 10.1.2.7, from WGCSE 2013).

The trends for >10m UK and French trawlers in 4&7.d and in 7.e closely matched the trend in total stock biomass estimates from the final WGCSE 2013 Stock Synthesis assessment whereas the UK trawlers in 7.a,f,&g had a much lower lpuein the early part of the time-series. These results indicated a potential for development of fishery lpue series for inclusion in future development of SS3 for sea bass, using more sophisticated trip filtering and using more statistical approaches such as delta-lognormal modelling with GLMs to develop standardised series. However, IBP-Bass focused more on developing the survey data inputs and did not progress the development of the fishery lpue series which remains a task for the future.

#### B4.1 UK bass logbook scheme

The UK bass logbook scheme is described in Section B1.1. Although the survey has severe limitations for estimation of total bass landings for UK vessels, individual logbooks provide time-series of varying duration on catch-rates of individual vessels using specific gears. The logbooks with sufficient data cover eight gear types within trawls, nets and lines, covering mainly 10 m and under vessels, excluding recreational vessels. The total numbers of logbooks have declined from 50–60 in earlier years to below 20 in recent years. No logbooks were issued in 2008:

| | Year | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| 1 | 7 | 9 | 11 | 19 | 9 | 8 | 15 | 16 | 15 | 22 | 16 | 14 | 18 | 16 | 16 |
| 2 | 0 | 10 | 10 | 15 | 17 | 14 | 13 | 23 | 10 | 25 | 24 | 20 | 24 | 19 | 17 |
| 3 | 2 | 4 | 6 | 5 | 7 | 7 | 4 | 6 | 7 | 6 | 9 | 3 | 8 | 5 | 3 |
| 4 | 5 | 5 | 7 | 9 | 7 | 8 | 7 | 11 | 11 | 4 | 6 | 4 | 4 | 4 | 4 |
| 5 | 7 | 6 | 10 | 13 | 9 | 9 | 10 | 18 | 8 | 10 | 9 | 7 | 11 | 12 | 11 |

| Region | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 16 | 19 | 14 | 12 | 13 | 8 | 6 | 0 | 3 | 3 |
| 2 | 15 | 15 | 13 | 14 | 7 | 10 | 5 | 0 | 3 | 2 |
| 3 | 2 | 5 | 3 | 5 | 5 | 5 | 7 | 0 | 3 | 3 |
| 4 | 4 | 5 | 6 | 7 | 1 | 3 | 4 | 0 | 3 | 1 |
| 5 | 9 | 10 | 9 | 4 | 2 | 5 | 6 | 2 | 1 | 1 |

(Region 1: North Sea 4.b,c, 2: eastern Channel 7.d; 3: western Channel 7.e,h; 4: Celtic Sea (7.f,g); Irish Sea (7.a). The trend in number of records per year shows roughly the same pattern across gears:

An exploratory GAM method was developed (Armstrong and Maxwell, 2012) to extract a common temporal trend in lpue from the individual series for ICES Areas 4.b,c&7.d, 7.eh and 7.afg (referred in the models as areas 1&2, 3 and 4&5). This is analogous to combining series of tree ring counts from timbers of various ages to give a single series describing climate changes. The general method involves estimating logbook factors and year factors (and interactions) to minimise residual model error. Following initial model development and evaluation, a negative binomial error distribution with log link was selected. This can accommodate zero values and allows for the variance to increase with the mean. Working with a log link implies that the estimated trend with year is multiplicative not additive. The R command showing the exact options used for areas 1&2 combined (North Sea and 7.d) is:

> bass.gam3.12 = gam(lpue ~ factor(BookGear) + s(Year, k=10, bs="ts"), family=negbin(c(1,10)), optimizer="perf", data=bass.dat, subset=ARegion=="1and2")

Fitted trends and confidence intervals suggest an increasing lpue trend in regions 1&2 (North Sea & 7.d), and 3 (7.eh) (Figure B4-1). A relatively flat trend and possible recent decline is indicated in regions 4&5 (7.afg) although the recent trend is highly imprecise. Residual checks indicate the model assumptions are reasonable. Model diagnostics and sensitivity to smoothing and other parameters are given in Armstrong and Maxwell (2012).

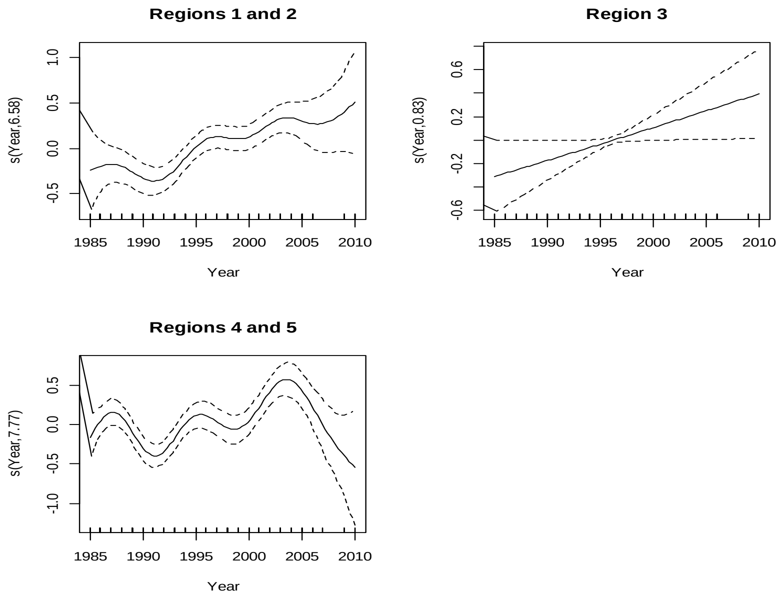



**Figure B4-1. Cefas bass logbook lpue: Selected model for combined regions, plots showing year effects from a fitted model with separate mean value for each book number-gear combination and negative binomial error distribution, dashed lines are a 95% confidence interval.**

### B4.2 UK fleet lpue based on official catch dataseries

Armstrong and Maxwell (2012) review trends in UK commercial fishery lpue for sea bass in the North Sea (4), eastern Channel (7.d), western Channel (7.e) and Irish/Celtic Seas (7.afg) from 1985–2011, and evaluate the possibility of using the time-series as relative abundance estimates for tuning stock assessment models.

Gears which catch bass are targeted at a variety of species, and the fishing effort is distributed across many areas where sea bass have zero or very low probability of capture. A number of approaches are possible to subset fishing trips to include only those that have a probability of catching the species for which lpue is to be estimated. One approach (Stephens and MacCall, 2004) is to cluster fishing trips according to species that occur in association, and use only the cluster with the species on interest for estimating lpue. This method has not yet been applied to UK data. An alternative method to subset trips was applied. This involved (a) selecting gear types that account for ~95% of the total bass landings in each area since 2005; (b) for the selected gears and areas, identify ICES rectangles accounting for ~95% of the total bass landings since 1985. Annual lpue was then estimated for each area and gear, separately for vessels of 10 m (LOA) and under and >10 m vessels. The LOA split is important because reporting of landings and effort of 10 m and under vessels has been very uncertain historically, particularly prior to the introduction of Buyers and Sellers regulations in 2005. Lpue of 10 m and under vessels may be very inaccurate prior to 1995.

It was not possible to evaluate the effect of any increase in targeting of bass by individual vessels using the selected gear types in the selected rectangles, or effects of technology creep. Increased targeting is likely to have happened for vessels with increasingly limited quotas for other species such as cod and which have switched to non-TAC species such as sea bass. For some gears, such as beam trawls, sea bass are not targeted and are purely a bycatch.

Too many lpue series have been examined to reproduce in the Stock Annex, but can be viewed in Armstrong and Maxwell, 2012.

### B4.2 French lpue sets

Lpue of French trawlers in 4.b,c, 7.d and 7.e,h is available from 2000 when Ifremer has estimated landings by ICES Divisions. A recent study has developed indices as kg/per day based on data from auction's sales. This study was carried out on French bottom trawlers (less than 18 m), having a fishing strategy with the least distant random sampling; this fleet usually doesn't target sea bass. Large bias can be caused where: 1. an auction sale corresponds to several days of fishing, 2. technological advances are not taken into account, and 3. changes in fishermen's strategies are not taken into account. Never the less, for information, those from the Channel and North Sea have been compared to the UK Otter trawls lpue, and similarities shown on Figure B4-2 are observed.

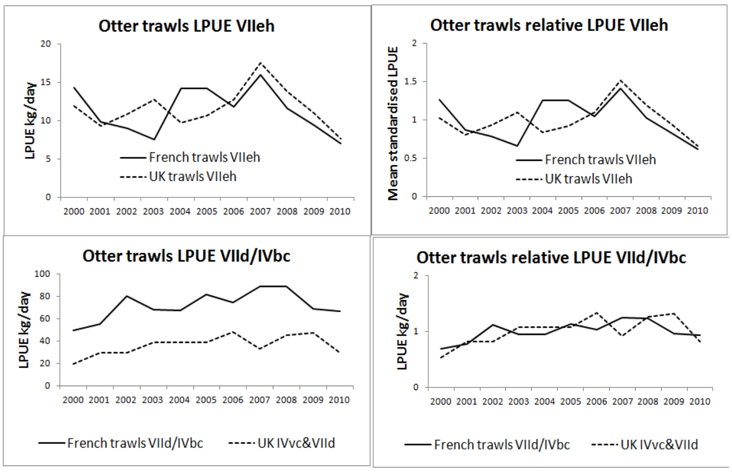


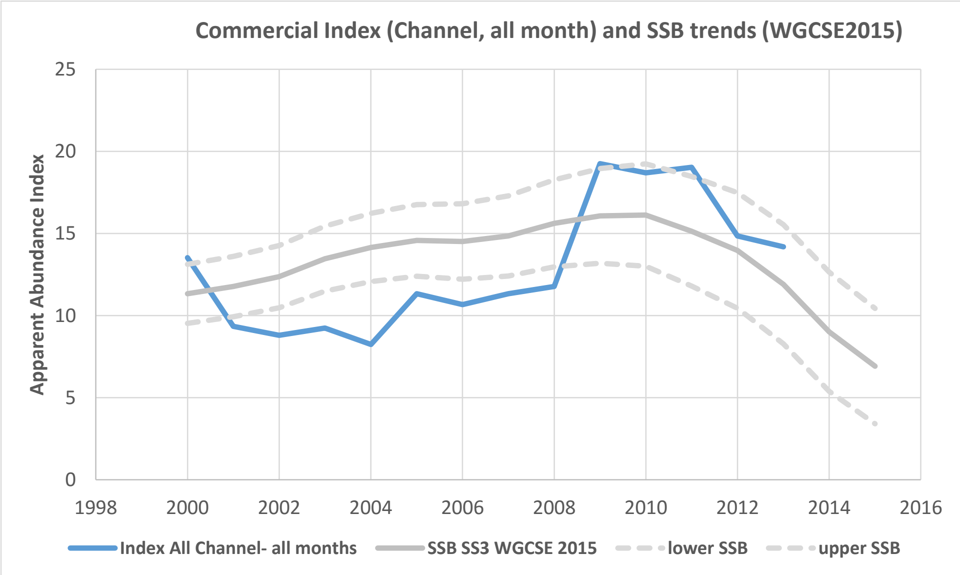

**Figure B4-2. UK fleet lpue based on official catch dataseries, compared to the French lpue sets based on auction hall sales.**

In 2015 for WGCSE, a study "French Logbook data analysis 2000–2013: possible contribution to the discussion of the sea bass stock(s) structure/annual abundance indices. Alain Laurec, M.Drogou"has been conducted and presented in a Working Document (WD_seabass_France_Abundance_Index.pdf: ICES, WGCSE 2015).

Daily catch rates per vessel, grouped within months and ICES squares, have been analysed basically through a multiplicative two factors model. The two factors, namely the fishing vessel effect and the stratum effect. A stratum corresponds to a so-called ICES square, a month and a year.

First conclusions provide a basic hypothesis about stock structures and spawning migrations, and directly related to this discussion apparent abundance index have been produced covering various option/areas.

The preliminary results of the study are considered promising by the group. Even if it's still under-development and should be benchmarked to use it directly in the assessment, some comparison of the Index from two various option with the SSB is presented in Figure B4-3. This shows similar trends in stock perception conforting results of the assessment (but question on the degree of the trends).



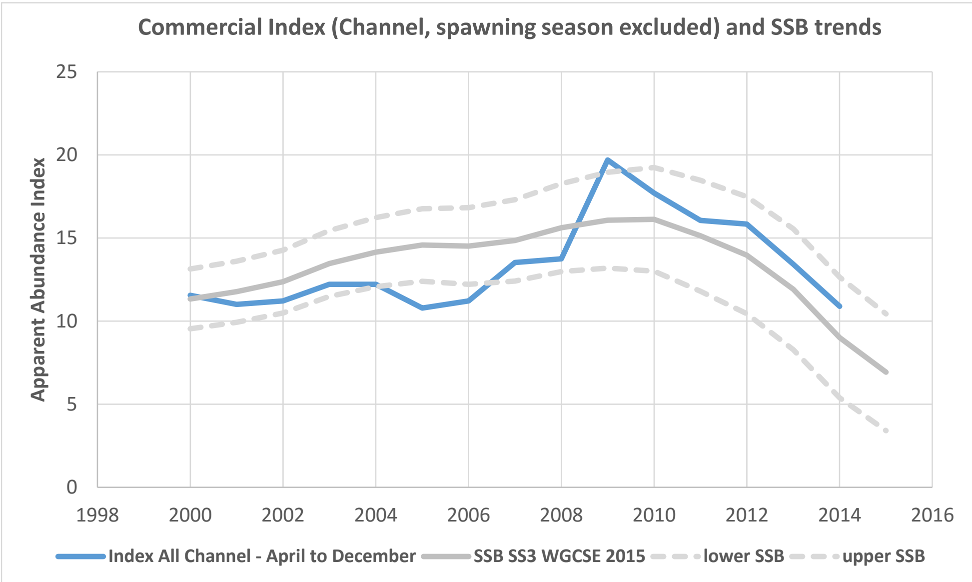




**Figure B.4.3. Bass-47: Trends in commercial lpue index for French fleets overlaid on this year's update assessment estimates of spawning–stock biomass (+/- 2 standard errors). Top: index based on data from all twelve months; bottom: index excluding fishing trips during spring spawning season.**

## B.5. Other relevant data

None.

## C. Assessment: data and method

### Software used and model options chosen

Model used: Stock Synthesis 3 (SS3) (Methot, 2010)

Software used: Stock synthesis v3.24f (Methot, 2011)

WGCSE 2015 conducted an update assessment using Stock Synthesis 3 (SS3) (Methot, 2010). The software used was Stock synthesis v3.23b (Methot, 2011), according to the Stock Annex developed by ICES IBPBass 2014 with inclusion of fishery data for 2014. The assessment requires a modelling framework capable of handling a mixture of age and length data for fisheries and surveys (fleet-based landings; landings age or length compositions, age-based survey indices for young bass) and biological information on growth rates and maturity. Landings-at-age were available for four UK fleets from 1985 onwards, whereas French fleets had length composition data that were available only since the 2000s. The Stock Synthesis assessment model was chosen, primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. The model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html.

IBPBass (ICES 2015) addressed the following recommendations of WGCSE 2015 for developing the assessment during the inter-benchmark meeting. Work completed is indicated in parenthesis:

- Review quality and performance of age composition data from French fishery landings in the stock synthesis model formulated by IBP-bass [*done, see below*];
- Develop input data for stock assessment including empirical weights at age [*Not done*];
- Develop age compositions for Channel ground fish survey and test in SS3 model [*Not done*];
- Evaluate the appropriateness of existing reference points and estimate new if necessary based on conclusions from WKMSYREF3 and 4 [*Not done*].

#### Deviations from Stock Annex

The Stock Annex has been revised to reflect the approaches developed by IBPBass2. The update assessment follows exactly the IBPBass2 data inputs and methods.

The assessment requires a modelling framework capable of handling a mixture of age and length data for fisheries, including data for French fleets that have length composition data but no age composition data, and for which the length data were available only since the 2000s. The Stock Synthesis (SS) assessment model was chosen, primarily for its highly flexible statistical model framework allowing the building of simple to complex models using a mix of data compositions available. The model is written in ADMB (www.admb-project.org), is forward simulating and available at the NOAA toolbox: http://nft.nefsc.noaa.gov/SS3.html. For European sea bass a model was built using Stock Synthesis 3 (SS3) version 3.24f to integrate the mix of fisheries and survey data available (fleet-based landings; landings age or length compositions, ages-based survey index for young bass and length-based CGFS survey indices) and biological information on growth rates and maturity.

Developments of the Stock Synthesis model by IBPBass2 including the following improvements:

- Include French age composition data.
- Included recreational catch as a separate fleet so that catches are consistent with recreational fishery removals of around 1 500 t in 2012.

Full details of the reasons for these changes, and diagnostics of model fits with these changes included, can be viewed in the IBP-Bass report. Information is given below on some of the key decisions of IBP-Bass concerning the final structure of the assessment model.

#### Changes to the plus-group

UK fishery age composition data show year-class structure extending well beyond the previous oldest true age used in the assessment (eleven years). This includes year classes well before the first year of input data (see Figure 10.1.2.1). IBP-Bass carried out runs with plus groups set at 12+, 16+, 18+ and 20+. The 16+ setting appeared sufficient to improve estimation of early recruit deviations prior to 1985, without causing problems of zero catch estimates appearing in the data file at old ages. All further runs were conducted with 16+ group.

#### Selectivity patterns for UK commercial fleets

The WGCSE 2013 assessment treated all commercial fleets from the UK and France as having asymptotic length-based selectivity. This reduced the number of parameters per fleet to only two, an important consideration when four UK fleets and one French fleet were being modelled. Having collapsed the UK trawls, nets and lines to a single fleet, IBPBass explored the use of a double normal selectivity pattern, which appeared to be appropriate for trawls and nets from the results of the Pawson *et al*. (2007) and Kupschus *et al*. (2008) separable model applied to separate UK fleets.

The form of the selectivity pattern was investigated initially using a simple cohort analysis applied to the aggregated catch-at-age for the four UK fleets since 2013. The terminal F for this aggregate "pseudo cohort" was adjusted until the pattern of partial F's for the UK midwater trawl and lines fleets were as close as possible to asymptotic, as these fleets target a wide range of adult and juvenile bass in inshore and offshore waters. The pattern of partial F's for the trawls and nets fleets were then revealed as being strongly domed, confirming previous results in the Pawson *et al*. (2007) separable model (Figure 10.1.3.1). Input initial parameters and bounds for a double-normal selectivity function (a selectivity form recommended in the Stock Synthesis manual) were derived for UK trawls and nets using the spreadsheet developed for Stock Synthesis. The fitted selectivity for this fleet and for the midwater trawl fleet in the update Stock Synthesis run closely match the selectivity patterns given by the empirical approach using cohort analysis (Figure 10.1.3.1).

Given the need to include the recreation catch as a separate fleet, IBPBass2 reintroduced the UK line fleet as a separate fleet with asymptotic selectivity so that the recreational catch could mirror the selectivity of this fleet.

The WGCSE 2016 update assessment uses the same selectivity models and input selectivity parameters as agreed by IBPBass2, fitting the parameters using soft bounds rather than priors with hard bounds. This resulted in fitting twelve selectivity parameters for commercial fleets (six for UK trawls and nets, and two each for UK lines, UK midwater trawls and combined French fleets. The "other fleet" was assumed to have the same selectivity as the French fleet).

#### Natural mortality and stock–recruit steepness

The value (or vector) of natural mortality used in an analytical assessment is a key parameter determining the estimated productivity, abundance and MSY or other reference points (RPs). The assumed shape of the stock–recruit curve acts with the assumed M to constrain any possible biological reference points (Mangel *et al*. 2013). A key parameter defining a stock–recruit curve is steepness, defined as the ratio of recruitment from an unfished population to recruitment when the spawning–stock biomass is at 20% of the unfished level.

IBP-Bass explored the performance of the Stock Synthesis model for a range of different values for natural mortality and stock–recruit steepness, using a similar model formulation to the WGCSE 2014 update but excluding the recreational fishing mortality vector. The total of negative log likelihood was compiled for the range of combinations, along with the SSB depletion in 2013 from the virgin SSB, and the relative standard error of the SSB in that year.

Total negative log likelihood tended to be lowest at steepness values approaching unity, with the greatest tendency at low values of M, and likelihood also decreased with increasing M (Figure 10.1.3.3. top left). Despite the lower value of negative log likelihood, the relative standard errors of the SSB estimates for 2012 (from the inverse Hessian) increased with increasing M but were almost unaffected by steepness (RSE values at steepness 0.999 were 0.158 at M=0.15; 0.164 at M=0.20; 0.175 at M=0.25 and 0.199 at M=0.30). The unusual value at steepness 0.8, M=0.3 in Figure 10.1.3.3 was a result of the selectivity curve for the combined UK trawls, nets and lines flipping from a domed to an asymptotic pattern. Otherwise, the values show smooth relationships with input M and steepness.

The depletion of SSB in 2013 compared with the virgin SSB was progressively lower as M was increased (Figure 10.1.3.3. top right), but was far less sensitive to steepness.

Recruitment in sea bass has varied widely in response to environmental factors including conditions in the estuarine and other inshore nursery habitats. There is almost no information to indicate declining recruitment at lower SSB and to discern the true value of steepness. A wide range of values appears plausible (Figure 10.1.3.3. lower plots), though the model fit slightly favours the (biologically implausible) steepness value of unity.

IBP-Bass decided to retain a fixed steepness value of 0.999 given the relative insensitivity of the assessment to this parameter. This means that F or biomass at MSY cannot be estimated, and that proxy $F_{MSY}$ reference points have to be specified using yield-per-recruit and spawner biomass per recruit computations.

The tendency for likelihoods to improve with increasing M, despite the inferences that a relatively low M is consistent with sea bass life-history traits and maximum age approaching 30 years, however suggested that additional mortality associated with the recreational fishery could perhaps be accommodated within the model.

#### Incorporating information on recreational fishery catches

Recent surveys in France, England and the Netherlands have provided estimates of recreational fishery removals that are around a third of the reported commercial fishery landings in each country (see Section 2). Taking possible hooking mortality of released fish into account, the total recreational removals from the stock may be as high as 1500t. The relative standard error of this estimate is likely to be in the range 0.2–0.3 based on the information available on the component surveys. With only one combined survey estimate available, IBPBass could see no easy way to incorporate this directly into Stock Synthesis.

However, by not representing recreational fishery removals in the assessment, the estimates of total mortality derived from the commercial fishery age and length composition data are attributed only to natural mortality and to commercial fishing mortality. In reality, part of the observed total mortality is attributable to the unaccounted-for recreational fishery removals. This becomes a problem when forecasting stock size and yields based on multipliers applied to the apparent commercial fishing mortality, when in fact only part of the apparent F is due to the commercial fleet.

IBP-Bass explored an approach for evaluating the magnitude of recreational fishery F by including a fixed vector of recreational F-at-age in the assessment, added to the fixed natural mortality vector.  The recreational F vector, with a plausible selectivity pattern for the harvest (kept component), was then scaled iteratively until the expected recreational removals in 2012 were around 1500 t; the recent total recreational removals estimate from the surveys in France, England and the Netherlands. This is equivalent to treating recreational fishers as a predator whose historical abundance and predation is largely unknown, but are assumed to impose a constant mortality in exactly the same was as all other predators are subsumed into a constant M vector.

There is some evidence from a series of surveys in England and Wales since 1970 that the number of people going sea angling has fluctuated without obvious increasing or decreasing trend (Table 10.1.3.1).  Part of the observed variability will relate to differences in survey methodology, but all are based on some form of sampling of the population as a whole. Sea bass has been a prized target for recreational sea anglers in England and Wales (and southern Ireland) over a much longer period than the current assessment, and sea bass angling was developed to a high level of technical skill and knowledge of the species as far back as the 1970s. There is no information on the actual effort expended by the angling population on sea bass as the stock has changed in abundance, or on changes in efficiency, but an assumption of a constant recreational fishing mortality is a reasonable first approximation for evaluating recreational F.

#### Recreational fishery selectivity

It is first necessary to identify an appropriate selectivity function to characterise the selectivity of recreational fishing. The recreational fishery in England and Wales is predominantly rod-and-line, but it is known that other gears (especially fixed or driftnets, or seines) are deployed recreationally throughout Europe. However, in France around 80% of the recreational fishing catch is from sea angling.

The length frequency of retained sea bass recorded during the recent *Sea Angling 2012* survey in England (Anon, 2014) is very noisy due to small samples (many bass are released) and a clear tendency in some cases for lengths to have been reported to the nearest 5 cm (Figure 10.1.3.2). However, the distribution is clearly much more similar to that of the UK commercial line fishery than to the other commercial fishery gear groups. It was therefore decided to use the UK commercial line fishery selectivity (age-based) to represent the combined selectivity and retention of the recreational fishery for the whole of the bass stock. The line fishery selectivity-at-age was obtained from a Stock Synthesis run treating lines as a separate fleet with asymptotic selectivity estimated from UK age composition inputs. The assumption regarding selectivity may not hold beyond the UK, but was adopted in the absence of other information. Weights-at-age in the retained catch were assumed to be the same as in the UK commercial fishery landings given the strong influence of minimum landing size of 36 cm on retention in both fisheries.

#### Natural mortality component of combined mortality vector

A range of natural mortality values from 0.15 to over 0.20 can be inferred from life-history parameters and observed maximum age (see earlier). IBPNew 2012 adopted a value of 0.20 for all ages. The SS3 runs carried out by IBP-Bass at different values of M indicated that likelihoods improved as M was increased, but the precision of recent biomass estimates declined, and at M=0.30 some instability in fitting selectivity parameters was evident. IBP-Bass therefore set up a run using the lower bound of M inferences (M=0.15) in order to avoid the combined M and recreational F going too high, and scaled the recreational fishery selectivity so that the calculated recreational landings in 2012 were 1500t. The selectivity and recreational F vector achieving this are given in Table 10.1.3.2. The recreational F(5–11) is 0.09 derived from a multiplier of 1.0 applied to the selectivity curve. The combination of M=0.15 and recreational F leads to a combined mortality vector increasing from 0.15 at the youngest ages to 0.25 at-age 8 with a combined F(5–11) of 0.24, compared with the total M value of 0.20 used by WGCSE 2013. The sensitivity of the assessment to different absolute values of recreational fishery harvest in 2012, and to the choice of M=0.15 or 0.20, is explored later in this report

The structure and input data/ parameters of the IBPbass2 (2015) model, used for the update assessment by WGCSE 2015, are summarized below:

The structure and input data/ parameters of the IBPbass2 revised SS3 model are summarized below:

#### Model structure

- Temporal unit: annual based data (landings, survey indices, age frequency and length frequency);
- Spatial structure: One area;
- Sex: Both sexes combined.

#### Fleet definition

Six fleets defined: 1. UK bottom trawls, nets; 2. UK lines; 3. UK midwater pair trawls; 4. French fleets (combined); 5. Other (other countries and other UK fleets combined); 6. Recreational fishery landings. [WGCSE 2015 assessment modelled selectivity for the combined UK trawls, nets and lines].

#### Landed catches

Annual landings in tonnes from 1985 to final year for the four fleets from ICES Subdivisions 4.b, c, 7.a, d–h. French data were as provided by Ifremer.

#### Abundance indices

Channel Groundfish Survey in 7.d in autumn (France), 1988 to present: total swept-area abundance index and associated length composition data. Number of stations with sea bass is used as initial input values for effective sample size. Input CV for survey = 0.30 all years. First three years of composition data are excluded. [Survey not included in WGCSE 2013 assessment].

Cefas Solent survey in autumn (7.d). Years 1986 to 2011; 2013. One single abundance index series were defined, combining the age groups (2, 3, 4 years old). It was treated as three independent surveys in WGCSE2015 (following a recommendation from R. Methot) to circumvent difficulties in estimating selectivity parameters for a survey series comprising only three young age groups, although this approach loses covariance information due to year-effects in the survey.

#### Fishery landings age composition data

Age bins: 0 to 15 with a plus group for ages 16 and over. Age compositions for fleets are expressed as fleet-raised numbers-at-age, although they are treated as relative compositions in SS3.

Year range for UK trawls/nets and UK lines: 1985 to present; UK midwater pair trawl: 1996 to present; French fleet 2000 to present;

#### Length composition data

The length bin was set from 4 to 100 cm by 2 cm intervals. Length compositions for the following fishing fleets were used: UK trawls/nets: 1985 to present; and UK lines: 1986 to present UK midwater pair trawl: 1996 to present; French all fleets combined: 2000 to present.

#### Effective sample size weighting for age and length composition data

Effective sample size for the fleets and survey age and length compositions were adjusted to equal the sample sizes (numbers of fishing trips sampled) as concluded in IBP-bass (ICES 2014). IPBBass2 revisited the sample sizes and where information was available used the number of trips per year for each of the datasets. Sample sizes were adjusted using the Francis method of weighting. This was carried out using an iterative re-weighting process of compositional data using the input sample sizes and the effective sample sizes based on model fit. This method reduces the disproportionate effect of the different dataset used. The table below provides the multiplier by fleet for each of the age and length composition data sources.

| Fleet | Data type | multiplier |
|---|---|---|
| UK otter trawl/nets | Length compositions | 0.2625 |
| | Age compositions | 0.2376 |
| UK Lines | Length compositions | 0.1539 |
| | Age compositions | 0.1591 |
| UK midwater trawl | Length compositions | 0.1601 |
| | Age compositions | 0.7251 |
| French – all gears | Length compositions | 0.2023 |
| | Age compositions | 0.3362 |
| Autumn Bass survey | Age compositions | 0.8443 |
| French channel ground fish survey (CGFS) | Length compositions | 0.3562 |

#### Model assumptions and parameters

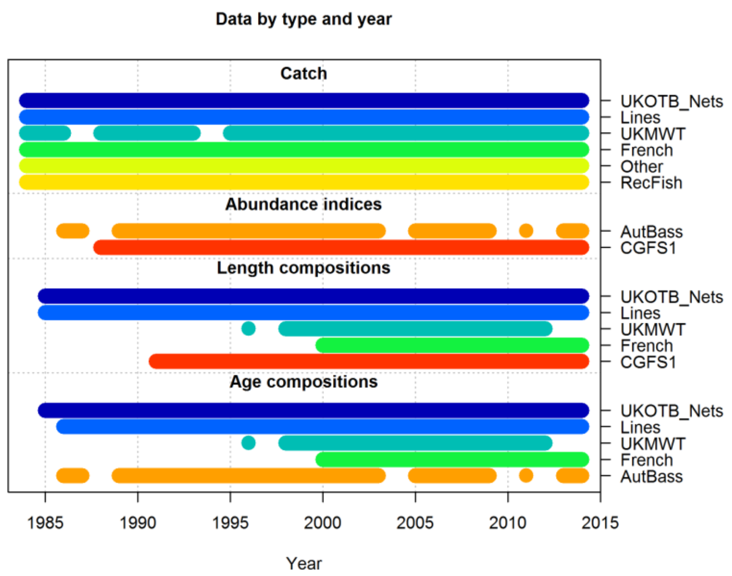
The following table summarises key model assumptions and parameters. Other parameter values and input data characteristics are defined in the SS3 control file Bass47.ctl, the forecast file Forecast.SS and the data file Bass47.dat as used by IBPBass2 2015. Model inputs and year ranges (for WGCSE 2016) are in Figure C1.

**Key model assumptions and parameters from the WGCSE 2014 update assessment.**

| CHARACTERISTIC | SETTINGS |
|---|---|
| Starting year | 1985 |
| Ending year | 2015 |
| Equilibrium catch for starting year | 0.82* landings in 1985 by fleet. |
| Number of areas | 1 |
| Number of seasons | 1 |
| Number of fishing fleets | 6 |
| Number of surveys | Two surveys: CGFS; Solent autumn survey. |
| Individual growth | von Bertalanffy, parameters fixed, combined sex |
| Number of active parameters | 83 |
| Population characteristics | |
| Maximum age | 30 |
| Genders | 1 |
| Population length bins | 4–100, 2 cm bins |
| Ages for summary total biomass | 0–30 |
| Data characteristics | |
| Data length bins (for length structured fleets) | 14–94, 2 cm bins |
| Data age bins (for age structured fleets) | 0–16+ |
| Minimum age for growth model | 2 |
| Maximum age for growth model | 30 |
| Maturity | Logistic 2-parameter – females; L50 = 40.65 cm |
| Fishery characteristics | |
| Fishery timing | -1 (whole year) |
| Fishing mortality method | Hybrid |
| Maximum F | 2.9 |
| Fleet 1: UK Trawl/nets selectivity | Double normal, length-based |
| Fleet 2: UK lines selectivity | Asymptotic, length-based |
| Fleet 3: UK Midwater trawl selectivity | Asymptotic, length-based |
| Fleet 4: Combined French fleet selectivity | Asymptotic, length-based |
| Fleet 5: Other fleets/gears selectivity | Asymptotic: mirrors French fleet |
| Fleet 6: Recreational fishery selectivity | Asymptotic: morrors UK lines fleet |
| Survey characteristics | |
| Solent autumn survey timing (yr) | 0.83 |
| CGFS survey timing (yr) | 0.75 |
| Catchabilities (all surveys) | Analytical solution |
| Survey selectivities: Solent autumn: | Age and length based selectivity |
| Survey selectivities: CGFS | Double normal, length based |
| Fixed biological characteristics | |
| Natural mortality | 0.15 |
| Beverton–Holt steepness | 0.999 |
| Recruitment variability (σR) | 0.9 |
| Weight–length coefficient | 0.00001296 |
| Weight–length exponent | 2.969 |

| CHARACTERISTIC | SETTINGS |
|---|---|
| Maturity inflection (L50%) | 40.649 cm |
| Maturity slope | -0.33349 |
| Length-at-age Amin | 19.6 cm at Amin=2[1] |
| Length-at-Amax | 80.26 cm |
| von Bertalanffy k | 0.09699 |
| von Bertalanffy Linf | 84.55 cm |
| von Bertalanffy t0 | -0.730 yr |
| Std. Deviation length-at-age (cm) | SD = 0.1166 * age + 3.5609 |
| Age error matrix | CV 12% at-age |
| Other model settings | |
| First year for main recruitment deviations for burn-in period | 1969 |
| Last year for recruit deviations | 2014 (last year class with survey indices) |
| Last year no bias adjustment | 1971 |
| First year full bias adjustment | 1982.5 |
| Last year full bias adjustment | 2011 |
| First year recent year no bias adjustment | 2013 |
| Maximum bias adjustment | 0.92 |

**[1] as recommended by R. Methot after scrutinizing earlier SS3 runs during IBPNEW 2012, and used by IBPNEW and WGCSE. The WGCSE 2013 tabulated the original value of 5.78 cm at-age 0 in error.**



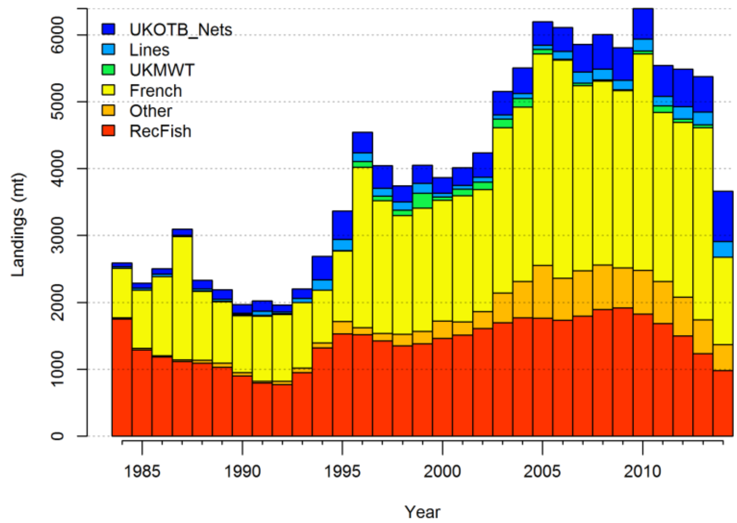




**Figure C1. Summary of inputs and year ranges for Stock Synthesis assessment.**

### C.2 Assessment procedure

The model is run with the executable file SS3.exe in the same folder as the following files:

| | |
|---|---|
| Bass47.ctl | SS3 configuration file |
| Bass47.dat | SS3 data inputs |
| Starter.SS | SS3 startup file |
| Forecast.SS | SS3 forecast file |

Results are ouput in the same folder (key results file is "results.sso"). Plots can be generated using r4ss after calling library(r4ss), using the following code (adjusted with correct path name):

```
age <- SS_output(dir= 'C:/Users/ma02/Documents/ICES/WGCSE2014/Bass47/SS3 update assessment')
SS_plots(replist=age,pdf=F,png=T,dir='C:/Users/ma02/Documents/ICES/WGCSE2014/Bass47/SS3update assessment')#,uncertainty=F)
```

Retrospective analysis is done with the output files from the base run in the same folder as the file retro.bat. For five retrospectives, six Starter files are included. The base file Starter.SS includes the following code nine lines from the bottom:

```
-5 # retrospective year relative to end year (e.g. -4)
```

The five retrospective Starter files use the name convention Starter-5; Starter-4; Starter-3; Starter-2; Starter-1, amending the command -5 # retrospective year relative to end year (e.g. -4) to reflect the year peel stated in the file name. A piece of code "Retro-Plots_R4SS" is available to plot the retrospectives although an Excel file is currently used to read the results from each of the Report.sso files imported into worksheets.

The recreational landings were arrived at iteratively to generate a constant fishing mortality for the time-series equal to the recreational fishery mortality for the landings in 2012 of 1 500 t.

Future runs may need to revise this to generate a constant fishery mortality for recreational catch where data are estimated in the model.

When the end year for the Stock Synthesis run is specified as the last year with fishery data, the Report.sso file contains estimates of biomass and numbers only to the start of the final year with data, and Zs only to the year before the final one. A work-around to get biomass and numbers for survivors at the end of the last year with data, and Zs for the final year with data, the end year can be specified as the year after the last with data. F values, as used by ICES, are not generated automatically by Stock Synthesis but can be computed from the Zs after subtracting M.

## D. Forecast

Due to the original complexity of adding a fixed recreational fishing mortality for removals (harvest), and the time required to configure Stock Synthesis to mirror the ICES procedures for short-term forecasts, IBPBass2 decided not to try and develop a forecast procedure within Stock Synthesis for use by WGCSE. This loses the ability to provide MCMC confidence intervals around the assessment and forecasted variables, and the forecasts are entirely deterministic. Management options involving biological reference points (BRPs) adopt BRPs conditional on the assumptions in the assessment regarding M, selectivity, maturity, weights-at-age, etc. The procedures for deriving inputs for the short-term forecast are described below.

### D.1 Estimating year-class abundance

Stock Synthesis should be set up to estimate recruit deviations only until the last year that has survey data to make the estimates. E.g. including the Solent survey indices for ages 2–4 in 2014 means that the last year class tuned by a survey index is 2012 (two year-olds in 2014). SS3 will put a value from the fitted stock–recruit curve for later year classes. WGCSE overwrites these later year classes using the long-term (1985 onwards) geometric mean, or a short-term GM if there is a persistent reduction in recent recruitment. The numbers-at-age for the starting year of the forecast are also over-written for these year classes by reducing the GM recruitment by the appropriate number of years of M (as there is no catch for the first few years of age).

WGCSE (2013) reviewed some information on environmental influences on sea bass recruitment which supported a recent reduction in recruitment. Survival of 0-gp and 1-gp sea bass in nursery areas in estuaries and salt-marshes is thought to be enhanced by warmer conditions promoting survival through the first two winters, and increasing the growth rates (Pawson, 1992). WGCSE 2014 presented an argument for choosing a particular recruitment value for the 2012-year class for inclusion in forecasts, based on a consideration of past recruitment in relation to temperature. The data and arguments in WGCSE 2014 should be consulted for an explanation of the logic used.

The format for reporting the recruitment values for the short-term forecast are summarised using an example in Table D1.1., and an example of a short-term forecast input file is given in Table D.1.2.

**Table D.1.1. Example of recruitment estimates included in a short-term forecast for sea bass, from IBPBass 2013.**

| YEAR CLASS | SS3 (AGE 0) | GM 2008–2011 | GM 2008–2011 |
|---|---|---|---|
| 2011 | 2648 thousand | | |
| 2012 | | 1815 thousand | |
| 2013 | | | 6057 thousand |
| 2014 | | | 6057 thousand |

Example input for the short-term catch predictions is in Table D 1.2. The derivation of the inputs is described in Table D 1.3.

**Table D.1.2. Example inputs for sea bass short-term forecast, from WGCSE 2014. Inputs for short-term forecast. F(5–11) is mean for years 2011–2013. Numbers-at-ages 0–2 in 2014 are adjusted by replacing Stock Synthesis average values in 2012–2014 (years with no recruit deviations estimated) with the short-term (2008–2011) GM in 2012 and the long-term GM in 2013 and 2014, with adjustments for natural mortality. Rules are below table.**

| age | No. at age in 2014 | weight in stock | Proportion mature (female) | H.Cons mean F (2011-2013) | H.Cons mean weights | Recreational F | Recreational removals mean weight | M |
|---|---|---|---|---|---|---|---|---|
| 0 | **6057** | 0.002 | 0.000 | 0.000 | 0.007 | 0.000 | 0.007 | 0.15 |
| 1 | **5213** | 0.022 | 0.000 | 0.000 | 0.076 | 0.000 | 0.052 | 0.15 |
| 2 | **1345** | 0.101 | 0.000 | 0.000 | 0.388 | 0.000 | 0.154 | 0.15 |
| 3 | 1687 | 0.218 | 0.000 | 0.014 | 0.584 | 0.002 | 0.295 | 0.15 |
| 4 | 225 | 0.382 | 0.186 | 0.070 | 0.715 | 0.013 | 0.480 | 0.15 |
| 5 | 1433 | 0.587 | 0.419 | 0.161 | 0.877 | 0.054 | 0.702 | 0.15 |
| 6 | 830 | 0.825 | 0.638 | 0.220 | 1.093 | 0.091 | 0.954 | 0.15 |
| 7 | 1749 | 1.088 | 0.792 | 0.247 | 1.331 | 0.099 | 1.228 | 0.15 |
| 8 | 1491 | 1.370 | 0.885 | 0.256 | 1.588 | 0.100 | 1.517 | 0.15 |
| 9 | 808 | 1.664 | 0.937 | 0.266 | 1.860 | 0.100 | 1.815 | 0.15 |
| 10 | 625 | 1.964 | 0.965 | 0.271 | 2.143 | 0.100 | 2.116 | 0.15 |
| 11 | 519 | 2.264 | 0.980 | 0.274 | 2.431 | 0.100 | 2.416 | 0.15 |
| 12 | 312 | 2.562 | 0.989 | 0.275 | 2.719 | 0.100 | 2.711 | 0.15 |
| 13 | 140 | 2.853 | 0.993 | 0.276 | 3.002 | 0.100 | 2.998 | 0.15 |
| 14 | 60 | 3.135 | 0.996 | 0.276 | 3.276 | 0.100 | 3.275 | 0.15 |
| 15 | 77 | 3.406 | 0.998 | 0.276 | 3.540 | 0.100 | 3.540 | 0.15 |
| 16+ | 76 | 4.017 | 0.998 | 0.276 | 4.069 | 0.100 | 4.134 | 0.15 |

Age 0,1,2 over-written as follows

| | |
|---|---|
| 2014 yc | 2014 age 0 replaced by 1985-2011 LTGM (6057); |
| 2013 yc | 2014 age 1 replaced by SS3 survivor estimate at age 1, 2014 * LTGM / SS3 estimate of age 0 in 2013 |
| 2012 yc | 2014 age 2 replaced by SS3 survivor estimate at age 2, 2014 * STGM (1815) / SS3 estimate of age 0 in 2012 (weak y |
| 2011 yc | estimated from Solent survey in 2013, age 2 |

**Table D 1.3. Derivation of short-term forecast inputs (based on example from IBPBass 2014).**

| INPUT DATA | DERIVATION |
|---|---|
| Starting numbers-at-age 0–16+ in first year (intermediate year) | SS3 output. (N age zero overwritten where necessary by long-term GM, short-term GM or other predicition, reduced by M=0.15 the the require number of years (if no commercial catches) or multiply N at-age in starting year from the assessment by ratio of the replaced recruit value with the SS3 estimate. |
| Recruitment 2014 onwards | Long-term GM, short-termGM or other predictor. |
| Mean wt-at-age in stock | SS3 output |
| Proportion mature (female) | SS3 output |
| Commercial fishery (H-cons) mean F at-age | Rescaled F to the average last three years: SS3 output Zs minus M=0.15, partial Fs for commercial fleets using ratio from catch numbers by fleet. |
| Commercial fishery (H-cons) mean weight-at-age | SS3 output figures on mean weight in UK, French and other fleets, weighted by SS3 model estimates of landings numbers-at-age for the fleets |
| Recreational removals mean F at-age | Rescaled F to the average last three years: SS3 output Zs minus M=0.15, partial Fs for recreational fleet. |
| Recreational removals mean weights-at-age | SS3 output figures on mean weight. |
| M | 0.15 at all ages |

An example detailed forecast is given in Table D1.4 for the *status quo* F option, which is the most likely forecast given the absence of any restrictive management controls on effort or landings of sea bass. See WGCSE 2014 for examples of management options tables.

Future forecast routines may be configured in Stock Syntheses, allowing MCMC estimation of confidence limits.

**Table D 1.4. Example of detailed short-term forecast (WGCSE 2014).**

Year: 2014
H.cons F mult: 1 F(5-11): 0.242
Recreational F mult 1 F(5-11): 0.092

| Age | F(5-11): Commercial | F(5-11): Recreational | Catch Nos: Commercial | Yield: Commercial | Catch Nos: Recreational | Yield: Recreational | Stock Nos | Biomass | SSB nos. Jan 1 | SSB tonnes Jan 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 0.0 | 6057 | 9 | 0 | 0 |
| 1 | 0.000 | 0.000 | 0.0 | 0.0 | 0.1 | 0.0 | 5213 | 117 | 0 | 0 |
| 2 | 0.000 | 0.000 | 0.0 | 0.0 | 0.3 | 0.0 | 1345 | 135 | 0 | 0 |
| 3 | 0.014 | 0.002 | 21.1 | 12.3 | 2.8 | 0.8 | 1687 | 369 | 0 | 0 |
| 4 | 0.070 | 0.013 | 14.1 | 10.1 | 2.6 | 1.2 | 225 | 86 | 42 | 16 |
| 5 | 0.161 | 0.054 | 193.1 | 169.4 | 65.3 | 45.9 | 1433 | 841 | 601 | 352 |
| 6 | 0.220 | 0.091 | 146.3 | 159.9 | 60.3 | 57.5 | 830 | 684 | 530 | 437 |
| 7 | 0.247 | 0.099 | 340.7 | 453.4 | 136.2 | 167.2 | 1749 | 1903 | 1385 | 1507 |
| 8 | 0.256 | 0.100 | 300.2 | 476.7 | 116.8 | 177.3 | 1491 | 2044 | 1319 | 1808 |
| 9 | 0.266 | 0.100 | 168.0 | 312.5 | 63.1 | 114.5 | 808 | 1345 | 757 | 1260 |
| 10 | 0.271 | 0.100 | 132.1 | 283.1 | 48.7 | 103.0 | 625 | 1227 | 603 | 1184 |
| 11 | 0.274 | 0.100 | 110.7 | 269.1 | 40.4 | 97.6 | 519 | 1176 | 509 | 1153 |
| 12 | 0.275 | 0.100 | 66.7 | 181.3 | 24.2 | 65.7 | 312 | 798 | 308 | 789 |
| 13 | 0.276 | 0.100 | 30.1 | 90.2 | 10.9 | 32.7 | 140 | 400 | 139 | 397 |
| 14 | 0.276 | 0.100 | 12.9 | 42.3 | 4.7 | 15.3 | 60 | 188 | 60 | 188 |
| 15 | 0.276 | 0.100 | 16.5 | 58.4 | 6.0 | 21.1 | 77 | 261 | 77 | 261 |
| 16+ | 0.276 | 0.100 | 16.3 | 66.2 | 5.9 | 24.3 | 76 | 304 | 76 | 303 |
| Total | | | 1569 | 2585 | 588 | 924 | 22647 | 11887 | 6404 | 9654 |

Year: 2015
H.cons F mult: 1 F(5-11): 0.242
Recreational F mult 1 F(5-11): 0.092

| Age | F(5-11): Commercial | F(5-11): Recreational | Catch Nos: Commercial | Yield: Commercial | Catch Nos: Recreational | Yield: Recreational | Stock Nos | Biomass | SSB nos. Jan 1 | SSB tonnes Jan 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 0.0 | 6057 | 9 | 0 | 0 |
| 1 | 0.000 | 0.000 | 0.0 | 0.0 | 0.1 | 0.0 | 5213 | 117 | 0 | 0 |
| 2 | 0.000 | 0.000 | 0.0 | 0.0 | 0.9 | 0.1 | 4487 | 452 | 0 | 0 |
| 3 | 0.014 | 0.002 | 14.5 | 8.4 | 1.9 | 0.6 | 1157 | 253 | 0 | 0 |
| 4 | 0.070 | 0.013 | 89.6 | 64.1 | 16.4 | 7.9 | 1430 | 547 | 266 | 102 |
| 5 | 0.161 | 0.054 | 24.0 | 21.1 | 8.1 | 5.7 | 178 | 105 | 75 | 44 |
| 6 | 0.220 | 0.091 | 175.2 | 191.4 | 72.2 | 68.9 | 994 | 820 | 634 | 523 |
| 7 | 0.247 | 0.099 | 102.0 | 135.8 | 40.8 | 50.1 | 524 | 570 | 415 | 451 |
| 8 | 0.256 | 0.100 | 214.4 | 340.5 | 83.5 | 126.6 | 1065 | 1460 | 942 | 1291 |
| 9 | 0.266 | 0.100 | 186.9 | 347.6 | 70.2 | 127.4 | 899 | 1496 | 842 | 1401 |
| 10 | 0.271 | 0.100 | 102.0 | 218.5 | 37.6 | 79.5 | 482 | 947 | 465 | 914 |
| 11 | 0.274 | 0.100 | 79.1 | 192.3 | 28.9 | 69.8 | 371 | 840 | 364 | 824 |
| 12 | 0.275 | 0.100 | 65.8 | 178.9 | 23.9 | 64.8 | 307 | 788 | 304 | 779 |
| 13 | 0.276 | 0.100 | 39.5 | 118.7 | 14.3 | 43.0 | 184 | 526 | 183 | 522 |
| 14 | 0.276 | 0.100 | 17.8 | 58.3 | 6.4 | 21.1 | 83 | 260 | 82 | 259 |
| 15 | 0.276 | 0.100 | 7.6 | 27.0 | 2.8 | 9.8 | 36 | 121 | 35 | 121 |
| 16+ | 0.276 | 0.100 | 19.4 | 78.7 | 7.0 | 28.9 | 90 | 362 | 90 | 361 |
| Total | | | 1138 | 1981 | 415 | 704 | 23559 | 9670 | 4698 | 7591 |

Year: 2016
H.cons F mult: 1 F(5-11): 0.242
Recreational F mult 1 F(5-11): 0.092

| Age | F(5-11): Commercial | F(5-11): Recreational | Catch Nos: Commercial | Yield: Commercial | Catch Nos: Recreational | Yield: Recreational | Stock Nos | Biomass | SSB nos. Jan 1 | SSB tonnes Jan 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.000 | 0.000 | 0.0 | 0.0 | 0.0 | 0.0 | 6057 | 9 | 0 | 0 |
| 1 | 0.000 | 0.000 | 0.0 | 0.0 | 0.1 | 0.0 | 5213 | 117 | 0 | 0 |
| 2 | 0.000 | 0.000 | 0.0 | 0.0 | 0.9 | 0.1 | 4487 | 452 | 0 | 0 |
| 3 | 0.014 | 0.002 | 48.3 | 28.2 | 6.4 | 1.9 | 3861 | 844 | 0 | 0 |
| 4 | 0.070 | 0.013 | 61.5 | 44.0 | 11.3 | 5.4 | 981 | 375 | 183 | 70 |
| 5 | 0.161 | 0.054 | 152.7 | 133.9 | 51.7 | 36.3 | 1133 | 665 | 475 | 279 |
| 6 | 0.220 | 0.091 | 21.8 | 23.8 | 9.0 | 8.6 | 124 | 102 | 79 | 65 |
| 7 | 0.247 | 0.099 | 122.2 | 162.6 | 48.8 | 60.0 | 627 | 683 | 497 | 540 |
| 8 | 0.256 | 0.100 | 64.2 | 102.0 | 25.0 | 37.9 | 319 | 437 | 282 | 387 |
| 9 | 0.266 | 0.100 | 133.5 | 248.3 | 50.1 | 91.0 | 642 | 1068 | 601 | 1001 |
| 10 | 0.271 | 0.100 | 113.4 | 243.0 | 41.8 | 88.4 | 536 | 1053 | 518 | 1017 |
| 11 | 0.274 | 0.100 | 61.0 | 148.4 | 22.3 | 53.8 | 286 | 648 | 281 | 636 |
| 12 | 0.275 | 0.100 | 47.0 | 127.9 | 17.1 | 46.3 | 220 | 563 | 217 | 557 |
| 13 | 0.276 | 0.100 | 39.0 | 117.1 | 14.1 | 42.4 | 182 | 519 | 181 | 515 |
| 14 | 0.276 | 0.100 | 23.4 | 76.6 | 8.5 | 27.7 | 109 | 341 | 108 | 340 |
| 15 | 0.276 | 0.100 | 10.5 | 37.2 | 3.8 | 13.5 | 49 | 167 | 49 | 166 |
| 16+ | 0.276 | 0.100 | 15.9 | 64.9 | 5.8 | 23.8 | 74 | 298 | 74 | 297 |
| Total | | | 914 | 1558 | 317 | 537 | 24901 | 8341 | 3544 | 5869 |

## E. Biological reference points

### E.1 Background

The Stock synthesis model currently used fixes stock–recruit steepness at 0.999. There are insufficient observations at low SSB to suggest the possible steepness of the relationship. This means that MSY reference points cannot be obtained from a plausible stock–recruit relationship and have to be derived from yield-per-recruit. WGCSE 2013 and 2014, IBPBass 2014 and IBPBass2 2016 computed yield-per-recruit based biological reference points $F_{0.1}$ and $F_{35\%spr}$ based on the inputs and outputs of the stock synthesis update assessment. In 2013, with an input M of 0.20, the F(5–11) value for $F_{35\%spr}$ was 0.17 and the $F_{0.1}$ was 0.18. In 2014, WGCSE reduced the M to 0.15, and this caused a reduction in the $F_{35\%spr}$ to 0.13 for combined commercial and recreational landings, and the $F_{0.1}$ was 0.12. The F reference points therefore scale directly with M, as expected, with some effect of changes in estimated fishery selection patterns and weights-at-age.

The revised SS3 model proposed by IBPBass2 now includes an explicit recognition of the possible recreational fisher landings. The recreational landings is indicative only, in the sense that it is conditioned on a total annual recreational removal estimate of ~1 500 t in 2012, which is considered as a "plausible scenario". Different scenarios for total recreational removals affect how total fishing mortality is split between commercial and recreational F, but the combined F estimates are minimally affected as they are driven by the fishery composition data.

### E.2 MSY BRPs or proxies for sea bass

BRPs for this assessment based on advice from ICES WKMSYREF2 (ICES, 2014), and recognising that $F_{MSY}$ cannot be obtained from a fitted stock–recruit curve include:

1 ) Setting an $F_{MSY}$ proxy as $F_{0.1}$ or $F_{xx\%spr}$ based either on the commercial fishery only, or the combined commercial and recreational F.

2 ) Setting a $B_{MSY}$ trigger around a low percentile of the expected range of SSB when fishing at $F_{MSY}$.

Unfortunately it is not yet possible yet to carry out a full MCMC bootstrap of the sea bass assessment and to propagate this into a forecast period to evaluate the percentiles of expected SSB whilst fishing at $F_{MSY}$. A concern with sea bass is that recruitment has shown longer term changes in mean recruitment (and hence stock productivity) that appear related to changes in sea temperature at decadal scales. For a biomass reference point, WGCSE 2014 selected the lowest observed SSB ($B_{loss}$) as a value for $B_{lim}$, the limit reference point for SSB. There is therefore no MSY or precautionary reference point for biomass (Table E.2.1).

WGCSE chose $F_{35\%spr}$ as a proxy for $F_{MSY}$ (value: F(5–11) = 0.13 for combined commercial and recreational fishery). As for many stocks, this value is close to $F_{0.1}$. (Table E.2.1).

The yield per recruit curve is flat-topped and $F_{MSY}$ in sea bass is poorly defined (Figure E.2.1). Fishing at $F_{MAX}$ implies a yield-per-recruit only marginally higher than at $F_{35\%SPR}$ but requires much higher F, with much larger fishing costs where these are proportional to F.

### E.3 Inclusion of BRP in short-term forecast

For the estimation of Yield-per-recruit and Spawner biomass per recruit, WGCSE 2014 varied the multipliers on both fisheries by the same amount. The resulting yield-per-recruit curve therefore reflects total F and total yield, but does not assume a particular allocation between any fisheries.

For short-term forecasts, WGCSE agreed that the multiplier on the recreational F vector should be maintained at 1.0 for all management options except zero F, and only the commercial fishery vector is altered in management options. The relative contribution of commercial and recreational F to the total F will not be the same as the contribution used in calculating the $F_{MSY}$ based on the mean F for 2011 to 2013. However, the selectivity and weights-at-age for the two fisheries are sufficiently close that the agreed $F_{MSY}$ can be applied for different combinations of commercial and recreational F with relatively minor differences. This allows managers to select an F relative to $F_{MSY}$ for a forecast year but decide how the resultant catch forecast can be allocated between the different fishery sectors. This is no different to management of different commercial fishery fleets.

**Table E.2.1. BRPs proposed by IBPBass 2 2016 for sea bass in Areas 4 and 7.**

| | Type | Value | Technical basis |
|---|---|---|---|
| Precautionary approach | Blim | 8 075 t | Lowest observed spawning stock biomass |
| | Bpa | 12 673 t | Blim x exp(-1.645 x σ); σ=0.274 |
| | Flim | Undefined | |
| | Fpa | Undefined | |
| MSY approach | FMSY | 0.13 | Based on F giving SSB per recruit 35% of value at zero F. |
| | MSY Btrigger | 12 673 t | Bpa |

**$F_{MAX}$ is not definable.**

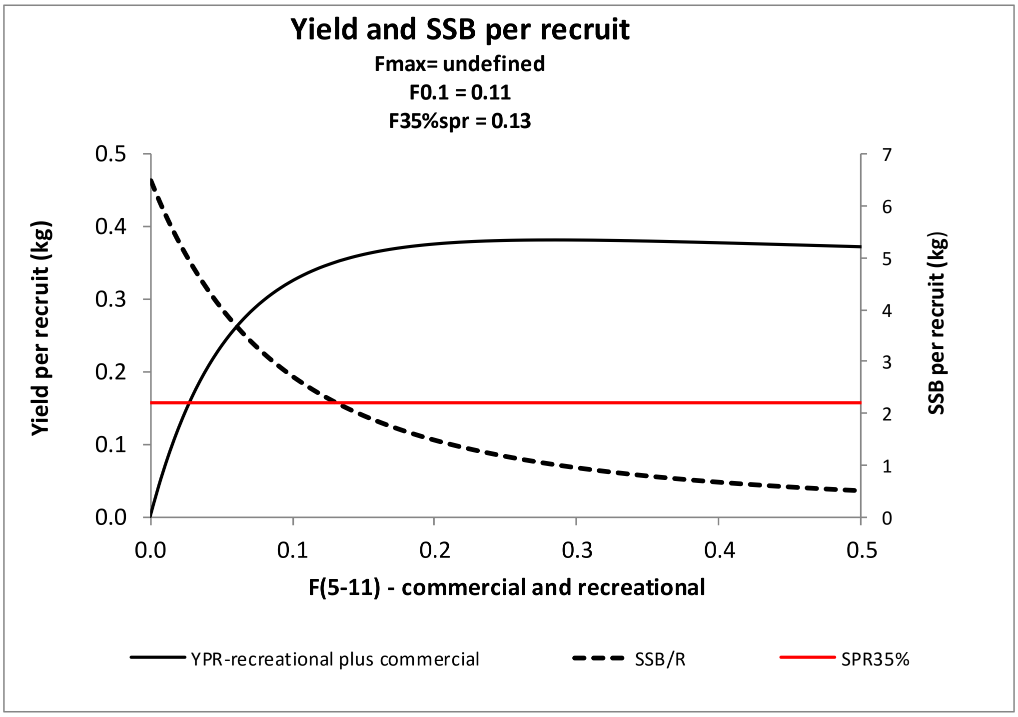



**Figure E.2.1. Yield and biomass per recruit analysis from IBPBass2 2016: conditional on mean pattern of F-at-age for 2011–2013. The 35%spr is indicated (red line) to show where this occurs on the SPR curve.**

## E.4 Yield-per-recruit reference point calculations

Example inputs for a yield-per-recruit analysis are given in Table E.4.1.1. They are identical to the short-term forecast inputs except that the values are extended to 30 years of age. SS3 provides population estimates out to this age. It is assumed that no fish survive after the 30th year, as no fish older than 28 years have been observed historically. The input data are entered into the ICES Standard Plots system on SharePoint, which produces the YPR and SPR plots together with estimates of $F_{MAX}$, $F_{0.1}$ and $F_{MED}$. $F_{35\%SPR}$ is not output but can easily be computed using a spreadsheet, checking that the $F_{0.1}$ and SPR values are the same as the ones generated by the ICES Standard Plots software. (This software cannot at present display the partial YPR values for individual fleets).

**Table E.4.1.1. Example inputs to yield-per-recruit analysis. F(5–11) and weights-at-age are the recent three year average. The values for a 16+ gp are indicated although using this prevents the mean stock weight to increase in the plus group as F is reduced, leading to a small bias in SSB per recruit at low or zero F. Bass in the wild have been recorded up to 28 years old.**

| Age | M | Pmat | Stock wt (kg) | F(5-11) | Catch wt (kg) |
|---|---|---|---|---|---|
| 0 | 0.15 | 0.000 | 0.003 | 0.000 | 0.000 |
| 1 | 0.15 | 0.000 | 0.023 | 0.000 | 0.055 |
| 2 | 0.15 | 0.001 | 0.096 | 0.000 | 0.171 |
| 3 | 0.15 | 0.012 | 0.209 | 0.006 | 0.470 |
| 4 | 0.15 | 0.068 | 0.369 | 0.065 | 0.621 |
| 5 | 0.15 | 0.241 | 0.570 | 0.197 | 0.769 |
| 6 | 0.15 | 0.513 | 0.807 | 0.294 | 0.961 |
| 7 | 0.15 | 0.749 | 1.073 | 0.327 | 1.207 |
| 8 | 0.15 | 0.887 | 1.359 | 0.332 | 1.495 |
| 9 | 0.15 | 0.951 | 1.659 | 0.332 | 1.804 |
| 10 | 0.15 | 0.978 | 1.967 | 0.332 | 2.118 |
| 11 | 0.15 | 0.990 | 2.278 | 0.331 | 2.431 |
| 12 | 0.15 | 0.995 | 2.588 | 0.331 | 2.740 |
| 13 | 0.15 | 0.997 | 2.892 | 0.331 | 3.041 |
| 14 | 0.15 | 0.998 | 3.189 | 0.331 | 3.333 |
| 15 | 0.15 | 0.999 | 3.475 | 0.331 | 3.614 |
| 16 | 0.15 | 0.999 | 3.750 | 0.331 | 3.882 |
| 17 | 0.15 | 1.000 | 4.012 | 0.331 | 4.138 |
| 18 | 0.15 | 1.000 | 4.261 | 0.331 | 4.380 |
| 19 | 0.15 | 1.000 | 4.496 | 0.331 | 4.608 |
| 20 | 0.15 | 1.000 | 4.717 | 0.331 | 4.822 |
| 21 | 0.15 | 1.000 | 4.924 | 0.331 | 5.022 |
| 22 | 0.15 | 1.000 | 5.117 | 0.331 | 5.208 |
| 23 | 0.15 | 1.000 | 5.296 | 0.331 | 5.380 |
| 24 | 0.15 | 1.000 | 5.462 | 0.331 | 5.539 |
| 25 | 0.15 | 1.000 | 5.614 | 0.331 | 5.685 |
| 26 | 0.15 | 1.000 | 5.753 | 0.331 | 5.818 |
| 27 | 0.15 | 1.000 | 5.880 | 0.331 | 5.938 |
| 28 | 0.15 | 1.000 | 5.994 | 0.331 | 6.046 |
| 29 | 0.15 | 1.000 | 6.095 | 0.331 | 6.142 |
| 30 | 0.15 | 1.000 | 6.322 | 0.331 | 6.358 |
| +16 | 0.15 | 1.000 | 4.699 | 0.331 | 4.334 |

There is currently no TAC for sea bass, and control of fishing mortality would have to be through other approaches to managing effort on sea bass, and including technical measures to alter selectivity and/or restrict fishing seasonally or spatially. Note that the inclusion of discards in the assessment would alter the reference points and historical series. In the absence of discards, it is difficult to infer benefits to YPR or SSB/R in improving the selectivity patterns of the fleets. There is currently no time-series of recreational fishing catches to monitor the impacts of any management measures, and the frequency and extent of future surveys remains uncertain.

# F. Other Issues

## F.1. Historical overview of previous assessment methods

Previous assessments of sea bass in the 4 & 7 area are summarised below.

2007: Pawson *et al*. 2007. ADMB separable model on UK data; updated 2008 at WGNEW (Kupschus *et al*., 2008).

2012: IBP-NEW (ICES, 2012). Development of age and length based Stock Synthesis assessment.

2013: WGCSE. Update assessment using IBP-NEW SS model. Recommended inter-benchmark to improve model.

2014: IBP-BASS. Added new CGFS surveys series; removed poorly performing surveys; improved fleet structure and selectivity model; incorporated recreational fishery information; developed forecast and BRPs.

2014: WGCSE. Update assessment using IBP-Bass model.

2015: WGCSE. Update assessment using IBP-Bass model.

## E. References

Armstrong, M.J. 2012. Life-history estimates of natural mortality of sea bass around the UK. Working Document: ICES IBP-NEW 2012; October 2012. 3pp.

Armstrong, M.J. and Walmsley, S. 2012a. An evaluation of the bass fleet census and logbook system for estimating annual landings by gear for fishing vessels in England and Wales. Working Document: ICES IBP-NEW 2012; October 2012. 11pp.

Armstrong and Walmsley. 2012b. Age and growth of sea bass sampled around the UK. Working Document: ICES IBP-NEW 2012; October 2012. 15pp.

Armstrong and Walmsley. 2012c. Maturity of sea bass sampled around the UK. Working Document: ICES IBP-NEW 2012; October 2012. 14pp.

Armstrong, M.J. and Maxwell, D. 2012. Commercial fleet lpue trends for sea bass around the UK. Working Document: ICES IBP-NEW 2012; October 2012. 29 pp.

Armstrong, M. and Readdy, L. 2014. Effect on sea bass Stock Synthesis model of expanding the UK fishery age compositions to a larger plus group. Working Document, ICES IBPBASS, 2014.

Armstrong, M.J. and Drogou, M. 2014. Seabass fisheries in Europe and their management. Commission request for services SI2. 680348. 83pp.; presented also to STECF July 2014 plenary.

Armstrong M, Brown A, Hargreaves J, Hyder K, Pilgrim-Morrison S, Munday M, Proctor S, Roberts A, Roche N, Williamson K (2013). Sea Angling 2012 – a survey of recreational sea angling activity and economic value in England. Defra report, © Crown copyright 2013.

http://webarchive.nationalarchives.gov.uk/20140108121958/http://www.marinemanagement.org.uk/seaangling/index.htm

Coppin, F., Le Roy, D., Schlaich, Y. 2002. Manuel des protocoles de campagne halieutique: Campagnes CGFS, Système d'information halieutiques - Campagnes à la mer. Ifremer, 09/2001-DRV/RH/DT/AN-NUMERO, 29pp. (in French).

Diodati, P. and R.A. Richards. 1996. Mortality of striped bass hooked and released in salt water. Transactions of the American Fisheries Society. 125: 300–307.

Drogou M *et al*. 2011. Synthèse des informations disponibles sur le Bar : flottilles, captures, marché. Reflexions autour de mesures de gestion.

Dunn, M.R. and Potten, S. 1994. National Survey of Bass Angling: Report to the Ministry of Agriculture, Fisheries and Food. University of Portsmouth, Centre for the Economics and Management of Aquatic Resources. 45pp + appendices.

Dunn, M., Potten, S., Radford, A. and Whitmarsh, D. 1989. An Economic Appraisal of the Fishery for Bass in England and Wales. Report to the Ministry of Agriculture, Fisheries and Food. University of Portsmouth. 217 pp.

Herfaut J., Levrel H., Drogou M. and Véron G. 2010. Monitoring of recreational fishing of sea bass (*Dicentrarchus labrax*) in France: output from a dual methodology (telephone survey and diary) ICES CM 2010/R: 05.

ICES. 2001. Report on the ICES Study Group on Bass. CM 2001/ACFM:25, 18 pp.

ICES. 2002. Report on the ICES Study Group on Bass. CM 2002/ACFM:11 ref.G, 59 pp.

ICES. 2004a. Report of the Study Group on Bass, Lowestoft, England, August 2003. ICES Document, CM 2004/ACFM: 04. 73 pp.

ICES. 2004b. Report of the Study Group on Bass, By Correspondence. ICES Document, CM 2004/ACFM: 31 Ref G. 56pp.

ICES. 2008. Report of the Working Group on the Assessment of New MoU Species (WGNEW). By Correspondence, ICES CM 2008/ACOM:25. 77 pp.

ICES. 2009. Report of the ICES Workshop on Sampling Methods for Recreational Fisheries (WKSMRF). ICES CM 2009/ACOM: 41.

ICES. 2010 Report of the Planning Group on Recreational Fisheries (PGRFS), 7–11 June 2010, Bergen, Norway. ICES CM 2010/ACOM:34. 168 pp.

ICES. 2011. Report of the Planning Group on Recreational Fisheries (PGRFS). ICES CM 2011/ACOM:23.

ICES. 2012a. Report of the Inter-Benchmark Protocol on New Species (Turbot and Sea bass; IBPNew 2012). ICES CM. 2012/ACOM:45.

ICES. 2012b. Report of the Working Group on Assessment of New MoU Species (WGNEW), 5–9 March 2012. ICES CM 2012/ACOM:20. 258 pp.

ICES. 2012c. Report of the Working Group on Recreational Fisheries Surveys (WGRFS). ICES CM 2012/ACOM:23. 55 pp.

ICES. 2013a. Report of the Working Group for Celtic Seas Ecoregion (WGCSE), 8–17May 2013, Copenhagen, Denmark. ICES CM 2013/ACOM:12. 1986 pp.

ICES. 2013. Report of the Working Group on Recreational Fisheries Surveys (WGRFS). ICES CM 2013/ACOM:23.

ICES. 2014. Report of the Inter-Benchmark Protocol for Sea Bass in the Irish Sea, Celtic Sea, English Channel and Southern North Sea (IBP Bass). ICES CM. 2014/ACOM:45.

Jennings, S., and Pawson, M. G. 1992. The origin and recruitment of bass, *Dicentrarchus labrax*, larvae to nursery areas. Journal of the Marine Biological Association of the United Kingdom, 72: 199–212.

Kennedy, M. and Fitzmaurice, P. 1968. Occurrence of eggs of bass, *Dicentrarchus labrax*, on the southern coasts of Ireland. Journal of the Marine Biological Association of the U.K., 48: 585–592.

Kennedy, M. and Fitzmaurice, P. 1972. The biology of the bass, *Dicentrarchus labrax* in Irish waters. Journal of the Marine Biological Association of the United Kingdom 52: 557–597.

Kupschus, S., Smith, M. T., Walmsley, S. A. 2008. Annex 2: Working Document. An update of the UK bass assessments 2007. Report of the Working Group on the Assessment of New MoU Species (WGNEW). By Correspondence, ICES CM 2008/ACOM:25. 77 pp.

Lam Hoai Thong. 1970. Contribution à l'étude des Bars de la région des Sables d'Olonne. Trav. Fac. Sci. Rennes, Ser. Océanogr. Biol., 3: 39–68.

Lancaster, J. E. 1991. The feeding ecology of juvenile bass *Dicentrarchus labrax* (L.). PhD thesis, University College of Swansea, 281 pp.

Laurec *et al*. 2012. Analysis of length distribution in sea bass for a given read age. WD to IBP-NEW 2012.

Mahé, K., Holmes, A., Huet, J., Sévin, K., Elleboode, R. 2012. Report of the Seabass (*Dicentrachus labrax*) Otolith and Scale Exchange Scheme 2011, 16 pp.

Masski, H. 1998. Identification de Frayères et Etude des Structures de Population de Turbot (*Psetta maxima* L.) et du Bar (*Dicentrarchus labrax* L.) en Manche Ouest et dans les Zones Avoisinantes. Thèse présentée a la Faculte des Sciences de Brest. Universite de Bretagne Occdentale. 136pp + annexes.

Mayer, I., Shackley, S.E. and Witthames, P.R. 1990. Aspects of the reproductive biology of the bass, *Dicentrarchus labrax* L. II. Fecundity and pattern of oocyte development. J. Fish Biol. 36:141–148.

Methot, R.D. 2000. Technical Description of the Stock Synthesis Assessment Program. National Marine Fisheries Service, Seattle, WA. NOAA Tech Memo. NMFS-NWFSC-43: 46 pp.

Methot, R.D. 2011. User Manual for Stock Synthesis, Model Version 3.23b. NOAA Fisheries Service, Seattle. 167 pp.

Pawson, M. G. 1992. Climatic influences on the spawning success, growth and recruitment of bass (*Dicentrarchus labrax* L.) in British Waters. ICES mar. Science Symp. 195: 388–392.

Pawson, M. G., Kupschus, S. and Pickett, G. D. 2007a. The status of sea bass (*Dicentrarchus labrax*) stocks around England and Wales, derived using a separable catch-at-age model, and implications for fisheries management. ICES Journal of Marine Science 64, 346–356.

Pawson, M. G., Kelley, D. F. and Pickett, G. D. 1987. The distribution and migrations of bass *Dicentrarchus labrax* L. in waters around England and Wales as shown by tagging. J. mar. biol. Ass. UK, 67: 183–217.

Pawson, M. G., and Pickett, G. D. 1996. The annual pattern of condition and maturity in bass (*Dicentrarchus labrax* L) in waters around the UK. Journal of the Marine Biological Association of the United Kingdom, 76: 107–126.

Pickett, G.D. 1990. Assessment of the UK bass fishery using a log-book-based catch recording system. Fish. Res. Tech. Rep., MAFF Direct. Fish Res., Lowestoft 90: 30pp.

Pickett, G. D., and Pawson, M. G. 1994. Bass. Biology, Exploitation and Management. Chapman & Hall, London, Fish and Fisheries Series, 12. 358 pp.

Quirijns, F. and Bierman, S. 2012. Growth and maturity of sea bass sampled around the Netherlands. Working Document: ICES IBP-NEW 2012; October 2012. 9pp.

Reynolds, W. J., Lancaster, J. E. and Pawson, M. G. 2003. Patterns of spawning and recruitment of bass to Bristol Channel nurseries in relation to the 1996 "Sea Empress" oil spill. J. Mar. Biol. Assoc. UK, 83: 1163–1170.

Rocklin D, Levrel H, Drogou M, Herfaut J, Veron G. 2014. Combining Telephone Surveys and Fishing Catches Self-Report: The French Sea Bass Recreational Fishery Assessment. PLoS ONE 9(1): e87271. doi:10.1371/journal.pone.0087271.

Stequert, B., 1972. Contribution à l'étude du bar *Dicentrarchus labrax* (L.) des reservoirs à poissons de la région d'Arcachon. Th. 3ème year: Faculté des Sciences.

Thompson, B. M., Harrop, R. T. 1987. The distribution and abundance of bass (*Dicentrarchus labrax*) eggs and larvae in the English Channel and Southern North Sea. Journal of the Marine Biological Association of the United Kingdom, 67, 263–274.

Tulp, I., Bolle, L. J. and Rijnsdorp, A.D. 2008. Signals from the shallows: In search of common patterns in long-term trends in Dutch estuarine and coastal fish. Journal of Sea Research 60 (1–2), pp. 54–73.

van der Hammen, T and de Graaf, M. 2012. Recreational fishery in the Netherlands: catch estimates of cod (*Gadus morhua*) and eel (*Anguilla anguilla*) in 2010. IMARES Wageningen UR, Report Number C014/12, 61 pp.

van der Hammen T, and de Graaf, M. 2015. Recreational fisheries in the Netherlands: analyses of the 2012–2013 logbook survey, 2013 online screening survey and 2013 random digit dialing survey. Imares C042/15, pp.55.

van der Hammen, T., Poos, J. J., van Overzee H. M.J., Heessen, H. J.L. and Rijnsdorp A. D. 2013. Data evaluation of data limited stocks: Horse mackerel, Sea bass, Greater Silver Smelt, Turbot and Brill. Imares report number C166/13.

van Beek, F. A., Rijnsdorp, A.D., de Clerck, R. 1989. Monitoring juvenile stocks of flatfish in the Wadden Sea and the coastal areas of the southeastern North Sea. Helgoländer Meeresuntersuchungen, 43 (3–4), pp. 461–477. doi: 10.1007/BF02365904.

Walmsley, S. and Armstrong, M. 2012. The UK commercial bass fishery in 2010. Working Document to ICES WGNEW 2012. August 2011.

## Appendix 1

Content of Stock Synthesis Control File (Bass47.ctl) selected as the final accepted assessment model at IBP-Bass 2 2016. Rows preceded by # are skipped, and are greyed out.

# C Sea bass 4 7 input control file

# _SS-V3.24f

# benchmark IBPBass2 2016

# -------------------------

# -------------------------

1 #_N_Growth_Patterns

1 #_N_Morphs_Within_GrowthPattern(GP)

#_Cond 1 #_Morph_between/within_stdev_ratio (no read if N_morphs=1)

#_Cond 1 #vector_Morphdist_(-1_in_first_val_gives_normal_approx)

#

##1 # N recruitment designs goes here if N_GP*nseas*area>1 #here 1 gp, 4 seasons, 1 area

##0 # placeholder for recruitment interaction request

# # GP seas area for each recruitment assignment

##1 1 1 # example recruitment design element for GP=1, season=1, area=1

#

#_Cond 0 # N_movement_definitions goes here if N_areas > 1

#_Cond 1.0 # first age that moves (real age at begin of season, not integer) also cond on do_migration>0

#_Cond 1 1 1 2 4 10 # example move definition for seas=1, morph=1, source=1 dest=2, age1=4, age2=10

#

# -------------------------

0 #_Nblock_Patterns

# #_blocks_per_pattern

# #begin and end years of blocks in first pattern

#

# -------------------------

0.5 #_fracfemale #? Note sex ratio in bass increases with length.

0 #_natM_type:_0=1Parm; 1=N_breakpoints;_2=Lorenzen;_3=agespecific;_4=agespec_withseasinterpolate

#0.150 0.150 0.150 0.152 0.163 0.209 0.247 0.256 0.257 0.257
0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257
0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257 0.257
0.257 0.257 0.257

# ------------------------

1 # GrowthModel: 1=vonBert with L1&L2; 2=Richards with L1&L2; 3=not implemented; 4=not implemented #note - maguire et al 2008 pg 1270, Downloaded from icesjms.oxfordjournals.org at ICES on October 17, 2011

2 #_Growth_Age_for_L1

28 #_Growth_Age_for_L2 (999 to use as Linf)

0 #_SD_add_to_LAA (set to 0.1 for SS2 V1.x compatibility)

3 #_CV_Growth_Pattern: 0 CV=f(LAA); 1 CV=F(A); 2 SD=F(LAA); 3 SD=F(A)

1 #_maturity_option: 1=length logistic; 2=age logistic; 3=read age-maturity matrix by growth_pattern; 4=read age-fecundity; 5=read fec and wt from wtatage.ss

# _placeholder for empirical age-maturity by growth pattern

# ------------------------

4 #_First_Mature_Age

1 #_fecundity option:(1)eggs=Wt*(a+b*Wt);(2)eggs=a*L^b;(3)eggs=a*Wt^b

0 #_hermaphroditism option: 0=none; 1=age-specific fxn

1 #_parameter_offset_approach (1=none, 2= M, G, CV_G as offset from female-GP1, 3=like SS2 V1.x)

1 #_env/block/dev_adjust_method (1=standard; 2=logistic transform keeps in base parm bounds; 3=standard w/ no bound check)

#_growth_parms

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn

0.01 0.5 0.15 0.15 -1 0.1 -3 0 0 0 0 0 0 0 # NatM_p_1_GP_1

-1 30 19.67 19.67 -1 0.5 -5 0 0 0 0 0 0 0 # L_at_Amin_GP_1

60 100 80.26 80.26 -1 15 -4 0 0 0 0 0 0 0 # L_at_Amax_GP_1

0.01 0.2 0.09699 0.09699 -1 0.05 -3 0 0 0 0 0 0 0 # VonBert_K_GP_1

2 6 3.9 3.9 -1 0.8 6 0 0 0 0 0 0 0 # CV_young_GP_1

4 10 6.9 6.9 -1 0.8 6 0 0 0 0 0 0 0 # CV_old_GP_1

# weight-length relationship

-1 1 0.00001296 0.00001296 -1 0.05 -3 0 0 0 0 0 0 0 # Wtlen_1

2 4 2.969 2.969 -1 0.05 -3 0 0 0 0 0 0 0 # Wtlen_2

# proportion mature at length

30 50 40.649 40.649 -1 5 -3 0 0 0 0 0 0 0 # Mat50%

-5 1 -0.33349 -0.33349 -1 0.03764 -3 0 0 0 0 0 0 0 # Mat_slope

# fecundity option 1, parm values from dissertation (units of millions of eggs per kg)

-3 3 1 1 -1 0.8 -3 0 0 0 0 0 0 0 # Eg/gm_inter

-3 3 0 0 -1 0.8 -3 0 0 0 0 0 0 0 # Eg/gm_slope_wt

# recruitment apportionment

0 0 0 0 -1 0 -3 0 0 0 0 0 0 0 # RecrDist_GP_1

0 0 0 0 -1 0 -3 0 0 0 0 0 0 0 # RecrDist_Area_1

0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # RecrDist_Seas_1

# cohort growth deviation (fix value at 1 with negative phase; needed for blocks or annual devs)

0 0 0 0 -1 0 -4 0 0 0 0 0 0 0 # CohortGrowDev

#

#_Cond 0 #custom_MG-env_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-environ parameters

#

#_Cond 0 #custom_MG-block_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no MG-block parameters

#_Cond No MG parm trends

#

#_seasonal_effects_on_biology_parms

0 0 0 0 0 0 0 0 0 0 #_femwtlen1,femwtlen2,mat1,mat2,fec1,fec2,L1,K

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no seasonal MG parameters

#

#-6 #_MGparm_Dev_Phase

#

#_Spawner-Recruitment

3 #_SR_function

#_LO HI INIT PRIOR PR_type SD PHASE

1 16 10 5 -1 1 1 # SR_R0

0.2 0.999 0.999 0.999 -1 0.2 -1 # SR_steep

0.1 2 0.9 0.9 -1 0.2 -5 # SR_sigmaR

-5 5 0 0 -1 1 -3 # SR_envlink

-5 5 0 -0.7 -1 2 -2 # SR_R1_offset

0 0 0 0 -1 0 -99 # SR_autocorr

0 #_SR_env_link

0 #_SR_env_target_0=none;1=devs;_2=R0;_3=steepness

1 #do_recdev: 0=none; 1=devvector; 2=simple deviations

1969 # first year of main recr_devs; early devs can preceed this era

2014 # last year of main recr_devs; forecast devs start in following year 2013. Youngest survey age 2gp 2013; revised WGCSE 2015

3 #_recdev phase

1 # (0/1) to read 13 advanced options

0 #_recdev_early_start (0=none; neg value makes relative to recdev_start)

-4 #_recdev_early_phase

0 #_forecast_recruitment phase (incl. late recr) (0 value resets to maxphase+1)

1 #_lambda for prior_fore_recr occurring before endyr+1

1971 #_last_early_yr_nobias_adj_in_MPD

1982.5 #_first_yr_fullbias_adj_in_MPD

2011 #_last_yr_fullbias_adj_in_MPD 2012

2013 #_first_recent_yr_nobias_adj_in_MPD 2013

0.92 #_max_bias_adj_in_MPD (1.0 to mimic pre-2009 models)

0 #_period of cycles in recruitment (N parms read below)

-5 #min rec_dev

5 #max rec_dev

0 # 3 #_read_recdevs

#_end of advanced SR options

#

#Fishing Mortality info

0.2 # F ballpark for tuning early phases

-2001 # F ballpark year (neg value to disable)

3 # F_Method: 1=Pope; 2=instan. F; 3=hybrid (hybrid is recommended)

2.9 # max F or harvest rate, depends on F_Method

# no additional F input needed for Fmethod 1

# if Fmethod=2; read overall start F value; overall phase; N detailed inputs to read

#0.3 3 0 # if Fmethod=3; read N iterations for tuning for Fmethod 3

5 # N iterations for tuning F in hybrid method (recommend 3 to 7)

#

#_initial_F_parms

#_LO HI INIT PRIOR PR_type SD PHASE

0 2 0.03 0.3 -1 0.5 1 # InitF_OTB_Nets_Lines

0 2 0.03 0.3 -1 0.5 1 # InitF_Lines

0 2 0.03 0.3 -1 0.5 1 # InitF_Midwater

0 2 0.03 0.03 -1 0.5 1 # InitF_French

0 2 0.03 0.03 -1 0.5 1 # InitF_Other

0 2 0.03 0.03 -1 0.5 1 # InitF_RecFish

#

#_Q_setup

# Q_type options: <0=mirror, 0/1=float, 2=parameter, 3=parm_w_random_dev, 4=parm_w_randwalk)

#_Den-dep env-var extra_se Q_type

0 0 0 0 # FISHERY1

0 0 0 0 # FISHERY2

0 0 0 0 # FISHERY3

0 0 0 0 # FISHERY4

0 0 0 0 # FISHERY5

0 0 0 0 # Fishery6

0 0 1 2 # SURVEY AutBass

0 0 1 2 # Survey CGFS1

#_Cond 0 #_If q has random component, then 0=read one parm for each fleet with random q; 1=read a parm for each year of index

#_Q_parms(if_any)

# LO HI INIT PRIOR PR_type SD PHASE

-5 5 0 0 -1 1 4 # Q_extraSD_AutBass

-5 5 0 0 -1 1 4 # Q_extraSD_CGFS1

-10 10 0 0 -1 1 1 # Q_type_AutBass

-10 10 0 0 -1 1 1 # Q_type_CGFS1

#

#_size_selex_types

24 0 0 0 # 1 UKTrawl_Nets #_RDM now all fleets have size selectivity

1 0 0 0 # 2 UKLines

1 0 0 0 # 3 UKMidwater

1 0 0 0 # 4 French

15 0 0 4 # 5 Other

15 0 0 2 # 6 RecFish

24 0 0 0 # 7 AutBass

24 0 0 0 # 8 CGFS1

#

#_age_selex_types

#_Pattern ___ Male Special

10 0 0 0 # 1 UKTrawl_Nets

10 0 0 0 # 2 UKLines

10 0 0 0 # 3 UKMidwater

10 0 0 0 # 4 French

15 0 0 4 # 5 Other

15 0 0 2 # 6 RecFish

11 0 0 0 # 7 AutBass

10 0 0 0 # 8 CGFS1

#_LO HI INIT PRIOR PR_type SD PHASE env-var use_dev dev_minyr dev_maxyr dev_stddev Block Block_Fxn

20 93 45 45 -1 0.05 2 0 0 0 0 0 0 0 # SizeSel_2P_1_OTB

-10.0 4.0 -6.0 -6.0 -1 0.05 3 0 0 0 0 0 0 0 # SizeSel_2P_2_OTB

```
1.0 5.0 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0        # SizeSel_2P_3_OTB
3.0 6.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0        # SizeSel_2P_4_OTB
-8.0 9.0 -8 -8 -1 0.05 2 0 0 0 0 0 0 0         # SizeSel_2P_5_OTB
-5.0 9.0 -1 -1 -1 0.05 2 0 0 0 0 0 0 0         # SizeSel_2P_6_OTB

20 91 39 30 -1 0.1 2 0 0 0 0 0 0 0             # SizeSel_5P_1_Lines
0.01 30 2 5 -1 0.01 3 0 0 0 0 0 0 0            # SizeSel_5P_2_Lines

20 91 39 30 -1 0.1 2 0 0 0 0 0 0 0             # SizeSel_5P_1_MWT
0.01 30 2 5 -1 0.01 3 0 0 0 0 0 0 0            # SizeSel_5P_2_MWT

20 91 38.8836 30 -1 0.1 2 0 0 0 0 0 0 0        # SizeSel_5P_1_French
0.01 30 5.18514 5 -1 0.01 3 0 0 0 0 0 0 0      # SizeSel_5P_2_French

19 93 32 32 -1 0.05 2 0 0 0 0 0 0 0            # SizeSel_2P_1_AutBass
-7.0 4.0 -6.0 -6.0 -1 0.05 3 0 0 0 0 0 0 0     # SizeSel_2P_2_AutBass
1.0 5.0 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0        # SizeSel_2P_3_AutBass
1.0 6.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0        # SizeSel_2P_4_AutBass
-11.0 9.0 -8 -8 -1 0.05 2 0 0 0 0 0 0 0        # SizeSel_2P_5_AutBass
-10.0 9.0 -1 -1 -1 0.05 2 0 0 0 0 0 0 0        # SizeSel_2P_6_AutBass

20 93 32 32 -1 0.05 2 0 0 0 0 0 0 0            # SizeSel_2P_1_CGFS1
-6.0 4.0 -6.0 -6.0 -1 0.05 3 0 0 0 0 0 0 0     # SizeSel_2P_2_CGFS1
1.0 5.0 3.3 3.3 -1 0.05 3 0 0 0 0 0 0 0        # SizeSel_2P_3_CGFS1
3.0 6.0 4.4 4.4 -1 0.05 3 0 0 0 0 0 0 0        # SizeSel_2P_4_CGFS1
-11.0 9.0 -8 -8 -1 0.05 2 0 0 0 0 0 0 0        # SizeSel_2P_5_CGFS1
-5.0 9.0 -1 -1 -1 0.05 2 0 0 0 0 0 0 0         # SizeSel_2P_6_CGFS1

#0 15.8 7.4 7.4 -1 0.05 2 0 0 0 0 0 0 0        # PEAK value ageSel_1P_1_OTB
#-6.0 4.0 -6.0 -6.0 -1 0.05 3 0 0 0 0 0 0 0    # TOP logistic ageSel_1P_1_OTB
#-3 9.0 0.3 0.3 -1 0.05 3 0 0 0 0 0 0 0        # WIDTH exp ageSel_1P_1_OTB
#-1.0 9.0 -0.8 -0.8 -1 0.05 3 0 0 0 0 0 0 0    # WIDTH exp ageSel_1P_1_OTB
#-10.0 9.0 -5 -5 -1 0.05 2 0 0 0 0 0 0 0       # INIT logistic ageSel_1P_1_OTB
#-5.0 9.0 1.8 1.8 -1 0.05 2 0 0 0 0 0 0 0      # FINAL logistic ageSel_1P_1_OTB

#0 16 7.0 7.0 -1 0.05 2 0 0 0 0 0 0 0                  # ageSel_2P_1_Lines
```

#0.01 30 7.02399 5 -1 0.05 3 0 0 0 0 0 0 0 # ageSel_2P_2_Lines

#0 16 7.0 7.0 -1 0.05 2 0 0 0 0 0 0 0 # ageSel_2P_1_MWT

#0.01 30 7.02399 5 -1 0.05 3 0 0 0 0 0 0 0 # ageSel_2P_2_MWT

#0 16 7.0 7.0 -1 0.05 2 0 0 0 0 0 0 0 # AgeSel__2P_1_French

#0.01 30 7.02399 5 -1 0.05 3 0 0 0 0 0 0 0 # AgeSel__2P_2_French

2 2 2 2 -1 99 -3 0 0 0 0 0 0 0 # AgeSel_10P_1_Autumn 2 min age

4 4 4 4 -1 99 -3 0 0 0 0 0 0 0 # AgeSel_10P_2_Autumn 4 max age

#_Cond 0 #_custom_sel-env_setup (0/1)

#_Cond -2 2 0 0 -1 99 -2 #_placeholder when no enviro fxns

#_custom_sel-blk_setup (0/1)

#_Cond No selex parm trends

#_Cond -4 # placeholder for selparm_Dev_Phase

#_env/block/dev_adjust_method (1=standard; 2=logistic trans to keep in base parm bounds; 3=standard w/ no bound check)

#

# Tag loss and Tag reporting parameters go next

0 # TG_custom: 0=no read; 1=read if tags exist

#_Cond -6 6 1 1 2 0.01 -4 0 0 0 0 0 0 0 #_placeholder if no parameters

#

1 #_Variance_adjustments_to_input_values

#_fleet/svy: 1 2 3 4 5 6 7 8

0 0 0 0 0 0 0 0 #_add_to_survey_CV

0 0 0 0 0 0 0 0 #_add_to_discard_stddev

0 0 0 0 0 0 0 0 #_add_to_bodywt_CV

0.5 0.5 0.5 0.5 0.5 0.5 1 1 #_mult_by_lencomp_N

0.5 0.5 0.5 0.5 0.5 0.5 1 1 #_mult_by_agecomp_N

1 1 1 1 1 1 1 1 #_mult_by_size-at-age_N

#

3 #_maxlambdaphase

1 #_sd_offset

#

0 # number of changes to make to default Lambdas (default value is 1.0)

# Like_comp codes: 1=surv; 2=disc; 3=mnwt; 4=length; 5=age; 6=SizeFreq; 7=sizeage; 8=catch;

# 9=init_equ_catch; 10=recrdev; 11=parm_prior; 12=parm_dev; 13=CrashPen; 14=Morphcomp; 15=Tag-comp; 16=Tag-negbin

# like_comp fleet/survey phase value sizefreq_method

# 5 1 1 0.1 1 #_RDM reduce emphasis on age comp and wt-at-age by 10x

# 5 2 1 0.1 1

# 5 3 1 0.1 1

# 5 4 1 0.1 1

# 7 1 1 0.1 1

# 7 2 1 0.1 1

# 7 3 1 0.1 1

# 7 4 1 0.1 1

#

# lambdas (for info only; columns are phases)

# 0 0 0 0 #_CPUE/survey:_1

# 1 1 1 1 #_CPUE/survey:_2

# 1 1 1 1 #_CPUE/survey:_3

# 1 1 1 1 #_lencomp:_1

# 1 1 1 1 #_lencomp:_2

# 0 0 0 0 #_lencomp:_3

# 1 1 1 1 #_agecomp:_1

# 1 1 1 1 #_agecomp:_2

# 0 0 0 0 #_agecomp:_3

# 1 1 1 1 #_size-age:_1

# 1 1 1 1 #_size-age:_2

# 0 0 0 0 #_size-age:_3

# 1 1 1 1 #_init_equ_catch

# 1 1 1 1 #_recruitments

# 1 1 1 1 #_parameter-priors

# 1 1 1 1 #_parameter-dev-vectors

# 1 1 1 1 #_crashPenLambda

0 # (0/1) read specs for more stddev reporting

# 1 1 -1 5 1 5 1 -1 5 # selex type, len/age, year, N selex bins, Growth pattern, N growth ages, NatAge_area(-1 for all), NatAge_yr, N Natages

# 5 15 25 35 43 # vector with selex std bin picks (-1 in first bin to self-generate)

# 1 2 14 26 40 # vector with growth std bin picks (-1 in first bin to self-generate)

# 1 2 14 26 40 # vector with NatAge std bin picks (-1 in first bin to self-generate)

999

## Appendix 2

Content of Stock Synthesis Data file (Bass47.dat) selected as the final accepted assessment model at IBP-Bass 2 2016. Rows preceded by # are skipped, and are greyed out.

# C  Sea bass 4 7 input data file

# benchmark IBPBass2 2016

#  -------------------------

#  -------------------------

1985 # _styr

2014 # _endyr

1 # _nseasons lr number of quarters in a year

12 # _nmonths per season

1 # _spawn_seas

6 # _Nfleet

2 # _Nsurveys

1 # _N_areas

#  -------------------------

# FLEET/SURVEY NAMES, TIMING, ETC.

#  -------------------------

# Fishery & survey names separated by "%"

#  -------------------------

UKOTB_Nets%Lines%UKMWT%French%Other%RecFish%AutBass%CGFS1

-1 -1 -1 -1 -1 -1 0.83 0.75 # _surveytiming_in_season

1 1 1 1 1 1 1 1 # _area_assignments_for_each_fishery_and_survey

1 1 1 1 1 1 # _units of catch:  1=bio; 2=num

0.1 0.1 0.1 0.1 0.1 0.1 # _se of log(catch) only used for init_eq_catch and for Fmethod 2 and 3

1 #_Ngenders

30 #_Nages

57.5 24.4 0.51 713.7 18.7 1625 # _init_equil_catch_for_each_fishery (1985 landings * 0.82 see IBPNEW2012)

30 # _N_lines_of_catch_to_read

# Retained catch in biomass (metric tonnes (mt))

# ------------------------------------------------

# includes RETAINED ONLY

# ------------------------------------------------

| #UKOTB_Nets | Lines | UKMWT | French | Other | RecFish | Year | Season |
|---|---|---|---|---|---|---|---|
| 70 | 30 | 1 | 870 | 23 | 1291 | 1985 | 1 |
| 84 | 33 | 2 | 1180 | 19 | 1186 | 1986 | 1 |
| 96 | 18 | 0 | 1840 | 25 | 1117 | 1987 | 1 |
| 129 | 30 | 8 | 1028 | 44 | 1092 | 1988 | 1 |
| 141 | 29 | 7 | 917 | 67 | 1028 | 1989 | 1 |
| 128 | 18 | 22 | 849 | 47 | 904 | 1990 | 1 |
| 152 | 60 | 14 | 971 | 29 | 794 | 1991 | 1 |
| 105 | 23 | 8 | 1001 | 49 | 772 | 1992 | 1 |
| 146 | 62 | 1 | 979 | 68 | 948 | 1993 | 1 |
| 354 | 154 | 0 | 786 | 76 | 1318 | 1994 | 1 |
| 424 | 169 | 4 | 1057 | 181 | 1532 | 1995 | 1 |
| 308 | 128 | 87 | 2395 | 104 | 1519 | 1996 | 1 |
| 335 | 119 | 71 | 1984 | 111 | 1422 | 1997 | 1 |
| 241 | 121 | 85 | 1773 | 170 | 1353 | 1998 | 1 |
| 274 | 148 | 220 | 1843 | 185 | 1380 | 1999 | 1 |
| 236 | 53 | 52 | 1805 | 261 | 1460 | 2000 | 1 |
| 263 | 58 | 97 | 1883 | 199 | 1511 | 2001 | 1 |
| 361 | 75 | 110 | 1825 | 251 | 1610 | 2002 | 1 |
| 353 | 65 | 127 | 2471 | 443 | 1696 | 2003 | 1 |
| 380 | 72 | 131 | 2604 | 544 | 1771 | 2004 | 1 |
| 353 | 59 | 68 | 3161 | 789 | 1766 | 2005 | 1 |
| 359 | 119 | 11 | 3259 | 629 | 1732 | 2006 | 1 |
| 413 | 166 | 37 | 2771 | 677 | 1794 | 2007 | 1 |
| 514 | 163 | 17 | 2750 | 663 | 1894 | 2008 | 1 |
| 486 | 147 | 9 | 2649 | 598 | 1919 | 2009 | 1 |
| 452 | 183 | 42 | 3236 | 649 | 1828 | 2010 | 1 |
| 462 | 143 | 98 | 2526 | 629 | 1682 | 2011 | 1 |
| 564 | 185 | 49 | 2610 | 579 | 1500 | 2012 | 1 |
| 530 | 191 | 39 | 2871 | 506 | 1236 | 2013 | 1 |
| 751 | 236 | 1 | 1303 | 391 | 979 | 2014 | 1 |

# ------------------------------------------------

52 #_N_cpue_and_surveyabundance_observations

#_Units: 0=numbers; 1=biomass; 2=F

#_Errtype: -1=normal; 0=lognormal; >0=T

#_Fleet Units Errtype

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 0 | # | UK OTB_Nets |
| 2 | 1 | 0 | # | UK Lines |
| 3 | 1 | 0 | # | UK MWT |
| 4 | 1 | 0 | # | French fleets |
| 5 | 1 | 0 | # | Other |
| 6 | 1 | 0 | # | RecFish |
| 7 | 0 | 0 | # | AutBass |
| 8 | 0 | 0 | # | CGFS1 |

################################

# yr qtr indexNumber(5-6) indexResult indexSE

| | | | | |
|---|---|---|---|---|
| ## | AutBass | | (numbers 2): | |
| 1986 | 1 | 7 | 5.84 | 0.433295234 |
| 1987 | 1 | 7 | 2.6 | 0.433295234 |
| 1989 | 1 | 7 | 7.05 | 0.433295234 |
| 1990 | 1 | 7 | 3.98 | 0.433295234 |
| 1991 | 1 | 7 | 3.32 | 0.433295234 |
| 1992 | 1 | 7 | 19.7 | 0.433295234 |
| 1993 | 1 | 7 | 14.63 | 0.433295234 |
| 1994 | 1 | 7 | 5.46 | 0.433295234 |
| 1995 | 1 | 7 | 10.24 | 0.433295234 |
| 1996 | 1 | 7 | 6.06 | 0.433295234 |
| 1997 | 1 | 7 | 38.2 | 0.433295234 |
| 1998 | 1 | 7 | 7.34 | 0.433295234 |
| 1999 | 1 | 7 | 20.91 | 0.433295234 |
| 2000 | 1 | 7 | 17.46 | 0.433295234 |
| 2001 | 1 | 7 | 39.91 | 0.433295234 |
| 2002 | 1 | 7 | 11.7 | 0.433295234 |
| 2003 | 1 | 7 | 13.55 | 0.433295234 |
| 2005 | 1 | 7 | 21.93 | 0.433295234 |
| 2006 | 1 | 7 | 19.73 | 0.433295234 |
| 2007 | 1 | 7 | 5.5 | 0.433295234 |
| 2008 | 1 | 7 | 25.52 | 0.433295234 |
| 2009 | 1 | 7 | 19.83 | 0.433295234 |

| | | | | |
|---|---|---|---|---|
| 2011 | 1 | 7 | 4.05 | 0.433295234 |
| 2013 | 1 | 7 | 1.52 | 0.433295234 |
| 2014 | 1 | 7 | 2.3 | 0.433295234 |
| ## | CGFS1: | | | |
| 1988 | 1 | 8 | 245776 | 0.6 |
| 1989 | 1 | 8 | 77716 | 0.6 |
| 1990 | 1 | 8 | 1129914 | 0.6 |
| 1991 | 1 | 8 | 4250635 | 0.3 |
| 1992 | 1 | 8 | 2617984 | 0.3 |
| 1993 | 1 | 8 | 2299918 | 0.3 |
| 1994 | 1 | 8 | 1097829 | 0.3 |
| 1995 | 1 | 8 | 1021740 | 0.3 |
| 1996 | 1 | 8 | 1224238 | 0.3 |
| 1997 | 1 | 8 | 1817599 | 0.3 |
| 1998 | 1 | 8 | 2531044 | 0.3 |
| 1999 | 1 | 8 | 1642270 | 0.3 |
| 2000 | 1 | 8 | 2570996 | 0.3 |
| 2001 | 1 | 8 | 3150674 | 0.3 |
| 2002 | 1 | 8 | 3872427 | 0.3 |
| 2003 | 1 | 8 | 8739057 | 0.3 |
| 2004 | 1 | 8 | 3598440 | 0.3 |
| 2005 | 1 | 8 | 3005317 | 0.3 |
| 2006 | 1 | 8 | 5517999 | 0.3 |
| 2007 | 1 | 8 | 3661314 | 0.3 |
| 2008 | 1 | 8 | 6468841 | 0.3 |
| 2009 | 1 | 8 | 2564696 | 0.3 |
| 2010 | 1 | 8 | 1804537 | 0.3 |
| 2011 | 1 | 8 | 1513745 | 0.3 |
| 2012 | 1 | 8 | 2034554 | 0.3 |
| 2013 | 1 | 8 | 995987 | 0.3 |
| 2014 | 1 | 8 | 669931 | 0.3 |

# -------------------------

# DISCARDED CATCH

# -------------------------

0 # _N_fleets_with_discard

0 # N discard obs

# -------------------------

# MEAN BODY WEIGHT

# -------------------------

0 # _N_meanbodywt_obs

30 #_DF_for_meanbodywt_T-distribution_like

# -------------------------

# LENGTH COMPOSITION SET-UP

# -------------------------

# population length bins (not necessarily same as data bins, below)

2 # length bin method: 1=use databins; 2=generate from binwidth,min,max below; 3=read vector

2 # number of population length bins to be read

4

94

-0.001 #_comp_tail_compression

1e-007 #_add_to_comp

0 #_combine males into females at or below this bin number

# -------------------------

# LENGTH COMPOSITION DATA

# -----------------------

41 #_N_LengthBins

# vector of length N_LengthBins with lower edges of each bin

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 |
| | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 |
| | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 |
| | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 |

125 #_N_Length_obs

#Yr Season Flt/Svy Gender Part Nsamp datavector(female-male)

# -------------------------------------------

##### LANDINGS OF COMMERCIAL FLEETS (1 TO 5), ORDERED BY YEAR AND QUARTER:

# -------------------------------------------

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1985 | 1 | 1 | 0 | 2 | 8.926117202 | | 0 | 0 | 65 | 0 |
| | 0 | 130 | 0 | 185 | 2154 | 9307 | 17771 | 11520 | 7353 | |
| | 6195 | 3248 | 4184 | 4005 | 4135 | 3269 | 1254 | 1171 | 1641 | |
| | 1224 | 1180 | 584 | 234 | 414 | 94 | 152 | 445 | 152 | 0 |
| | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1986 | 1 | 1 | 0 | 2 | 13.65170866 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 8881 | 6175 | 1522 | 7181 | 8854 | 4903 | 9250 | |
| | 8551 | 5295 | 4432 | 3045 | 2208 | 3867 | 2638 | 1567 | 1380 | |
| | 2851 | 995 | 1375 | 352 | 90 | 5036 | 311 | 1794 | 4 | 216 |
| | 109 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1987 | 1 | 1 | 0 | 2 | 29.66621305 | | 0 | 0 | 0 | 0 |
| | 0 | 188 | 0 | 0 | 5148 | 20706 | 17049 | 22638 | 11144 | |
| | 13791 | 5629 | 5008 | 2384 | 2475 | 1252 | 1681 | 1460 | 1001 | 913 |
| | 2667 | 2945 | 713 | 2229 | 194 | 761 | 381 | 660 | 191 | 0 |
| | 0 | 179 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1988 | 1 | 1 | 0 | 2 | 19.1648987 | | 16 | 16 | 0 | 0 |
| | 0 | 32 | 761 | 1431 | 7219 | 6402 | 12495 | 35742 | 14723 | |
| | 11915 | 12763 | 17220 | 6430 | 4406 | 1698 | 2566 | 1639 | 918 | |
| | 2439 | 1888 | 153 | 1194 | 822 | 1964 | 515 | 743 | 552 | 210 |
| | 172 | 177 | 33 | 20 | 0 | 0 | 0 | 0 | 0 | |
| 1989 | 1 | 1 | 0 | 2 | 24.67808873 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 10076 | 7434 | 16034 | 20457 | 12060 | |
| | 11120 | 15380 | 11197 | 11691 | 8578 | 6183 | 3381 | 3457 | 2999 | |
| | 2588 | 2852 | 2309 | 1579 | 1472 | 1344 | 427 | 540 | 56 | 41 |
| | 56 | 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1990 | 1 | 1 | 0 | 2 | 16.53957011 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 231 | 6223 | 6914 | |
| | 8672 | 4714 | 9034 | 16220 | 7610 | 9973 | 7415 | 5356 | 3246 | |
| | 1226 | 2895 | 1784 | 1441 | 1099 | 565 | 346 | 158 | 304 | 124 |
| | 0 | 98 | 148 | 0 | 566 | 0 | 0 | 0 | 0 | |
| 1991 | 1 | 1 | 0 | 2 | 17.58970154 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 60 | 179 | 7350 | 23199 | 11237 | |
| | 6005 | 4235 | 4202 | 4461 | 5509 | 5105 | 5275 | 5129 | 7434 | |
| | 3315 | 5836 | 2703 | 729 | 2551 | 2614 | 3546 | 727 | 84 | |
| | 1379 | 202 | 4 | 260 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1992 | 1 | 1 | 0 | 2 | 13.91424152 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 202 | 10251 | 34088 | 28604 | |
| | 14364 | 11787 | 4507 | 2927 | 1668 | 4105 | 1574 | 2119 | 1510 | |
| | 1313 | 1072 | 953 | 363 | 340 | 245 | 257 | 1502 | 604 | 0 |
| | 0 | 75 | 54 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1993 | 1 | 1 | 0 | 2 | 42.792856 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 22 | 3824 | 899 | 9580 | 63497 | 38604 | |
| | 24428 | 12330 | 8183 | 4533 | 4499 | 2704 | 1619 | 1925 | 1808 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 2365 | 1700 | 1273 | 547 | 1136 | 448 | 331 | 395 | 419 | 845 |
| | 64 | 23 | 0 | 189 | 0 | 0 | 0 | 0 | 0 | |
| 1994 | 1 | 1 | 0 | 2 | 79.02239052 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 41 | 294 | 3134 | 13855 | 24439 | 129505 | 123864 | |
| | 80678 | 40573 | 17235 | 9901 | 7294 | 4994 | 3368 | 2752 | 2401 | |
| | 2438 | 2518 | 2146 | 1616 | 1584 | 1156 | 1246 | 931 | 354 | 300 |
| | 303 | 296 | 201 | 196 | 0 | 0 | 196 | 0 | 0 | |
| 1995 | 1 | 1 | 0 | 2 | 64.05801756 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 18 | 1789 | 16942 | 92179 | 102900 | |
| | 94279 | 70417 | 47122 | 23608 | 19100 | 5219 | 4526 | 5666 | 1680 | |
| | 1067 | 1828 | 3109 | 1553 | 1670 | 3025 | 756 | 919 | 322 | 158 |
| | 0 | 61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1996 | 1 | 1 | 0 | 2 | 47.78098031 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 381 | 6026 | 41792 | 52179 | |
| | 69395 | 65619 | 42281 | 25995 | 9847 | 5172 | 4918 | 7792 | 1453 | |
| | 2656 | 2956 | 677 | 590 | 800 | 618 | 765 | 169 | 1402 | 520 |
| | 96 | 96 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | |
| 1997 | 1 | 1 | 0 | 2 | 46.73084888 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 13 | 2701 | 24764 | 39040 | |
| | 40706 | 42434 | 40369 | 39013 | 34893 | 20836 | 13939 | 8078 | 5869 | |
| | 2309 | 2564 | 825 | 601 | 1231 | 2317 | 1583 | 849 | 73 | 516 |
| | 68 | 0 | 29 | 6 | 0 | 0 | 0 | 0 | 0 | |
| 1998 | 1 | 1 | 0 | 2 | 33.86673879 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 523 | 1819 | 11497 | 31816 | 36175 | |
| | 37154 | 31132 | 24428 | 23014 | 15281 | 13728 | 8376 | 5485 | 4375 | |
| | 2326 | 1545 | 962 | 927 | 284 | 445 | 527 | 193 | 102 | 13 |
| | 0 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | |
| 1999 | 1 | 1 | 0 | 2 | 33.60420594 | | 0 | 0 | 0 | 0 |
| | 77 | 38 | 0 | 38 | 77 | 426 | 14262 | 61905 | 70065 | |
| | 61131 | 44444 | 26605 | 15904 | 10526 | 8488 | 5975 | 5417 | 3118 | |
| | 2648 | 1680 | 1630 | 520 | 389 | 289 | 278 | 123 | 225 | 91 |
| | 0 | 38 | 0 | 0 | 47 | 0 | 0 | 0 | 0 | |
| 2000 | 1 | 1 | 0 | 2 | 40.16752741 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 12 | 5287 | 48896 | 64332 | |
| | 53940 | 33900 | 22938 | 15274 | 6262 | 8145 | 5403 | 4637 | 3391 | |
| | 2036 | 1356 | 1179 | 252 | 475 | 368 | 84 | 38 | 84 | 133 |
| | 386 | 32 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | |
| 2001 | 1 | 1 | 0 | 2 | 42.53032314 | | 0 | 0 | 0 | 0 |
| | 0 | 25 | 19 | 39 | 19 | 2288 | 15716 | 64089 | 52490 | |
| | 49167 | 37384 | 17952 | 14200 | 7642 | 8485 | 5841 | 7872 | 3872 | |
| | 3937 | 3812 | 3380 | 1995 | 1560 | 786 | 161 | 34 | 66 | 775 |
| | 3 | 30 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2002 | 1 | 1 | 0 | 2 | 81.38518625 | | 0 | 98 | 16 | 0 |
| | 49 | 65 | 16 | 325 | 446 | 893 | 31390 | 85336 | 93085 | |
| | 69271 | 40986 | 29133 | 19327 | 15215 | 10706 | 7096 | 7106 | 5447 | |
| | 3998 | 2393 | 2191 | 1579 | 1080 | 1665 | 625 | 59 | 87 | 159 |
| | 40 | 49 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 1 | 1 | 0 | 2 | 74.82186478 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 34 | 46 | 1424 | 8235 | 57062 | 77986 | |
| | 70341 | 43681 | 29493 | 20640 | 18412 | 15623 | 11819 | 7903 | 6477 | |
| | 3672 | 2989 | 1869 | 2803 | 1021 | 723 | 294 | 1397 | 197 | 193 |
| | 348 | 0 | 0 | 118 | 0 | 0 | 0 | 0 | 0 | |
| 2004 | 1 | 1 | 0 | 2 | 48.83111175 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 30 | 477 | 7112 | 56436 | 77855 | |
| | 88743 | 75236 | 57578 | 43440 | 17089 | 10998 | 7706 | 2454 | 1193 | |
| | 1019 | 705 | 1193 | 1093 | 797 | 277 | 382 | 310 | 149 | 88 |
| | 54 | 0 | 0 | 0 | 0 | 0 | 48 | 0 | 0 | |
| 2005 | 1 | 1 | 0 | 2 | 18.37730012 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 15 | 480 | 9736 | 118997 | 87391 | |
| | 54041 | 51857 | 41817 | 31495 | 23782 | 9021 | 5197 | 4800 | 2206 | |
| | 2090 | 1049 | 1075 | 717 | 324 | 221 | 221 | 113 | 36 | 46 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2006 | 1 | 1 | 0 | 2 | 17.58970154 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 3306 | 22629 | 108391 | 100915 | |
| | 86929 | 45290 | 32101 | 20844 | 15954 | 10699 | 7506 | 3681 | 2838 | |
| | 1708 | 1912 | 511 | 761 | 2580 | 308 | 132 | 0 | 154 | 22 |
| | 0 | 22 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2007 | 1 | 1 | 0 | 2 | 16.80210297 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 470 | 3489 | 54082 | 70396 | |
| | 64601 | 54445 | 58842 | 37746 | 18707 | 11681 | 15625 | 7831 | 4841 | |
| | 8448 | 2259 | 3735 | 4278 | 438 | 455 | 117 | 1226 | 316 | 159 |
| | 117 | 0 | 255 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2008 | 1 | 1 | 0 | 2 | 25.72822017 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 401 | 13790 | 175049 | 148847 | |
| | 104728 | 76223 | 44614 | 33457 | 14676 | 13238 | 11255 | 8194 | 5767 | |
| | 2706 | 1499 | 1369 | 1236 | 777 | 862 | 222 | 113 | 0 | 8 |
| | 586 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2009 | 1 | 1 | 0 | 2 | 29.66621305 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 146 | 2887 | 104904 | 107730 | |
| | 93431 | 55081 | 50155 | 25947 | 30223 | 16007 | 15940 | 12696 | 7388 | |
| | 6801 | 2355 | 683 | 4323 | 91 | 486 | 955 | 1257 | 337 | |
| | 1781 | 108 | 108 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 1 | 1 | 0 | 2 | 25.72822017 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 40 | 3168 | 80969 | 65663 | |
| | 100554 | 56013 | 63911 | 49857 | 14519 | 12059 | 8624 | 6881 | 7079 | |
| | 4950 | 4215 | 3011 | 2984 | 2604 | 1229 | 1072 | 1059 | 335 | 302 |
| | 410 | 358 | 254 | 127 | 0 | 0 | 0 | 0 | 0 | |
| 2011 | 1 | 1 | 0 | 2 | 27.04088446 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 82 | 3514 | 42567 | 46238 | |
| | 51629 | 63594 | 50320 | 59307 | 31597 | 27273 | 18416 | 13379 | 6216 | |
| | 7016 | 3569 | 5620 | 2394 | 1025 | 2151 | 1077 | 718 | 1327 | 289 |
| | 86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2012 | 1 | 1 | 0 | 2 | 29.92874591 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 2232 | 12451 | 100744 | 129415 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 87343 | 57287 | 33655 | 19594 | 22391 | 21406 | 19679 | 17983 | 11586 | |
| | 10398 | 8571 | 5215 | 3351 | 2452 | 2792 | 1025 | 865 | 521 | 499 |
| | 410 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2013 | 1 | 1 | 0 | 2 | 34.39180451 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 209 | 2114 | 10865 | 65525 | 91135 | |
| | 87003 | 60752 | 37589 | 32577 | 21034 | 21530 | 19731 | 23574 | 19268 | |
| | 7202 | 10270 | 6993 | 3741 | 2360 | 1532 | 4060 | 682 | 1944 | 0 |
| | 189 | 108 | 0 | 94 | 0 | 13 | 0 | 0 | 0 | |
| 2014 | 1 | 1 | 0 | 2 | 29.40368019 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 6555 | 39382 | 72183 | |
| | 82901 | 67301 | 47751 | 35694 | 26112 | 26014 | 28791 | 31275 | 31236 | |
| | 27240 | 19207 | 13470 | 8783 | 4304 | 5533 | 3379 | 2344 | 939 | 796 |
| | 174 | 0 | 0 | 123 | 0 | 0 | 0 | 0 | 0 | |
| 1985 | 1 | 2 | 0 | 2 | 2.924411826 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 2822 | 5368 | 5711 | 5594 | 1624 | 2170 | 3688 | |
| | 1284 | 1590 | 1002 | 2424 | 1123 | 1485 | 1669 | 1171 | 457 | 143 |
| | 443 | 207 | 139 | 325 | 7 | 14 | 0 | 125 | 257 | 375 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1986 | 1 | 2 | 0 | 2 | 4.771408768 | | 0 | 0 | 0 | 0 |
| | 0 | 32 | 59 | 461 | 1123 | 2607 | 2174 | 3118 | 1579 | |
| | 1540 | 963 | 1083 | 1435 | 1868 | 2033 | 1350 | 1721 | 863 | 741 |
| | 621 | 539 | 681 | 351 | 392 | 254 | 177 | 177 | 59 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1987 | 1 | 2 | 0 | 2 | 10.62023242 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 26 | 102 | 245 | 658 | 757 | 1024 | 924 | |
| | 1630 | 497 | 1079 | 214 | 461 | 358 | 806 | 1122 | 717 | 526 |
| | 431 | 172 | 98 | 77 | 97 | 562 | 44 | 240 | 46 | 183 |
| | 17 | 28 | 39 | 7 | 4 | 0 | 0 | 4 | | |
| 1988 | 1 | 2 | 0 | 2 | 8.15756983 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 24 | 838 | 4597 | 4578 | 3030 | 1744 | |
| | 2166 | 2108 | 1304 | 1295 | 1215 | 747 | 740 | 481 | 841 | 630 |
| | 651 | 884 | 398 | 429 | 308 | 311 | 156 | 52 | 59 | 61 |
| | 24 | 169 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1989 | 1 | 2 | 0 | 2 | 4.001826709 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 276 | 630 | 21750 | 21856 | 999 | 366 |
| | 259 | 183 | 24 | 75 | 49 | 75 | 235 | 420 | 235 | 231 |
| | 429 | 169 | 328 | 210 | 50 | 185 | 25 | 93 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1990 | 1 | 2 | 0 | 2 | 3.386161061 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 119 | 164 | 474 | 533 |
| | 1063 | 1380 | 1324 | 1085 | 967 | 760 | 769 | 414 | 494 | 627 |
| | 345 | 277 | 266 | 190 | 196 | 0 | 196 | 156 | 74 | 0 |
| | 74 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1991 | 1 | 2 | 0 | 2 | 8.15756983 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 10 | 10 | 1811 | 3158 | 2495 | 860 |
| | 591 | 628 | 1053 | 1530 | 1536 | 1440 | 1344 | 1062 | 1067 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1756 | 1191 | 1411 | 2280 | 1280 | 1312 | 1273 | 1286 | 565 | 556 |
| | 109 | 256 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1992 | 1 | 2 | 0 | 2 | 17.08472172 | | 0 | 0 | 0 | 0 |
| | 44 | 88 | 0 | 0 | 0 | 3 | 616 | 3464 | 2977 | |
| | 2124 | 1332 | 974 | 719 | 557 | 446 | 654 | 523 | 499 | 697 |
| | 343 | 286 | 264 | 525 | 228 | 222 | 231 | 176 | 172 | 149 |
| | 59 | 13 | 44 | 21 | 0 | 0 | 0 | 0 | | |
| 1993 | 1 | 2 | 0 | 2 | 18.93171866 | | 0 | 0 | 0 | 7 |
| | 7 | 4 | 11 | 331 | 1975 | 1314 | 2175 | 5307 | 5933 | |
| | 4077 | 3082 | 2857 | 2235 | 1507 | 1104 | 1531 | 1073 | 1688 | |
| | 1991 | 2262 | 999 | 1125 | 1423 | 887 | 547 | 662 | 727 | 606 |
| | 176 | 128 | 20 | 0 | 5 | 24 | 0 | 0 | 0 | |
| 1994 | 1 | 2 | 0 | 2 | 23.85704384 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 53 | 2507 | 17514 | 41410 | 36295 | |
| | 20278 | 13387 | 7327 | 5906 | 4144 | 1898 | 2142 | 2831 | 1407 | |
| | 3143 | 2615 | 1872 | 1361 | 1706 | 787 | 194 | 525 | 59 | 253 |
| | 543 | 408 | 15 | 27 | 0 | 0 | 0 | 0 | 0 | |
| 1995 | 1 | 2 | 0 | 2 | 16.46905607 | | 0 | 0 | 0 | 37 |
| | 147 | 73 | 73 | 37 | 73 | 110 | 4051 | 14846 | 32436 | |
| | 33924 | 23719 | 10655 | 6757 | 4376 | 2709 | 2763 | 2189 | 1069 | |
| | 2014 | 1888 | 2907 | 2051 | 2210 | 2218 | 898 | 2550 | 1295 | 142 |
| | 10 | 25 | 253 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1996 | 1 | 2 | 0 | 2 | 16.31513966 | | 0 | 0 | 0 | 24 |
| | 24 | 0 | 0 | 0 | 0 | 0 | 3204 | 11374 | 8560 | |
| | 13522 | 18431 | 17622 | 9343 | 7156 | 4070 | 2591 | 2349 | 2779 | |
| | 1182 | 937 | 1737 | 889 | 1512 | 685 | 1409 | 914 | 835 | 748 |
| | 177 | 178 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1997 | 1 | 2 | 0 | 2 | 21.08654843 | | 0 | 0 | 0 | 14 |
| | 29 | 58 | 29 | 100 | 138 | 533 | 1294 | 7827 | 7802 | |
| | 9038 | 11155 | 12767 | 14218 | 11620 | 7425 | 4019 | 2324 | 1931 | |
| | 1348 | 753 | 768 | 755 | 1027 | 1130 | 655 | 463 | 407 | 330 |
| | 143 | 28 | 94 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1998 | 1 | 2 | 0 | 2 | 17.08472172 | | 0 | 0 | 0 | 0 |
| | 0 | 731 | 1269 | 1079 | 1366 | 786 | 676 | 5281 | 7589 | |
| | 10236 | 9821 | 10320 | 8341 | 9011 | 6339 | 7604 | 4291 | 3777 | |
| | 2994 | 1642 | 1015 | 892 | 741 | 854 | 435 | 545 | 354 | 295 |
| | 86 | 144 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1999 | 1 | 2 | 0 | 2 | 22.93354537 | | 0 | 0 | 0 | 0 |
| | 104 | 260 | 122 | 177 | 602 | 1074 | 1957 | 11654 | 15277 | |
| | 19251 | 14093 | 11303 | 9710 | 6904 | 6689 | 6477 | 4380 | 4305 | |
| | 3643 | 2446 | 2370 | 1599 | 1327 | 1026 | 1015 | 652 | 624 | 283 |
| | 93 | 0 | 79 | 66 | 66 | 28 | 0 | 0 | 0 | |
| 2000 | 1 | 2 | 0 | 2 | 10.00456677 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 16 | 18 | 138 | 5880 | 5954 | |
| | 7621 | 5425 | 4950 | 3902 | 2189 | 1791 | 1704 | 1245 | 1306 | |
| | 1464 | 1074 | 860 | 647 | 172 | 260 | 50 | 199 | 68 | 64 |
| | 0 | 155 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | 1 | 2 | 0 | 2 | 17.54647095 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 246 | 4393 | 4273 | |
| | 5531 | 7145 | 5337 | 4579 | 2859 | 2679 | 1560 | 1386 | 1932 | |
| | 1651 | 1315 | 1332 | 529 | 635 | 247 | 220 | 185 | 200 | 70 |
| | 44 | 89 | 70 | 0 | 35 | 0 | 0 | 0 | 0 | |
| 2002 | 1 | 2 | 0 | 2 | 22.31787972 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 85 | 1113 | 4776 | 4791 | |
| | 4551 | 5657 | 7479 | 6871 | 5474 | 3452 | 2449 | 2632 | 2723 | |
| | 1873 | 1572 | 792 | 1243 | 909 | 446 | 523 | 394 | 396 | 171 |
| | 180 | 85 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2003 | 1 | 2 | 0 | 2 | 13.85247707 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 12 | 12 | 347 | 6738 | 7562 | |
| | 8447 | 7163 | 6892 | 5129 | 4649 | 3693 | 3070 | 1752 | 1639 | |
| | 1094 | 974 | 609 | 580 | 388 | 315 | 191 | 119 | 266 | 8 |
| | 107 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2004 | 1 | 2 | 0 | 2 | 10.62023242 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 151 | 114 | 3383 | 4778 | |
| | 7305 | 7164 | 6298 | 5551 | 4972 | 4272 | 3418 | 3519 | 1990 | |
| | 1623 | 1259 | 1182 | 957 | 1195 | 511 | 161 | 429 | 124 | 3 |
| | 136 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2005 | 1 | 2 | 0 | 2 | 3.847910297 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 1459 | 5096 | |
| | 5733 | 5562 | 5847 | 2889 | 2587 | 1756 | 2391 | 2107 | 2111 | |
| | 1980 | 2538 | 812 | 1071 | 42 | 400 | 849 | 261 | 163 | 142 |
| | 0 | 240 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2006 | 1 | 2 | 0 | 2 | 10.3123996 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 74 | 0 | 3969 | 12293 | |
| | 12638 | 14461 | 14923 | 10989 | 8786 | 9345 | 5063 | 4132 | 4038 | |
| | 4524 | 2755 | 1619 | 2088 | 621 | 794 | 551 | 244 | 169 | 560 |
| | 344 | 54 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2007 | 1 | 2 | 0 | 2 | 4.771408768 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 1136 | 5131 | 14565 | |
| | 15142 | 14050 | 12606 | 10768 | 12287 | 8705 | 5167 | 6074 | 4873 | |
| | 3812 | 4817 | 4253 | 2142 | 3384 | 1247 | 1252 | 0 | 747 | 487 |
| | 0 | 0 | 24 | 24 | 24 | 0 | 0 | 0 | 0 | |
| 2008 | 1 | 2 | 0 | 2 | 4.617492356 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 313 | 4013 | 11689 | |
| | 16359 | 18034 | 18687 | 12444 | 10441 | 7197 | 13773 | 7484 | 3684 | |
| | 3598 | 3289 | 2458 | 2440 | 303 | 506 | 318 | 615 | 591 | 0 |
| | 0 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2009 | 1 | 2 | 0 | 2 | 2.924411826 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 8613 | 14610 | |
| | 12252 | 18429 | 15522 | 11032 | 9124 | 7768 | 5868 | 4579 | 4902 | |
| | 2018 | 3718 | 2757 | 1475 | 1029 | 814 | 667 | 147 | 520 | 299 |
| | 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2010 | 1 | 2 | 0 | 2 | 6.310572887 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2315 | 16065 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30120 | 30121 | 40653 | 24649 | 10232 | 6746 | 3421 | 2913 | 2137 | |
| | 1626 | 1675 | 507 | 760 | 539 | 302 | 598 | 331 | 222 | 56 |
| | 0 | 56 | 28 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2011 | 1 | 2 | 0 | 2 | 8.619319065 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 12 | 180 | 2327 | 7968 | |
| | 10975 | 13369 | 10926 | 11254 | 10787 | 9886 | 6722 | 6716 | 4301 | |
| | 3064 | 2450 | 2410 | 2342 | 1525 | 625 | 501 | 297 | 251 | 228 |
| | 145 | 102 | 69 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2012 | 1 | 2 | 0 | 2 | 15.39164119 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 520 | 4350 | 11740 | |
| | 12483 | 14279 | 12748 | 12865 | 7284 | 13932 | 9586 | 9411 | 10724 | |
| | 5622 | 4735 | 2099 | 2450 | 2478 | 1173 | 566 | 675 | 137 | 394 |
| | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2013 | 1 | 2 | 0 | 2 | 6.464489299 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 569 | 6040 | 14247 | |
| | 17604 | 17459 | 11704 | 10487 | 7481 | 10703 | 9458 | 9034 | 6570 | |
| | 6686 | 5108 | 5206 | 1152 | 1560 | 1394 | 1065 | 555 | 742 | 507 |
| | 292 | 244 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2014 | 1 | 2 | 0 | 2 | 11.23589807 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 241 | 4662 | 10862 | |
| | 13728 | 25651 | 20722 | 19848 | 13851 | 10523 | 9996 | 9716 | 8768 | |
| | 8485 | 6856 | 5460 | 3433 | 2486 | 1624 | 627 | 279 | 564 | 190 |
| | 12 | 161 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1985 | 1 | -3 | 0 | 2 | 0.320262515 | | 0 | 1 | 3 | 2 |
| | 1 | 1 | 1 | 2 | 2 | 2 | 0 | 1 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 264 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1987 | 1 | -3 | 0 | 2 | 0.160131257 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 |
| | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1988 | 1 | -3 | 0 | 2 | 0.320262515 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 76 | 228 | 301 |
| | 882 | 1103 | 594 | 515 | 443 | 367 | 149 | 145 | 76 | 76 |
| | 0 | 76 | 228 | 152 | 76 | 76 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1989 | 1 | -3 | 0 | 2 | 0.640525029 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 8 | 20 | 51 | 40 | 16 | 60 | 198 | 235 | 401 | 306 |
| | 421 | 532 | 207 | 140 | 85 | 69 | 0 | 4 | 11 | 26 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1991 | 1 | -3 | 0 | 2 | 0.160131257 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 435 | 2111 | 2590 | 1683 | 720 | 820 | 0 | 0 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 56 | 224 | 56 | 0 | 279 | 112 | 56 | 56 | 0 | 56 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1992 | 1 | -3 | 0 | 2 | 0.320262515 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 59 | 20 | 277 | 138 | 296 | 692 | 415 | 1502 | 573 | 217 |
| | 158 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1995 | 1 | -3 | 0 | 2 | 0.320262515 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1629 | 1303 | |
| | 1303 | 1629 | 326 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1996 | 1 | 3 | 0 | 2 | 10.72879424 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 4942 | |
| | 11074 | 20191 | 14350 | 12533 | 10412 | 5550 | 3274 | 417 | 980 | 596 |
| | 98 | 204 | 196 | 588 | 490 | 98 | 0 | 98 | 0 | 98 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1998 | 1 | 3 | 0 | 2 | 7.366037838 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 129 | 4038 | |
| | 7185 | 3523 | 8141 | 13079 | 7721 | 8577 | 1929 | 5980 | 433 | 673 |
| | 902 | 199 | 392 | 352 | 41 | 117 | 240 | 234 | 117 | 0 |
| | 234 | 117 | 117 | 0 | 0 | 0 | 0 | 0 | | |
| 1999 | 1 | 3 | 0 | 2 | 19.5360134 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 25 | 328 | 1227 | 4512 | |
| | 5855 | 13377 | 17206 | 19594 | 15317 | 13967 | 14170 | 9191 | 11296 | |
| | 9324 | 4411 | 2947 | 961 | 1097 | 1251 | 941 | 237 | 430 | 0 |
| | 237 | 474 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2000 | 1 | 3 | 0 | 2 | 7.686300353 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 180 | 755 | |
| | 1873 | 2069 | 2545 | 2801 | 3193 | 2432 | 2263 | 2199 | 3200 | |
| | 2323 | 1452 | 1193 | 812 | 443 | 279 | 248 | 195 | 63 | 42 |
| | 11 | 21 | 11 | 11 | 0 | 0 | 0 | 0 | 0 | |
| 2001 | 1 | 3 | 0 | 2 | 28.82362632 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 660 | 1911 | |
| | 5559 | 5737 | 9292 | 8880 | 7489 | 7173 | 4855 | 3800 | 3923 | |
| | 2801 | 2684 | 2456 | 1644 | 598 | 774 | 215 | 355 | 80 | 42 |
| | 6 | 22 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | |
| 2002 | 1 | 3 | 0 | 2 | 4.003281434 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 | 83 | 632 |
| | 2074 | 6855 | 13290 | 4344 | 8459 | 6963 | 3175 | 3608 | 4927 | |
| | 3119 | 2214 | 1583 | 1856 | 1065 | 946 | 344 | 163 | 128 | 12 |
| | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2003 | 1 | 3 | 0 | 2 | 4.803937721 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 6845 | 9901 | 17114 | |
| | 23691 | 17034 | 15347 | 9762 | 6692 | 5434 | 3443 | 2193 | 1503 | 941 |
| | 785 | 974 | 378 | 378 | 345 | 0 | 0 | 95 | 43 | 43 |
| | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2004 | 1 | 3 | 0 | 2 | 7.045775324 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 535 | 2809 | 6208 | |
| | 12248 | 12365 | 8469 | 13915 | 17395 | 19369 | 4008 | 9317 | 288 | |
| | 1054 | 1196 | 1196 | 566 | 677 | 278 | 343 | 167 | 56 | 56 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2005 | 1 | 3 | 0 | 2 | 12.65036933 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 173 | 785 | |
| | 3157 | 6929 | 9226 | 11041 | 10516 | 6448 | 3185 | 2440 | 1366 | |
| | 1541 | 794 | 494 | 311 | 311 | 92 | 103 | 22 | 46 | 22 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2006 | 1 | 3 | 0 | 2 | 4.483675206 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 106 | 741 | |
| | 1904 | 2328 | 2116 | 635 | 952 | 529 | 423 | 529 | 106 | 106 |
| | 106 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2007 | 1 | 3 | 0 | 2 | 19.21575088 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 18 | 37 | 320 | 883 | |
| | 2096 | 2641 | 5049 | 4236 | 3881 | 2081 | 2455 | 1652 | 906 | 619 |
| | 617 | 373 | 150 | 150 | 113 | 56 | 37 | 75 | 18 | 18 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2008 | 1 | 3 | 0 | 2 | 10.8889255 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 33 | 135 | 542 | 993 |
| | 1095 | 1112 | 1005 | 1319 | 1199 | 1169 | 1206 | 722 | 709 | 446 |
| | 362 | 229 | 120 | 75 | 17 | 10 | 7 | 9 | 2 | 2 |
| | 7 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2009 | 1 | 3 | 0 | 2 | 22.25824477 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 81 | 239 | 690 |
| | 1020 | 1615 | 1163 | 827 | 967 | 510 | 227 | 99 | 183 | 83 |
| | 96 | 39 | 41 | 21 | 20 | 3 | 4 | 10 | 4 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2010 | 1 | 3 | 0 | 2 | 6.885644066 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 633 | 2147 | 3259 | |
| | 5121 | 5036 | 3218 | 3657 | 2543 | 962 | 1850 | 1217 | 755 | |
| | 1023 | 384 | 180 | 178 | 197 | 100 | 50 | 17 | 33 | 0 |
| | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2011 | 1 | 3 | 0 | 2 | 16.01312574 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 293 | 1045 | |
| | 4271 | 4583 | 11310 | 8588 | 9653 | 9609 | 7336 | 3924 | 3130 | |
| | 2508 | 2382 | 1785 | 925 | 934 | 312 | 293 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2012 | 1 | 3 | 0 | 2 | 22.57850729 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 200 | 3001 | 2588 | |
| | 4530 | 5537 | 5034 | 7019 | 4509 | 4023 | 4008 | 1503 | 1589 | 587 |
| | 644 | 71 | 57 | 43 | 71 | 100 | 43 | 43 | 29 | 57 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2000 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 9931 | 34932 | 85866 | |

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|---|---|---|---|---|---|---|---|---|---|---|
| | 126730 | 102836 | 80478 | 93344 | 80934 | 55399 | 52948 | 42094 | 26460 | |
| | 27357 | 23581 | 14295 | 18044 | 10773 | 9903 | 5709 | 5721 | 2345 | |
| | 2595 | 2102 | 888 | 1021 | 548 | 123 | 0 | 0 | 0 | 0 |
| 2001 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 17962 | 19809 | 68920 | |
| | 76594 | 98008 | 109595 | 106857 | 77694 | 57055 | 51658 | 36737 | 35839 | |
| | 22762 | 25834 | 18773 | 13532 | 11068 | 9120 | 11771 | 5733 | 5345 | |
| | 2782 | 1691 | 583 | 296 | 204 | 0 | 61 | 0 | 0 | 0 |
| 2002 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 1015 | 0 | 12469 | 38249 | 46427 | |
| | 62503 | 82461 | 91064 | 86723 | 62163 | 55905 | 46180 | 35998 | 26001 | |
| | 19019 | 14210 | 11129 | 16771 | 11011 | 5447 | 4795 | 4559 | 1825 | |
| | 1260 | 357 | 155 | 109 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2003 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 3455 | 13054 | 58717 | 105655 | 125326 | 180475 | |
| | 119495 | 145456 | 104545 | 130023 | 115806 | 91915 | 93878 | 48742 | 60839 | |
| | 31614 | 33688 | 30691 | 18823 | 13230 | 7960 | 5374 | 5617 | 3275 | |
| | 1356 | 297 | 783 | 112 | 148 | 0 | 0 | 0 | 0 | 0 |
| 2004 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 14 | 13057 | 78811 | 127801 | 124051 | |
| | 227214 | 282390 | 243107 | 188494 | 126685 | 72581 | 82331 | 50633 | 60284 | |
| | 31334 | 19126 | 23996 | 14799 | 10650 | 8569 | 4880 | 2974 | 2675 | |
| | 2567 | 548 | 425 | 149 | 295 | 0 | 149 | 0 | 0 | 0 |
| 2005 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 9903 | 29872 | 97890 | 128022 | |
| | 231750 | 266905 | 344681 | 270532 | 239265 | 169478 | 115269 | 62106 | 67741 | |
| | 61132 | 43591 | 35774 | 25788 | 12456 | 13360 | 8908 | 8053 | 9811 | |
| | 5020 | 2378 | 1365 | 107 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 15689 | 32459 | 179130 | 285704 | 217657 | |
| | 178250 | 196868 | 289998 | 285451 | 263272 | 200874 | 119836 | 99509 | 99674 | |
| | 54522 | 45908 | 23763 | 20607 | 14969 | 13976 | 9653 | 4521 | 3424 | |
| | 2883 | 731 | 201 | 261 | 30 | 0 | 0 | 0 | 0 | 0 |
| 2007 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 181 | 4715 | 39335 | 102714 | |
| | 146272 | 145122 | 164011 | 130859 | 100043 | 99210 | 75929 | 74405 | 55147 | |
| | 46087 | 28056 | 23057 | 18091 | 8715 | 8793 | 4835 | 2707 | 1962 | |
| | 1010 | 399 | 158 | 37 | 59 | 0 | 0 | 0 | 0 | 0 |
| 2008 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 8250 | 28986 | 229758 | 263071 | |
| | 266408 | 237160 | 270810 | 228996 | 142650 | 112385 | 74336 | 66260 | 48853 | |
| | 39689 | 29840 | 28335 | 14420 | 12694 | 9039 | 6821 | 4714 | 1623 | |
| | 1257 | 534 | 261 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2009 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 292 | 473 | 2239 | 10714 | 124925 | 211881 | |
| | 225545 | 193030 | 222613 | 238849 | 155222 | 159658 | 114530 | 84649 | 96257 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 51578 | 36547 | 57472 | 24016 | 21415 | 27466 | 20198 | 12083 | 7551 | 979 |
| | 1765 | 264 | 1004 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2010 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 717 |
| | 0 | 0 | 0 | 0 | 0 | 9811 | 28290 | 169311 | 177571 | |
| | 182105 | 283064 | 251956 | 230227 | 188149 | 186310 | 109212 | 120550 | 71590 | |
| | 62211 | 31544 | 19076 | 62005 | 26388 | 9340 | 8541 | 29128 | 1884 | |
| | 2114 | 182 | 5525 | 6097 | 863 | 0 | 1207 | 0 | 0 | 0 |
| 2011 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 1976 | 13885 | 57121 | 87842 | |
| | 128838 | 187586 | 201447 | 199487 | 194697 | 145447 | 124239 | 92526 | 72471 | |
| | 46869 | 31690 | 19998 | 17624 | 14720 | 7906 | 6114 | 2082 | 1163 | |
| | 1096 | 476 | 148 | 104 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2012 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 1219 | 0 | 1583 | 6518 | 85760 | 172510 | |
| | 140273 | 147895 | 162333 | 180752 | 158490 | 130759 | 107214 | 90638 | 78934 | |
| | 54869 | 35387 | 33085 | 17714 | 15170 | 9374 | 8114 | 4147 | 2313 | |
| | 1540 | 1134 | 282 | 451 | 29 | 27 | 0 | 0 | 0 | 0 |
| 2013 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 146 | 0 | 1504 | 29667 | 88507 | |
| | 149070 | 146130 | 123170 | 140677 | 127136 | 116842 | 99156 | 103818 | 89197 | |
| | 59004 | 65851 | 64579 | 53482 | 37744 | 23884 | 32512 | 14996 | 9001 | |
| | 2640 | 2073 | 176 | 1566 | 0 | 1115 | 0 | 0 | 0 | 0 |
| 2014 | 1 | 4 | 0 | 2 | 40.45080885 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 3076 | 3620 | 33532 | 68262 | |
| | 74871 | 82684 | 51365 | 61292 | 39844 | 38109 | 29929 | 39911 | 32298 | |
| | 30016 | 21467 | 16797 | 16261 | 8387 | 5579 | 8995 | 3027 | 642 | 773 |
| | 0 | 198 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1988 | 1 | -8 | 0 | 0 | 2.137019948 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58885 | 0 | |
| | 76121 | 20143 | 0 | 0 | 0 | 20143 | 0 | 39616 | 0 | |
| | 15434 | 15434 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1989 | 1 | -8 | 0 | 0 | 1.068509974 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 22235 | 0 | 22235 | 0 | |
| | 11011 | 0 | 0 | 0 | 0 | 22235 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1990 | 1 | -8 | 0 | 0 | 2.849359931 | | 0 | 0 | 32733 | |
| | 98199 | 120021 | 96615 | 222797 | 345962 | 107244 | 0 | 0 | 18463 | 0 |
| | 6106 | 0 | 6106 | 23906 | 0 | 17254 | 17254 | 17254 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1991 | 1 | 8 | 0 | 0 | 6.767229836 | | 0 | 0 | 0 | 0 |
| | 0 | 304624 | 1719409 | 1119677 | 531390 | 110365 | 162253 | 126980 | 45607 | |
| | 16723 | 16703 | 10625 | 0 | 16885 | 0 | 5352 | 30272 | 16885 | 0 |
| | 0 | 0 | 0 | 0 | 16885 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

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|---|---|---|---|---|---|---|---|---|---|---|
| 1992 | 1 | 8 | 0 | 0 | 8.191909801 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 63079 | 287513 | 510612 | 638459 | 530944 | 309090 | |
| | 78328 | 79289 | 26490 | 42201 | 0 | 0 | 15138 | 5247 | 0 | |
| | 10494 | 0 | 0 | 0 | 15853 | 0 | 0 | 5247 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1993 | 1 | 8 | 0 | 0 | 7.479569819 | | 0 | 0 | 0 | 0 |
| | 0 | 5551 | 38106 | 121556 | 170213 | 347228 | 237317 | 321637 | 247396 | |
| | 266632 | 204261 | 133186 | 158039 | 17036 | 0 | 0 | 14798 | 0 | 0 |
| | 16962 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1994 | 1 | 8 | 0 | 0 | 6.767229836 | | 0 | 0 | 0 | |
| | 18458 | 0 | 5108 | 71094 | 30647 | 64428 | 59303 | 79319 | 77545 | |
| | 139680 | 69887 | 157500 | 113756 | 52799 | 63325 | 37992 | 18996 | 18996 | 0 |
| | 0 | 0 | 0 | 18996 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1995 | 1 | 8 | 0 | 0 | 6.054889853 | | 0 | 0 | 0 | 0 |
| | 0 | 65628 | 182886 | 191483 | 118285 | 68606 | 94174 | 58735 | 62595 | |
| | 72147 | 8650 | 15487 | 10698 | 0 | 20034 | 15487 | 0 | 0 | |
| | 17299 | 0 | 0 | 0 | 19546 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1996 | 1 | 8 | 0 | 0 | 9.260419775 | | 0 | 0 | 0 | 0 |
| | 10096 | 71187 | 198585 | 162449 | 209883 | 102756 | 137006 | 50619 | 60715 | 0 |
| | 46710 | 0 | 25805 | 38406 | 67089 | 0 | 0 | 0 | 21710 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 21222 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1997 | 1 | 8 | 0 | 0 | 11.04126973 | | 0 | 0 | 0 | 0 |
| | 0 | 52420 | 172277 | 157267 | 364320 | 311146 | 265276 | 102658 | 136668 | |
| | 71024 | 62096 | 42836 | 3198 | 27070 | 0 | 36775 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 12568 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 1998 | 1 | 8 | 0 | 0 | 13.53445967 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 10254 | 42156 | 199875 | 248028 | 445903 | 469290 | 406992 | |
| | 271169 | 77307 | 56211 | 109682 | 49306 | 13620 | 13620 | 0 | 25037 | |
| | 27240 | 13620 | 13620 | 0 | 0 | 0 | 11417 | 0 | 26697 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 1999 | 1 | 8 | 0 | 0 | 13.17828968 | | 0 | 0 | 0 | 0 |
| | 18433 | 15128 | 83225 | 167646 | 146928 | 90595 | 177558 | 153662 | 195992 | |
| | 214407 | 105858 | 79810 | 47256 | 78075 | 7863 | 17639 | 0 | 9059 | 0 |
| | 9059 | 0 | 15018 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 9059 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2000 | 1 | 8 | 0 | 0 | 12.82211969 | | 0 | 0 | 0 | |
| | 18644 | 65257 | 62040 | 125296 | 417455 | 440978 | 309620 | 338993 | 204879 | |
| | 181687 | 95559 | 108703 | 70962 | 23940 | 21506 | 14766 | 0 | 24695 | 0 |
| | 14306 | 0 | 9307 | 13096 | 0 | 9307 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2001 | 1 | 8 | 0 | 0 | 13.89062966 | | 0 | 0 | 0 | 0 |
| | 0 | 59740 | 413187 | 767358 | 518235 | 300493 | 248669 | 158653 | 247952 | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 66992 | 125042 | 43191 | 37193 | 10236 | 24597 | 0 | 14837 | 24648 | |
| | 13083 | 52462 | 0 | 0 | 12053 | 0 | 0 | 12053 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2002 | 1 | 8 | 0 | 0 | 15.67147962 | | 0 | 0 | 0 | 0 |
| | 0 | 10739 | 67655 | 197986 | 381355 | 832988 | 623508 | 439729 | 380196 | |
| | 270697 | 189153 | 102893 | 112164 | 50660 | 44892 | 16171 | 27189 | 21612 | |
| | 15932 | 12167 | 0 | 27484 | 12167 | 25511 | 0 | 0 | 9579 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2003 | 1 | 8 | 0 | 0 | 14.60296965 | | 0 | 0 | 0 | 0 |
| | 22663 | 13218 | 161174 | 795498 | 720874 | 802826 | 1375758 | 1218315 | 1251975 | |
| | 623889 | 464021 | 274147 | 207776 | 203176 | 72670 | 136756 | 185043 | 89875 | |
| | 52508 | 26254 | 27514 | 0 | 13127 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2004 | 1 | 8 | 0 | 0 | 15.67147962 | | 0 | 0 | 0 | 0 |
| | 0 | 2692 | 0 | 122879 | 403673 | 714884 | 730822 | 416792 | 287359 | |
| | 324966 | 129278 | 137035 | 115126 | 31042 | 39375 | 29156 | 18125 | 9347 | 0 |
| | 61811 | 2692 | 2692 | 9347 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 9347 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2005 | 1 | 8 | 0 | 0 | 14.24679965 | | 0 | 0 | 0 | 0 |
| | 15565 | 0 | 210994 | 418270 | 315562 | 267295 | 354515 | 215506 | 225666 | |
| | 181642 | 106404 | 138927 | 146271 | 109108 | 98370 | 34142 | 9487 | 52772 | |
| | 51553 | 21543 | 10751 | 10751 | 0 | 0 | 10223 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2006 | 1 | 8 | 0 | 0 | 12.82211969 | | 0 | 0 | 0 | 0 |
| | 0 | 9814 | 197122 | 866753 | 893641 | 788190 | 1120577 | 531053 | 311464 | |
| | 137430 | 190156 | 96298 | 71441 | 84223 | 86273 | 31873 | 22996 | 25308 | |
| | 19628 | 9814 | 3032 | 0 | 9814 | 0 | 0 | 11099 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2007 | 1 | 8 | 0 | 0 | 11.75360971 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 47391 | 407308 | 386452 | 394375 | 609358 | 479157 | 314000 | |
| | 219897 | 169994 | 170481 | 111148 | 80056 | 57131 | 123245 | 25737 | 18311 | 0 |
| | 11929 | 0 | 10662 | 5331 | 19351 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2008 | 1 | 8 | 0 | 0 | 14.24679965 | | 0 | 0 | 0 | 0 |
| | 10729 | 52876 | 128066 | 266412 | 229414 | 731914 | 1661470 | 931172 | 880632 | |
| | 758996 | 224765 | 208707 | 112521 | 79753 | 13259 | 72807 | 14967 | 28587 | |
| | 19628 | 0 | 0 | 0 | 42166 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2009 | 1 | 8 | 0 | 0 | 9.260419775 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 21413 | 77225 | 253598 | 386804 | 279160 | 234313 | 217371 | |
| | 238780 | 238652 | 168707 | 110777 | 82775 | 99010 | 56555 | 38480 | 0 | |
| | 21413 | 12158 | 0 | 0 | 0 | 12249 | 0 | 0 | 15256 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2010 | 1 | 8 | 0 | 0 | 10.68509974 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 20661 | 79020 | 106240 | 232673 | 118288 | 117886 | 316567 | |
| | 207944 | 97593 | 110810 | 191255 | 62479 | 14580 | 62090 | 0 | 22711 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 14580 | 0 | 14580 | 0 | 0 | 0 | 0 | 14580 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2011 | 1 | 8 | 0 | 0 | 9.616589767 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 13881 | 0 | 45451 | 95055 | 204438 | 227355 | 208472 | |
| | 118040 | 120428 | 68027 | 88143 | 90627 | 60054 | 47411 | 9869 | 0 | |
| | 33403 | 36907 | 46184 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2012 | 1 | 8 | 0 | 0 | 8.904249784 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 29922 | 15009 | 161369 | 400458 | 247182 | 200887 | 183315 | |
| | 84361 | 197280 | 103031 | 86442 | 77382 | 31957 | 43195 | 19956 | 39781 | |
| | 11851 | 40610 | 19956 | 20305 | 20305 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 2013 | 1 | 8 | 0 | 0 | 6.767229836 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 42825 | 113195 | 62476 | 113528 | 127750 | 96177 | 135950 | |
| | 70592 | 33717 | 44279 | 61410 | 11237 | 17382 | 17382 | 48087 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 2014 | 1 | 8 | 0 | 0 | 7.123399827 | | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 68544 | 62919 | 72216 | 235064 | |
| | 138177 | 171873 | 205729 | 78929 | 0 | 0 | 0 | 38360 | 25884 | 0 |
| | 0 | 0 | 0 | 28103 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |

# -------------------------------------------

# AGE COMPOSITION SET-UP

# -------------------------------------------

17 #_N_age_bins

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

# -------------------------------------------

# AGEING ERROR

# -------------------------------------------

1 #_N_ageerror_definitions

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | 1.5 | 2.5 | 3.5 | 4.5 | 5.5 | 6.5 | 7.5 | 8.5 | 9.5 | 10.5 |
| | 11.5 | 12.5 | 13.5 | 14.5 | 15.5 | 16.5 | 17.5 | 18.5 | 19.5 | 20.5 |
| | 21.5 | 22.5 | 23.5 | 24.5 | 25.5 | 26.5 | 27.5 | 28.5 | 29.5 | 30.5 |
| 0.05 | 0.15 | 0.25 | 0.35 | 0.45 | 0.55 | 0.65 | 0.75 | 0.85 | 0.95 | 1.05 |
| | 1.15 | 1.25 | 1.35 | 1.45 | 1.55 | 1.65 | 1.75 | 1.85 | 1.95 | 2.05 |
| | 2.15 | 2.25 | 2.35 | 2.45 | 2.55 | 2.65 | 2.75 | 2.85 | 2.95 | 3.05 |

# -------------------------------------------

# AGE COMPOSITION DATA

# -------------------------------------------

116 #_N_Agecomp_obs

1 #_Lbin_method: 1=poplenbins; 2=datalenbins; 3=lengths (set to 3 for cond'l age-at-length?)

0 #_combine males into females at or below this bin number

#Yr Seas Flt/Svy Gender Part Ageerr Lbin_lo Lbin_hi Nsamp datavector(female-male)

1985 1 1 0 0 1 -1 -1 31.12561412 0
0 65 11844 30828 6121 9692 1240 3914 9713
2454 2581 1320 343 841 286 892

1986 1 1 0 0 1 -1 -1 10.92960496 0
0 0 15673 20303 18759 3453 7662 704 3197
10503 1833 1403 2889 1222 1688 3595

1987 1 1 0 0 1 -1 -1 26.84881218 0
0 0 439 30263 58458 13753 2095 2437 656 726
5731 2565 1889 761 817 2796

1988 1 1 0 0 1 -1 -1 8.316003773 0
0 0 1930 20862 54472 41710 12803 1721 2315 780
451 5503 2024 1312 801 2589

1989 1 1 0 0 1 -1 -1 71.04243223 0
0 33394 5411 1223 7659 43911 26891 9002 3076
2901 1878 2896 8914 1499 1286 3436

1990 1 1 0 0 1 -1 -1 31.60081434 0
0 0 3035 2503 3770 16047 31459 21020 5042
2186 1463 846 1100 4837 353 2703

1991 1 1 0 0 1 -1 -1 68.19123094 0
0 1533 6933 36938 2381 1283 6576 18064 16248
7033 589 2617 2321 480 6659 3674

1992 1 1 0 0 1 -1 -1 47.99522178 0
0 0 15982 55550 33557 1183 796 1956 4750
4762 1230 451 433 139 497 3202

1993 1 1 0 0 1 -1 -1 51.7968235 0
0 0 657 81429 65981 21858 1351 627 1796
4803 3920 1500 710 735 475 2347

1994 1 1 0 0 1 -1 -1 67.0032304 0
0 2 1328 30970 369416 41472 16079 1130 294
2282 5842 4387 1596 650 646 3717

1995 1 1 0 0 1 -1 -1 27.3240124 0
0 0 5599 37064 81529 334815 17932 6931 702 415
1046 3440 3215 1846 2699 2680

1996 1 1 0 0 1 -1 -1 38.72881757 0
0 191 11473 43831 31632 64618 173733 8235 3622 216
315 454 1881 1688 534 1784

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 32.55121477 | 0 |
| | 0 | 0 | 2490 | 8501 | 64000 | 45238 | 39229 | 145407 8105 | |
| | 4456 | 632 | 640 | 294 | 2689 | 1712 | 2235 | | |
| 1998 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 39.20401779 | 0 |
| | 0 | 0 | 1103 | 44997 | 49461 | 69489 | 25366 | 15136 41057 | |
| | 2671 | 860 | 96 | 96 | 385 | 623 | 811 | | |
| 1999 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 51.7968235 | 0 |
| | 0 | 241 | 82 | 80414 | 146338 | 43841 | 28582 | 9612 6192 | |
| | 18072 | 1112 | 729 | 40 | 270 | 97 | 830 | | |
| 2000 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 93.85204258 | 0 |
| | 0 | 0 | 9528 | 2584 | 151515 | 72747 | 11772 | 11046 4992 | |
| | 4636 | 8323 | 818 | 184 | 14 | 55 | 643 | | |
| 2001 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 67.95363083 | 0 |
| | 0 | 614 | 11085 | 92408 | 29064 | 105169 | 25329 | 7388 8742 | |
| | 5811 | 8136 | 7522 | 804 | 768 | 69 | 759 | | |
| 2002 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 8.553603881 | 0 |
| | 0 | 338 | 11495 | 43605 | 240476 | 16779 | 67647 | 16021 7450 | |
| | 8022 | 2682 | 3842 | 10166 | 645 | 193 | 568 | | |
| 2003 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 36.5904166 | 0 |
| | 0 | 0 | 5698 | 75254 | 70415 | 154267 | 8719 | 38901 14072 | |
| | 4789 | 3196 | 2260 | 1599 | 3937 | 937 | 756 | | |
| 2004 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 22.33441013 | 0 |
| | 0 | 0 | 4406 | 38270 | 214112 | 76652 | 95133 | 2733 12227 | |
| | 4039 | 1583 | 994 | 802 | 263 | 1029 | 221 | | |
| 2005 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 18.05760819 | 0 |
| | 0 | 0 | 18910 | 135210 | 89202 | 124422 | 33796 | 30175 3112 | |
| | 7357 | 1390 | 1123 | 363 | 173 | 650 | 842 | | |
| 2006 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 10.45440474 | 0 |
| | 0 | 0 | 20497 | 141335 | 144890 | 54069 | 56281 | 17344 24148 | |
| | 2207 | 3475 | 2277 | 859 | 210 | 188 | 1433 | | |
| 2007 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 43.95601994 | 0 |
| | 0 | 0 | 955 | 33606 | 169272 | 96625 | 44423 | 34061 12877 | |
| | 14366 | 11530 | 4527 | 1621 | 11 | 254 | 428 | | |
| 2008 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 21.14640959 | 0 |
| | 0 | 0 | 9338 | 110875 | 296983 | 139083 | 47617 | 19838 17332 | |
| | 8660 | 6128 | 852 | 793 | 988 | 317 | 824 | | |
| 2009 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 38.49121746 | 0 |
| | 0 | 0 | 2659 | 73056 | 169969 | 172602 | 64997 | 19002 14443 | |
| | 9064 | 8631 | 3610 | 2235 | 1302 | 0 | 249 | | |
| 2010 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 17.34480787 | 0 |
| | 0 | 0 | 319 | 77100 | 155258 | 118179 | 78410 | 28938 11821 | |
| | 6979 | 6043 | 2645 | 2083 | 2273 | 534 | 1663 | | |
| 2011 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 18.53280841 | 0 |
| | 0 | 0 | 845 | 28630 | 124625 | 92582 | 71094 | 54338 31775 | |
| | 10438 | 11227 | 6347 | 2933 | 2203 | 675 | 1692 | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 23.99761089 | | 0 |
| | 0 | 0 | 1620 | 14135 | 166965 | 219883 | 61319 | 39609 | 31669 | |
| | 15268 | 9427 | 4092 | 3864 | 2546 | 538 | 930 | | | |
| 2013 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 2.613601186 | | 0 |
| | 0 | 0 | 0 | 45016 | 60547 | 182858 | 117821 | 33448 | 30222 | |
| | 22727 | 17473 | 11825 | 2908 | 2687 | 2429 | 2133 | | | |
| 2014 | 1 | 1 | 0 | 0 | 1 | -1 | -1 | 24.71041121 | | 0 |
| | 0 | 0 | 6888 | 33495 | 118368 | 66823 | 131890 | 88847 | 41481 | |
| | 28525 | 32526 | 20835 | 5954 | 1978 | 2186 | 1690 | | | |
| 1985 | 1 | -2 | 0 | 0 | 1 | -1 | -1 | 0.795510267 | | 0 |
| | 0 | 0 | 9225 | 11491 | 3441 | 5902 | 891 | 1113 | 5133 | |
| | 1176 | 694 | 913 | 46 | 122 | 134 | 936 | | | |
| 1986 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 8.432408826 | | 0 |
| | 0 | 0 | 577 | 8939 | 3343 | 933 | 2354 | 358 | 758 | |
| | 5428 | 960 | 871 | 953 | 573 | 645 | 1307 | | | |
| 1987 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 9.546123199 | | 0 |
| | 0 | 0 | 108 | 1052 | 3719 | 2132 | 581 | 477 | 432 | 523 |
| | 1578 | 845 | 211 | 167 | 179 | 1187 | | | | |
| 1988 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 14.63738891 | | 0 |
| | 0 | 0 | 33 | 1751 | 13389 | 5067 | 2398 | 551 | 1014 | 209 |
| | 456 | 1863 | 895 | 715 | 523 | 977 | | | | |
| 1989 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 10.50073552 | | 0 |
| | 0 | 22 | 0 | 538 | 8171 | 36046 | 1842 | 371 | 104 | 208 |
| | 58 | 215 | 1040 | 115 | 87 | 334 | | | | |
| 1990 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 39.61641128 | | 0 |
| | 0 | 0 | 305 | 82 | 185 | 1284 | 3456 | 2407 | 897 | 357 |
| | 369 | 193 | 242 | 1261 | 81 | 828 | | | | |
| 1991 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 44.70767698 | | 0 |
| | 0 | 0 | 131 | 8420 | 471 | 177 | 792 | 4927 | 4024 | |
| | 1842 | 89 | 1229 | 1685 | 367 | 4831 | 2887 | | | |
| 1992 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 56.79943304 | | 0 |
| | 0 | 0 | 1195 | 5473 | 5267 | 294 | 269 | 518 | 1193 | |
| | 1633 | 563 | 130 | 195 | 169 | 143 | 1411 | | | |
| 1993 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 66.50465829 | | 0 |
| | 0 | 16 | 526 | 11652 | 11776 | 7569 | 590 | 289 | 931 | |
| | 3941 | 3344 | 1367 | 663 | 703 | 643 | 3789 | | | |
| 1994 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 45.6622893 | | 0 |
| | 0 | 0 | 71 | 4059 | 119784 | 18540 | 9393 | 943 | 173 | |
| | 1754 | 5414 | 5570 | 1205 | 639 | 274 | 2790 | | | |
| 1995 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 33.88873736 | | 0 |
| | 0 | 0 | 486 | 6943 | 21979 | 97509 | 7380 | 5313 | 480 | 699 |
| | 831 | 5684 | 3696 | 1936 | 840 | 4733 | | | | |
| 1996 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 26.41094085 | | 0 |
| | 0 | 0 | 210 | 8804 | 12487 | 15338 | 57127 | 4566 | 4979 | 127 |
| | 510 | 364 | 2521 | 1573 | 1300 | 2346 | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 24.97902237 | | 0 |
| | 0 | 59 | 454 | 3102 | 15613 | 11415 | 8287 | 50819 | 2853 | |
| | 1635 | 557 | 354 | 243 | 2195 | 1065 | 1570 | | | |
| 1998 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 23.06979773 | | 0 |
| | 0 | 0 | 3676 | 8366 | 10920 | 22630 | 10485 | 6452 | 28231 | |
| | 2949 | 1091 | 138 | 196 | 793 | 1381 | 1254 | | | |
| 1999 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 29.27477781 | | 0 |
| | 0 | 479 | 255 | 25158 | 37306 | 13589 | 13697 | 5288 | 5001 | |
| | 20522 | 1669 | 2038 | 247 | 777 | 315 | 3314 | | | |
| 2000 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 37.70718664 | | 0 |
| | 0 | 0 | 421 | 294 | 19380 | 12402 | 2696 | 3285 | 1476 | |
| | 1248 | 4697 | 330 | 258 | 16 | 88 | 559 | | | |
| 2001 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 65.39094391 | | 0 |
| | 0 | 54 | 471 | 7385 | 1392 | 17864 | 7702 | 2027 | 3239 | |
| | 1685 | 1761 | 3774 | 440 | 301 | 27 | 420 | | | |
| 2002 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 78.75551639 | | 0 |
| | 0 | 30 | 729 | 2609 | 14173 | 2686 | 17358 | 7757 | 2621 | |
| | 5179 | 1463 | 1766 | 3687 | 322 | 101 | 180 | | | |
| 2003 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 37.54808458 | | 0 |
| | 0 | 0 | 80 | 7166 | 7917 | 25014 | 2167 | 10164 | 3262 | |
| | 1473 | 982 | 796 | 681 | 1704 | 186 | 166 | | | |
| 2004 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 24.1835121 | | 0 |
| | 0 | 0 | 279 | 1697 | 13884 | 8601 | 17310 | 2398 | 6365 | |
| | 3626 | 1181 | 1189 | 1172 | 406 | 2243 | 143 | | | |
| 2005 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 20.20596077 | | 0 |
| | 0 | 0 | 621 | 2669 | 5059 | 14699 | 5529 | 6985 | 589 | |
| | 5697 | 1845 | 236 | 1307 | 33 | 189 | 606 | | | |
| 2006 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 13.84187864 | | 0 |
| | 0 | 0 | 44 | 16121 | 35990 | 13714 | 22306 | 5794 | 12717 | |
| | 1644 | 3135 | 1258 | 305 | 358 | 1016 | 734 | | | |
| 2007 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 8.750612933 | | 0 |
| | 0 | 0 | 22 | 6611 | 31578 | 28396 | 14511 | 17834 | 8499 | |
| | 10951 | 5163 | 3121 | 5119 | 85 | 344 | 485 | | | |
| 2008 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 15.27379712 | | 0 |
| | 0 | 0 | 199 | 5010 | 27319 | 42071 | 21561 | 12265 | 12566 | |
| | 5458 | 4960 | 1372 | 1032 | 3431 | 198 | 992 | | | |
| 2009 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 6.045878026 | | 0 |
| | 0 | 0 | 315 | 8415 | 19843 | 33661 | 25695 | 12017 | 9320 | |
| | 5021 | 5371 | 4748 | 811 | 1075 | 0 | 0 | | | |
| 2010 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 8.114204719 | | 0 |
| | 0 | 0 | 814 | 7029 | 45515 | 54766 | 39716 | 15835 | 5147 | |
| | 2395 | 2910 | 706 | 522 | 359 | 81 | 277 | | | |
| 2011 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 5.409469813 | | 0 |
| | 0 | 0 | 8 | 5209 | 11538 | 24667 | 19293 | 16668 | 13032 | |
| | 4947 | 6066 | 2695 | 1941 | 2187 | 522 | 657 | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2012 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 7.955102666 | | 0 |
| | 0 | 0 | 91 | 1695 | 18362 | 28593 | 23507 | 22946 | 17909 | |
| | 10199 | 7725 | 2994 | 2672 | 2158 | 596 | 820 | | | |
| 2013 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 14.47828685 | | 0 |
| | 0 | 0 | 0 | 1187 | 6979 | 35135 | 32251 | 18057 | 14762 | |
| | 10333 | 10543 | 6106 | 3730 | 2886 | 1957 | 1938 | | | |
| 2014 | 1 | 2 | 0 | 0 | 1 | -1 | -1 | 6.523184186 | | 0 |
| | 0 | 0 | 980 | 4985 | 26081 | 20743 | 39548 | 28357 | 15323 | |
| | 12440 | 12413 | 8018 | 4889 | 1976 | 1673 | 1322 | | | |
| 1996 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 48.5821764 | | 0 |
| | 0 | 0 | 0 | 289 | 796 | 3892 | 71666 | 5583 | 1648 | 21 |
| | 334 | 154 | 622 | 485 | 199 | 559 | | | | |
| 1998 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 245 | 5979 | 11845 | 8553 | 8135 | 25138 | |
| | 2517 | 345 | 93 | 53 | 119 | 893 | 569 | | | |
| 1999 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 2983 | 18409 | 15106 | 27147 | 13818 | 18060 | |
| | 43097 | 4389 | 1686 | 324 | 387 | 308 | 2689 | | | |
| 2000 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 15 | 60 | 2476 | 7587 | 3270 | 4497 | 1459 | |
| | 2830 | 7077 | 634 | 174 | 39 | 96 | 420 | | | |
| 2001 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 179 | 899 | 19777 | 20290 | 7042 | 5268 | |
| | 3124 | 2845 | 9666 | 857 | 636 | 123 | 261 | | | |
| 2002 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 3 | 37 | 2380 | 1578 | 24087 | 9693 | 6297 | |
| | 5978 | 450 | 5664 | 9215 | 0 | 0 | 530 | | | |
| 2003 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 2689 | 10619 | 39257 | 7971 | 40551 | 10293 | |
| | 3162 | 3254 | 618 | 169 | 4043 | 77 | 281 | | | |
| 2004 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 7 | 1254 | 12502 | 14372 | 48109 | 3199 | 20694 | |
| | 8010 | 353 | 1797 | 1141 | 91 | 968 | 18 | | | |
| 2005 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 114 | 2103 | 15321 | 14397 | 17408 | 1907 | |
| | 5182 | 0 | 1831 | 99 | 0 | 40 | 599 | | | |
| 2006 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 227 | 567 | 608 | 4076 | 1423 | 3085 | 254 |
| | 176 | 111 | 0 | 0 | 0 | 53 | | | | |
| 2007 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 0 | 385 | 2517 | 7038 | 5387 | 6833 | 2795 | |
| | 1900 | 631 | 807 | 12 | 37 | 19 | 121 | | | |
| 2008 | 1 | 3 | 0 | 0 | 1 | -1 | -1 | 36.25535552 | | 0 |
| | 0 | 0 | 45 | 445 | 1540 | 3279 | 1787 | 1412 | 1557 | 755 |
| | 960 | 30 | 183 | 490 | 0 | 40 | | | | |

2009 1 3 0 0 1 -1 -1 36.25535552 0
0 0 0 90 635 2175 2596 843 784 168
298 173 11 169 0 0

2010 1 3 0 0 1 -1 -1 36.25535552 0
0 0 9 36 1741 5546 8261 6678 4755 403
3786 152 294 313 551 50

2011 1 3 0 0 1 -1 -1 36.25535552 0
0 0 0 255 4397 10231 13640 15909 13642
4424 4233 2773 1688 1003 264 423

2012 1 3 0 0 1 -1 -1 36.25535552 0
0 0 0 391 4461 10776 10016 8757 5789
2741 1134 290 433 143 127 226

2000 1 4 0 0 1 -1 -1 33.61582887 0
0 0 0 9440 222655 273687 139562 79413 47258
43924 49293 20207 10767 4925 4927 10901

2001 1 4 0 0 1 -1 -1 33.61582887 0
0 0 2651 55640 47734 298773 211740 90962 44742
21074 39908 36007 17787 4394 6838 8034

2002 1 4 0 0 1 -1 -1 33.61582887 0
0 0 8114 73892 125531 90294 236147 86108 31151
23025 17823 14760 15912 9752 3743 1553

2003 1 4 0 0 1 -1 -1 33.61582887 0
0 2611 10800 364427 241694 318445 96562 254050 114829
57883 26223 19879 14232 18088 6600 4028

2004 1 4 0 0 1 -1 -1 33.61582887 0
0 3 4 80483 627951 438799 297961 65297 131612
77533 25416 14848 14254 13528 7628 5270

2005 1 4 0 0 1 -1 -1 33.61582887 0
0 0 24195 77794 253455 735235 352182 443765 39104
161572 69617 26314 17996 19238 17974 22718

2006 1 4 0 0 1 -1 -1 33.61582887 0
0 3138 74600 131099 564668 361515 841651 146484 253945
13655 132370 84910 22068 6648 6999 16069

2007 1 4 0 0 1 -1 -1 33.61582887 0
0 0 5307 73224 135809 460583 124606 139879 79978
69214 33191 65868 68599 11131 9034 5486

2008 1 4 0 0 1 -1 -1 33.61582887 0
0 1208 79917 175402 545960 401231 456312 143871 147881
40719 57341 17882 35092 12669 5518 6091

2009 1 4 0 0 1 -1 -1 33.61582887 0
0 315 23355 119979 282754 473020 238022 408951 100487
200417 73570 37114 32657 55506 33537 23529

2010 1 4 0 0 1 -1 -1 33.61582887 0
0 717 1962 39409 221063 515711 411737 437222 200328
172430 109342 75421 46461 21880 4806 16480

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2011 | 1 | 4 | 0 | 0 | 1 | -1 | -1 | 33.61582887 | | 0 |
| | 0 | 0 | 0 | 6087 | 172404 | 252236 | 312186 | 303804 | 314164 | |
| | 125800 | 89188 | 34465 | 28352 | 12942 | 5585 | 337 | | | |
| 2012 | 1 | 4 | 0 | 0 | 1 | -1 | -1 | 33.61582887 | | 0 |
| | 0 | 0 | 406 | 14357 | 65157 | 262593 | 346334 | 308183 | 264012 | |
| | 214803 | 83939 | 50701 | 24784 | 8470 | 3191 | 1583 | | | |
| 2013 | 1 | 4 | 0 | 0 | 1 | -1 | -1 | 33.61582887 | | 0 |
| | 0 | 0 | 60 | 569 | 52216 | 96064 | 609903 | 377156 | 367869 | |
| | 481247 | 245982 | 158757 | 43008 | 21825 | 14812 | 11520 | | | |
| 2014 | 1 | 4 | 0 | 0 | 1 | -1 | -1 | 33.61582887 | | 0 |
| | 0 | 0 | 603 | 6846 | 11735 | 123435 | 149938 | 133129 | 143241 | |
| | 39242 | 39476 | 12679 | 7347 | 3067 | 198 | 0 | | | |
| 1986 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 12.66472795 | | 0 |
| | 0 | 0.27 | 4.26 | 1.31 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1987 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 14.35335834 | | 0 |
| | 0 | 0.05 | 0.28 | 2.27 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1989 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 17.73061913 | | 0 |
| | 0 | 6.68 | 0.37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1990 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 20.26356472 | | 0 |
| | 0 | 2.81 | 1.15 | 0.02 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1991 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 15.19767354 | | 0 |
| | 0 | 3.08 | 0.21 | 0.03 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1992 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | | 0 |
| | 0 | 0.95 | 18.59 | 0.16 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1993 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | | 0 |
| | 0 | 6.65 | 3.59 | 4.39 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1994 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | | 0 |
| | 0 | 3.33 | 1.84 | 0.29 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1995 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 30.39534708 | | 0 |
| | 0 | 4.83 | 4.69 | 0.72 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1996 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 28.70671669 | | 0 |
| | 0 | 5.52 | 0.43 | 0.11 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |
| 1997 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | | 0 |
| | 0 | 33.62 | 4.52 | 0.06 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1998 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 30.39534708 | 0 |
| | 0 | 1.22 | 5.5 | 0.61 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 1999 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 27.86240149 | 0 |
| | 0 | 19.37 | 0.67 | 0.87 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2000 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 30.39534708 | 0 |
| | 0 | 6.07 | 11.35 | 0.03 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2001 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 27.86240149 | 0 |
| | 0 | 34.42 | 3.92 | 1.57 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2002 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 30.39534708 | 0 |
| | 0 | 7.42 | 3.87 | 0.4 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2003 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | 0 |
| | 0 | 8.37 | 4.6 | 0.59 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2005 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | 0 |
| | 0 | 13.12 | 7.98 | 0.84 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2006 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 28.70671669 | 0 |
| | 0 | 9.51 | 9.21 | 1.02 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2007 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 28.70671669 | 0 |
| | 0 | 3.42 | 1.78 | 0.3 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2008 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 30.39534708 | 0 |
| | 0 | 18.52 | 6.66 | 0.34 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2009 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | 0 |
| | 0 | 13.25 | 6.25 | 0.33 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2011 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | 0 |
| | 0 | 2.25 | 1.39 | 0.42 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2013 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 29.55103189 | 0 |
| | 0 | 1.34 | 0.08 | 0.1 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| 2014 | 1 | 7 | 0 | 0 | 1 | -1 | -1 | 28.70671669 | 0 |
| | 0 | 1.17 | 1.02 | 0.11 | 0 | 0 | 0 | 0 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 | | | |

# --------------------------------

# MEAN LENGTH OR BODYWEIGHT-AT-AGE

# --------------------------------

0 #_N_MeanSize-at-Age_obs

#Yr Seas Flt/Svy Gender Part Ageerr Ignore datavector(female-male)

# samplesize(female-male)

# --------------------------------

# ENVIRONMENTAL DATA

# --------------------------------

0 #_N_environ_variables

0 #_N_environ_obs

# --------------------------------

# GENERALIZED SIZE COMPOSTION DATA

# --------------------------------

0 # N WtFreq methods

# --------------------------------

# TAG-RECAPTURE

# --------------------------------

0 # Do_Tags (0=omit, 1=enter conditional data per manual)

# --------------------------------

# STOCK COMPOSITION

# --------------------------------

0 # no morphcomp data

999 # end of data file marker

## Appendix 3

Content of Stock Synthesis Starter file (Starter.SS) selected as the final accepted assessment model at IBP-Bass 2 2016.

# SS3 V3.24f # Bass-47 IBPBass2 final proposed assessment

Bass47.dat

Bass47.ctl

0 # 0=use init values in control file; 1=use ss3.par

1 # run display detail (0,1,2)

1 # detailed age-structured reports in REPORT.SSO (0,1)

0 # write detailed checkup.sso file (0,1)

4 # write parm values to ParmTrace.sso (0=no,1=good,active; 2=good,all; 3=every_iter,all_parms; 4=every,active)

1 # write to cumreport.sso (0=no,1=like&timeseries; 2=add survey fits)

1 # Include prior_like for non-estimated parameters (0,1)

1 # Use Soft Boundaries to aid convergence (0,1) (recommended)

2 # Number of bootstrap datafiles to produce

8 # Turn off estimation for parameters entering after this phase

10 # MCMC burn interval

2 # MCMC thin interval

0 # jitter initial parm value by this fraction

-1 # min yr for sdreport outputs (-1 for styr)

-1 # max yr for sdreport outputs (-1 for endyr; -2 for endyr+Nforecastyrs

0 # N individual STD years

#vector of year values

0.0001 #0.0001 # final convergence criteria (e.g. 1.0e-04)

0 # retrospective year relative to end year (e.g. -4)

0 # min age for calc of summary biomass

2 # Depletion basis: denom is: 0=skip; 1=rel X*B0; 2=rel X*Bmsy; 3=rel X*B_styr

0.4 # Fraction (X) for Depletion denominator (e.g. 0.4)

2 # SPR_report_basis: 0=skip; 1=(1-SPR)/(1-SPR_tgt); 2=(1-SPR)/(1-SPR_MSY); 3=(1-SPR)/(1-SPR_Btarget); 4=rawSPR

2 # F_report_units: 0=skip; 1=exploitation(Bio); 2=exploitation(Num); 3=sum(Frates)

#COND 3 10 #_min and max age over which average F will be calculated with F_reporting=4

0 # F_report_basis: 0=raw; 1=F/Fspr; 2=F/Fmsy ; 3=F/Fbtgt

999 # check value for end of file

## Appendix 4

Content of Stock Synthesis Forecast file (Forecast.SS) selected as the final accepted assessment model at IBP-Bass 2 2016. This is not used for creating forecasts yet, but has to be available.

#V3.24f

# for all year entries except rebuilder; enter either: actual year, -999 for styr, 0 for endyr, neg number for rel. endyr

1 # Benchmarks: 0=skip; 1=calc F_spr,F_btgt,F_msy

1 # MSY: 1= set to F(SPR); 2=calc F(MSY); 3=set to F(Btgt); 4=set to F(endyr)

0.4 # SPR target (e.g. 0.40)

0.4 # Biomass target (e.g. 0.40)

#_Bmark_years: beg_bio, end_bio, beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)

0 0 0 0 0 0

# 2010 2010 2010 2010 2010 2010 # after processing

1 #Bmark_relF_Basis: 1 = use year range; 2 = set relF same as forecast below

#

0 # Forecast: 0=none; 1=F(SPR); 2=F(MSY) 3=F(Btgt); 4=Ave F (uses first-last relF yrs); 5=input annual F scalar

3 # N forecast years

1 # F scalar (only used for Do_Forecast==5)

#_Fcast_years: beg_selex, end_selex, beg_relF, end_relF (enter actual year, or values of 0 or -integer to be rel. endyr)

0 0 0 0

# 1180696575 1667592815 7631713 0 # after processing

1 # Control rule method (1=catch=f(SSB) west coast; 2=F=f(SSB) )

0.4 # Control rule Biomass level for constant F (as frac of Bzero, e.g. 0.40); (Must be > the no F level below)

0.1 # Control rule Biomass level for no F (as frac of Bzero, e.g. 0.10)

0.75 # Control rule target as fraction of Flimit (e.g. 0.75)

3 #_N forecast loops (1=OFL only; 2=ABC; 3=get F from forecast ABC catch with allocations applied)

3 #_First forecast loop with stochastic recruitment

0 #_Forecast loop control #3 (reserved for future bells&whistles)

0 #_Forecast loop control #4 (reserved for future bells&whistles)

0 #_Forecast loop control #5 (reserved for future bells&whistles)

2011 #FirstYear for caps and allocations (should be after years with fixed inputs)

0 # stddev of log(realized catch/target catch) in forecast (set value>0.0 to cause active impl_error)

0 # Do West Coast gfish rebuilder output (0/1)

-1 # Rebuilder: first year catch could have been set to zero (Ydecl)(-1 to set to 1999)

-1 # Rebuilder: year for current age structure (Yinit) (-1 to set to endyear+1)

1 # fleet relative F: 1=use first-last alloc year; 2=read seas(row) x fleet(col) below

# Note that fleet allocation is used directly as average F if Do_Forecast=4

0 # basis for fcast catch tuning and for fcast catch caps and allocation (2=deadbio; 3=retainbio; 5=deadnum; 6=retainnum)

# Conditional input if relative F choice = 2

# Fleet relative F: rows are seasons, columns are fleets

#_Fleet:

# 0 0 0 0

# 0 0 0 0

# 0 0 0 0

# 0 0 0 0

# max totalcatch by fleet (-1 to have no max) must enter value for each fleet

-1

# max totalcatch by area (-1 to have no max); must enter value for each fleet

-1

# fleet assignment to allocation group (enter group ID# for each fleet, 0 for not included in an alloc group)

0

#_Conditional on >1 allocation group

# allocation fraction for each of: 0 allocation groups

# no allocation groups

0 # Number of forecast catch levels to input (else calc catch from forecast F)

2 # basis for input Fcast catch: 2=dead catch; 3=retained catch; 99=input Hrate(F) (units are from fleetunits; note new codes in SSV3.20)

# Input fixed catch values

#Year Seas Fleet Catch(or_F)

#

999 # verify end of input