REPORT OF THE 2014 ATLANTIC BLUEFIN TUNA STOCK ASSESSMENT SESSION

(*Madrid, Spain – September 22 to 27, 2014*)

1. Opening, adoption of the Agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid. Drs. Clay Porch (USA) and Sylvain Bonhommeau (EC-France), BFT Rapporteurs for the western and eastern stocks, respectively, co-chaired the meeting. Drs. Porch and Bonhommeau welcomed meeting participants ("the Group") and proceeded to review the Agenda, which was adopted without changes (**Appendix 1**).

A List of Participants is attached as **Appendix 2** and the List of Documents presented at the meeting is attached as **Appendix 3**.

The following participants served as Rapporteurs for various sections of the report:

Section	*Rapporteurs*
1, 9, 10	S. Bonhommeau
3	C. Porch, S. Bonhommeau
4.1	E. Rodríguez-Marín, D. Secor, J.M. Ortiz de Urbina
4.2	H. Arrizabalaga, A. Kimoto, G. Díaz
4.3	A. Kimoto, J. Walter
4.4	S. Cadrin
5	M. Lauretta, H. Arrizabalaga, JM Fromentin, A. Kimoto, C. Porch
6	M. Lauretta, S. Cass-Calay, C. Porch, J. Walter, S. Bonhommeau, JM Fromentin
7	M. Lauretta, L. Kell, J. Walter, J.M. Fromentin, C. Porch
8	C. Porch, M. Ortiz, S. Deguara, S. Bonhommeau

2. Review of the scientific papers presented at the Group

Due to the considerable number of documents submitted it was decided to organize the presentation by groups and to conduct a general discussion at the end of each group of presentations. Consequently the report was restructured in a way that, for some items, the summaries of the documents were moved to an appendix (**Appendix 4**) and only the general discussions were included in the main text.

3. Review of the Rebuilding Plans for Atlantic and Mediterranean bluefin tuna and previous SCRS advice

Recommendation 08-05 (which replaced Rec-06-05) called for a 15-year rebuilding period for Eastern Atlantic and Mediterranean bluefin tuna, starting in 2007, with the objective of recovering the stock to BMSY with greater than 50% probability. A number of technical measures, including minimum size, fishery closures, and TACs were implemented in the Plan, which also calls for SCRS to monitor and advise the Commission on the odds of the Plan‘s objectives being met based upon available data. Based upon information available in 2007, the SCRS advised that overall, preliminary results indicate that the measures adopted in the Plan were a step in the right direction, but were unlikely to fully fulfill the objective of the plan to rebuild to the MSY level in 15 years with greater than 50% probability. The SCRS advised that this depends on several factors, particularly how well regulations are implemented (including a severe reduction in fishing effort by 2023) and future recruitment. If implementation were perfect and if future recruitment were at about the 1990s level and unaffected by recent spawning biomass level, there was estimated to be about 50% probability of rebuilding by 2023 under regulations called for in Rec 08-05. The SCRS advised, however, perfect implementation was unlikely because, even with perfect enforcement, the Committee believed that it was not feasible to avoid totally discard mortality of small fish (in excess of tolerance) and while continually and severely reducing fishing effort to very low levels to achieve the objectives of the Rebuilding Plan. With other plausible assumptions (either imperfect implementation or recruitment that decreases from recent levels as spawning biomass decreases, or both) the objectives of the Rebuilding Plan would not be met without further adjustments. The best advice of the Committee was to follow an $F_{0.1}$ (or another adequate F_{MSY} proxy) strategy to rebuild the stock, because such strategies appear much more robust than that imbedded in [Rec. 06-05] and possibly also in [Rec. 08-05] to a wide range of uncertainties about the data, the current status and future productivity. These strategies would imply much lower catches during the next few years (on the order of 15,000 t or less), but the long-term gain could lead to catches of about 50,000 t with substantial increases in spawning biomass. For a long lived species such as bluefin tuna, it will take some time (> 10 years) to realize the benefit. The Committee advised that an overall reduction in fishing effort and mortality was needed to reverse current trends.

In response to the advice from the Committee, the Commission further modified the rebuilding plan in 2009 [Rec 09-06] and established a TAC at 13,500 t for 2010 and also established a framework to set future TAC at levels sufficient to rebuild the stock to BMSY by 2023 with at least 60% probability. The Commission further required SCRS to present a Kobe II strategy matrix reflecting recovery scenarios of eastern Atlantic and Mediterranean bluefin tuna that achieve BMSY with probabilities ranging from 50-90% taking into account [Rec 09-12].

The Supplemental Recommendation by ICCAT Concerning the Western Atlantic Bluefin Tuna Rebuilding Program [Rec. 08-04] calls for a 20-year rebuilding period starting in 1999 with the objective of recovering the stock to BMSY with at least a 50% probability by the end of the Plan‘s time frame (through 2018). A number of technical measures, including TACs, were implemented in this Plan which also calls for SCRS to monitor and advise the Commission on the odds of the Plan‘s objectives being met based upon available data. Based upon an assessment of western stock status conducted in 2008, which indicated that a constant total allowable catch (TAC) below 2,100 t over the period of 2009-2010 would produce gains in spawning stock biomass (SSB) of western Atlantic bluefin tuna and considering new evidence which the SCRS cautioned suggested that current regulations may be insufficient to achieve the objectives, the Commission amended its rebuilding plan to have a total allowable catch (TAC), inclusive of dead discards, of 1,900 t in 2009 and 1,800 t in 2010.

The Committee conducted another assessment of Atlantic bluefin tuna in 2010. Based on the results, the Committee concluded that, while the outlook for Eastern Atlantic and Mediterranean bluefin tuna had improved in comparison to previous assessments, the stock remained overfished (SSB was estimated to be only about 35% of the biomass that is expected under a MSY strategy) and was undergoing overfishing (the fishing mortality rate in 2009 was estimated to be above the reference target F0.1). The Commission responded reducing the TAC to 12,900 t annually, effective beginning in 2011 and thereafter, until such time the TAC is changed following the SCRS advice [Rec. 10-04]. The Commission also implemented a series of other measures (including closed seasons and minimum size limits) and strengthened several control mechanisms to ensure the management measures would be respected and to ensure the traceability of all the catches. An update of the assessment was conducted in 2012. Estimates of the stock status relative to MSY benchmarks led to the conclusion that F_{2011} was below the reference target $F_{0.1}$ and that SSB was about 63% (from 37% to 89% depending on the recruitment level hypothesis) of the biomass that is expected under a $F_{0.1}$ strategy using the reported catch and 76% (from 37% to 116% depending on the recruitment level hypothesis) of the biomass that is expected under an $F_{0.1}$ strategy using the inflated catch. The Commission subsequently slightly increase the TAC at 13,500 t annually while other measures where kept.

In the case of western Atlantic bluefin tuna, the results from the 2010 and 2012 assessments indicated that, under the low recruitment scenario, the stock was above the biomass level that can support MSY, but under the high recruitment scenario (under which higher sustainable yields are possible in the future), the stock remains overfished and overfishing would continue under the current TAC. The Committee also advised the Commission to protect the strong 2003 year class until it reaches maturity and can contribute to spawning, In response, the Commission reduced the TAC to 1,750 t for 2011 - 2014 [Rec. 10-03, 12-02, 13-09].

4. Summary of available data for assessment

A discussion of catch statistics, fishery trends and relative abundance indices is available in the Report of the 2014 ICCAT Bluefin Data Preparatory Meeting. For the most part the present document does not depart from the established work plan or the recommendations made at the data preparatory meeting. However, there was a significant departure from the work plan in regards to generating the catch-at-size and catch-at-age, which is detailed below.

4.1 Biology

The Group reviewed several working papers describing recent advances in bluefin tuna biology. A complete compilation of summaries of the working papers is provided in **Appendix 4**. A summary of the Group's discussions are presented in this section.

Size conversions

A reanalysis of data from SCRS/2014/053, presented at the 2014 Atlantic bluefin tuna data preparatory meeting, was conducted for weight-length relationship (SCRS/2014/053 Rev). Meeting participants deemed it important to allow standardization of size measures that are used in reporting and in biological studies. Extensive sampling over 15 years in 13 regions was carried out throughout the Atlantic and Mediterranean to improve existing weight-length relationships for both stocks. . SCRS/2014/053 rev presented by stock unit, size to size, weight to weight conversion factors, and weight at size relationships for samples with a representative number of fish measured. Overall size-size and weight-weight relationship show a high degree of correlation between observed and fitted data with *r*-squares values on average above 0.98, except for some size conversions involving pre-opercular and snout to first dorsal spine (LD1) measurements.

After several sensitivity analyses it was decided to estimate the weight-length relationship for each stock unit using the most complete datasets with RWT and SFL, including original observations with these type measures as well observations standardized to RWT and SFL for which the original size or weight measure had a size or weight conversion factor(s) with high degree (r-square > 0.98) coefficient of determination (SCRS/2014/053 Rev). The nonlinear weight-length relationships were fitted using the Gauss-Newton method weighed by the inverse variability (observed coefficient of variance by 5 cm SFL bin size) to minimize the effect of outliers. There was found almost no difference between both stocks for the RWT-SFL annual relationships with a difference of 6%. Monthly models to account for seasonal variations in weight varied between minus 5% and plus 4% for eastern bluefin, and minus 21% and plus 8% for western bluefin. Monthly variations were consistent with expected seasonal differences in feeding and reproduction. As expected the absolute variations in weight are greater for larger fish.

It was noted that these relationships are useful for practical applications in cage operations but need to be carefully evaluated by the SCRS since differ from previously used equations by 12% to 10% with respect the West Atlantic and East Atlantic stock functions. Differences are found with bluefin tuna being heavier in previous functions adopted by ICCAT from 180 SFL (cm) onwards.

SCRS/2014/151 presented a length-weight relationship for ABFT in the eastern Atlantic and Mediterranean based on a limited number of samples of ABFT spawners collected by the Atlantic traps of Morocco and Spain in the Strait of Gibraltar during April and May and a set of samples of juvenile fishes. Quantile regression was used to better capture changes in mean and variance across regression of weight on size. Results were compared with annual weight-length relationship from SCRS/2014/53Rev indicating significant differences. Also it was indicated that the latter paper did not use quantile regression and conversions give somewhat biased estimates of low weights for very large specimens.

Questions raised the fact that comparison should be made with monthly estimations instead of the annual one from SCRS/2014/53Rev. Results of quantile fitting applied to SCRS/2014/53Rev data gave similar predictions as did fitting procedure used in the selected model using the Gauss-Newton method. It was discussed the difficulty to have weight length relationship for each month and fishery, and that the goal was to realistically generalize a weight length relationship and its variance accounting for annual, seasonal, and regional components.

SCRS/2014/140 reported weight length relationship from bluefin tuna caught in the Tyrrhenian Sea with traps and long line in May-June 2013. It was proposed to compare this data with SCRS/2014/53Rev fitting, and it was argued that this latter paper represent a much wider sampling in years, months and geographic areas. The proposed annual weight-length functions by stock (SCRS/2014/53Rev) represent the average for the population in year terms, and are good representation of population trends when working in annual components. The WG will now use these functions for future stock assessments.

In conclusion the WG agreed that the size, weight and weight at size relationship presented in SRCS/2014/053 Rev are the best estimates for west and east/Mediterranean bluefin tuna (**Table 5**). The WG will now use these functions for future stock assessments. For population level average the annual weight at size relationship adopted are:

West-BFT RWT (kg) = 1.59137E-5*SFL(cm)^3.0205843

East/Med-BFT RWT (kg) = 3.15551E-5*SFL(cm)^2.8984539

It was however; concluded that given the variance of weight at size and its correlation with fish condition factor, the monthly estimates of weight at size should be used when estimating catches from time specific data, for example when estimating catch at size, size distributions of monthly catches, etc. (**Table 6**). The WG also recommended further evaluating differences in weight-size relationships or condition factor associated with geographic areas, particularly in the Mediterranean Sea.

Direct ageing

An age calibration exchange study within the GBYP framework was reported in SCRS/2014/150. This ageing precision study included 21 readers from 13 laboratories, who interpreted images of paired calcified structures, otoliths and spines, coming from the same specimen. The mean coefficient of variation and average per cent error were around 20% and 15% respectively. Precision was lower for inexperienced readers than for experienced ones, being experience a major factor in the age interpretation from otoliths viewed under reflected light and for large specimens using spines under transmitted light. There was generally good agreement in the ageing among different structures coming from the same specimen. Otoliths aged using different types of lighting showed a good agreement with no significant bias ($p>0.05$), while spine showed no sign of bias with respect to otoliths viewed under transmitted light ($p>0.05$) but a slight under ageing was detected when compared with reflected light otoliths ($p<0.05$) for a small number of specimens older than 14 years. Further standardization of age reading criteria between laboratories and a description of the annual formation of otolith edge type is needed. Questions were raised in relation to quality control monitoring in age determination including the use of a reference collection to prevent bias and increase ageing precision.

Spawning areas and larval studies

Research on larval ecology of Atlantic bluefin tuna has advanced in recent years through oceanographic habitat suitability models, down-scaled climate models, directed sampling, and studies on larval growth, condition, and trophic ecology. Comparison between larvae sampled in the Gulf of Mexico and the Balearic Sea (Mediterranean Sea) indicated larvae from the Gulf of Mexico were unique in exhibiting early piscivory (consumption of fish larvae), and were of lower condition and lower apparent trophic position (SCRS/2014/103, SCRS/2014/173). Growth rates of larvae collected in the Gulf of Mexico (~0.5 mm/d) were similar to those previously observed (SCRS/2014/175).
Down-scaled climate variables were input into oceanographic habitat models in the Gulf of Mexico and indicated that climate change (warming) could substantially diminish potential spawning habitat within the next 50 years (SCRS/2014/174). Still, temporal and spatial scale of such predictions are likely coarse. These same habitat models showed potential habitats for spawning outside of the Gulf of Mexico, in the Caribbean Sea. A directed ichthyoplankton survey resulted in 18 bluefin tuna larvae being recovered in 9 of 97 stations near the Bahama Islands (SCRS/2014/176). Six of these stations came from oceanographically complex regions characterized by cyclonic and anticyclonic gyres. Oceanographic habitat models have also been developed for the Mediterranean Sea (SCRS/2014/102). These have in some but not all instances provided feasible predictions of spawning habitat based upon known distributions.

Mixing and stock structure

Substantial progress has been made in estimating regional mixing levels for Atlantic bluefin tuna from otolith stable isotope analysis (SCRS/2014/171). For the period 2007-2014 >2000 otoliths have been analyzed for important management regions. Lack of mixing between the two principal stocks for Gulf of Mexico, Gulf of St. Lawrence, Eastern Atlantic, and Mediterranean samples was consistent with stock mixing patterns for otolith samples collected 1990-2002 (Rooker et al. 2008). In contrast, recent analyses show diminished contributions by the Mediterranean population to US Mid-Atlantic and evidence of small but significant contributions by this population to Canadian maritime fisheries. Mixing levels in the US Mid-Atlantic, Canadian Maritimes, and North Central Atlantic show non-stationary dynamics, meriting additional sampling and analyses. To further “operationalize” this stock composition analysis and its utility to stock assessments, more attention is needed to sampling sizes, sampling design and potential biases. A second stock discrimination method based on identification and examination of parasites (SCRS/2014/149), showed promise. Significant differences in parasite assemblages in YOY bluefin tuna hosts were observed between the Balearic, Ionian, Ligurian, and Tyrrhenian Seas. Additional information on stock mixing and related discrimination approaches were presented at the 2014 Atlantic Bluefin Data Preparatory Meeting (SCRS/2014/014).

4.2 Catch and other Fishery Statistics

4.2.1 Eastern Atlantic and Mediterranean catches

- Nominal catches and fishery trends

The Task I (nominal catch and fleet characteristics) and Task II (catch and effort, size frequencies, and catch-at-size) catch statistics reported by the ICCAT CPCs through 2013 were provided to the Group during the meeting.

The revised annual bluefin nominal catches (Task I) from 1950 to 2013 presented by the Secretariat and summarized in **Table 1** and **Figure 1** show the spatial distribution of bluefin catches (1950-2013) by gear and decade. **Figures 2 and 3** show the reported annual bluefin catches by area and main gear. These figures also included the Group estimates of non-reported catch for 1998-2007 (gray shade).

Reported catches in the East Atlantic and Mediterranean reached a peak of over 50,000 t in 1996 and, then decreased substantially, stabilizing around TAC levels established by ICCAT (**Table 1** with total catches, **Figure 2** total catches by area, and **Figure 3** total catches by gear). Both the increase and the subsequent decrease in declared catch occurred mainly for the Mediterranean (**Figure 2**). Information available showed that catches of bluefin tuna from the eastern Atlantic and Mediterranean were seriously under-reported from 1998 to 2007. Farming activities in the Mediterranean since 1997 have produced a great change in fishing strategy of purse seiners resulting in a deterioration of bluefin tuna size sampling coverage and, consequently, catch at size of these important fleets. Task I data reported catch for 2011 and 2013 were 9,774 t, 10,857 t, and 13,333 t, respectively.

- Catch-at-size (CAS) and catch-at-age (CAA)

Following the work plan of the data preparatory meeting , the updated CAS and CAA were provided at the end of June 2014 by the ICCAT Secretariat, using the Task I submitted before the deadline of May 31st 2014 (**Tables 1**). Because this stock assessment is an update, only years 2011 to 2013 were changed. Thus, the same substitution rules used for the 2012 assessment were applied (see Section 5 in the data preparatory group report) (**Tables 2, 3 and 4)**. As in previous assessments, the relative differences between Task-I and the CAS weight equivalent catches, mostly found in two Flags (Japan and USA) were not addressed in this updated version.

In addition to the updated CAS and CAA, fully revised CAS and CAA for the preliminary benchmark analysis (see Section 5 in the data preparatory group report) were also generated and provided to the Group at the end of July by the Secretariat. These include all the new size information collected under GBYP and other sources (size farmed samples corrected from growth on cages as presented in SCRS/2014/040). During preliminary analyses of the fully revised CAA, there were identified substantial problems for the early 2000s with large proportions of age 1. The Group concluded that additional work has to be done for improving the data quality of catch at size for this period.

The Group noted that estimation of CAS and CAA requires representative size frequency samples from each fishery, in the case of purse seine fleets in the Mediterranean it has been particularly difficult to obtained size samples because most of the catch is destined to farming operations. The CAS for fleets without sampling is constructed using substitutions following the guidelines from the WG. In the case of EU-Croatia purse seine catch has been converted to CAS using the EU-France size frequency from 2001 to 2013. However, it appears that the trends of CAS and mean weight of PS EU-France do not longer reflect the catch size distribution of EU-Croatia. Two new size data sources from EU-Croatia that were available recently corroborate this (**Figure 4**): *i*) file of size distribution of bluefin caught, tagged and release under the GBYP project done in July - 2013 with 1130 samples, and *ii*) Size frequency data collected in 2014 from caging operations with stereo video camera systems in July 2014 from 2 farms and 8 caging operations. Both of this data indicated catches of primarily small bluefin tuna of 60 FL to 120 FL cm, which is substantially different than the CAS from PS_EU-France that indicate catches of much larger size fish with average of 175 FL cm. The WG had recognized the limitations of the purse seine size distribution information; and during the data preparatory meeting it was recommended to estimate CAS distribution from the size information at harvest from farming operations taking into account growth at farm (SCRS/2014/040). This information was integrated in the pilot assessment (CAS and CAA, preliminary benchmark), however the Group did not have sufficient time to fully explore the implications of the new information.

4.2.2 Western Atlantic catches

− *Nominal catches and fishery trends*

The total catch for the West Atlantic peaked at 18,671 t in 1964, mostly due to the Japanese longline fishery for large fish off Brazil that began in 1962 and the U.S. purse seine fishery for juvenile fish (**Table 1**). Catches dropped sharply thereafter with the collapse of the bluefin longline fishery off Brazil in 1967 and the decline in purse seine catches, but increased again to average over 5,000 t in the 1970s due to the expansion of the Japanese longline fleet into the northwest Atlantic and the Gulf of Mexico and an increase in purse seine effort targeting larger fish for the sashimi market.

Since 1982, the total catch for the West Atlantic including discards has generally been relatively stable due to the imposition of quotas. However, following a total catch level of 3,319 t in 2002 (the highest since 1981), the total catch in the West Atlantic declined steadily to a level of 1,638 t in 2007 (**Figures 5 and 6**), the lowest level since 1982, before rising to 2,007 t in 2011, which was above the TAC of 1,750 t. The decline prior to 2009 was primarily due to considerable reductions in catch levels for U.S. fisheries. Preliminary catch in 2013 was 1,484 t.

Canada: Canadian bluefin tuna fisheries currently operate in several geographic areas off the Atlantic coast from July to November, when bluefin tuna have migrated into Canadian waters. The spatial distribution of the Canadian fisheries has not changed significantly, but there were anecdotal reports of tuna occurring in areas where they have not been observed in many years (for example, the Baie des Chaleurs in the western Gulf of St. Lawrence). Catches for 2007-2013 (including reported dead discards) totaled 491, 576, 533, 530, 510 t, 493 t, and 480 t respectively. The 2006 catch, 735 t, was the highest recorded since 1977. The 2013 landings were taken by rod and reel, tended line, longline, harpoon and trap gear.

United States: The catches (landings and discards) of U.S. vessels fishing in the northwest Atlantic (including the Gulf of Mexico) in 2002 reached 2,014 t of bluefin tuna, the highest level since 1979. However, catches in 2003-2008 declined precipitously, and the United States did not catch its quota in 2004-2008 with catches of 1066, 848, 615, 858 and 922 t, respectively. Catches increased in 2009, and for the period 2009-2011 they were (including reported dead discards) 1273, 953, and 905 t, respectively. The 2013 catches, including dead discards, by gear were: 45 t by harpoon, 190 t by longline, 43 t by purse seine, and 381 t by rod and reel and handline gear combined.

Japan: Japan uses longline gear to catch bluefin tuna in the Atlantic Ocean. The number of boats engaged in bluefin fishing in the West Atlantic has declined to less than 10 boats after 2009. Recent catches in the west (about 280-420 t in Japanese fishing year) have fluctuated possibly due to the management regulations. The recent fishing grounds for bluefin changed and/or shrank substantially, due to the introduction of IQ system for Japanese longline vessels since 2009 in the West Atlantic. Fishing bluefin in the West Atlantic normally starts in early December. However, this fishing activity started earlier in the northwestern area in recent years, and some fishers operated in an area north and east of Florida/Bahamian Bank (southern ICCAT area BF55/northern ICCAT area BF61) in December to February if the individual vessel had quota left. As soon as the individual vessel quota is filled, the vessel stops fishing. The West Atlantic bluefin tuna catch of the Japanese longline fleet in calendar years 2012 and 2013 were 289, and 317 t, respectively.

− *Catch-at-size (CAS) and catch-at-age (CAA)*

The CAS and CAA for the western Atlantic were generated by the Secretariat using the methods described in documents SCRS/2010/119 (revised) and SCRS/2010/120. However, the evaluation team discovered an error in the 2011 CAS statistics submitted by the United States. While the correct statistics were submitted to the Secretariat shortly after the error was discovered, it was well after the May 31, 2014 deadline and there was insufficient time for the Secretariat staff to reconstruct the CAS database and recalculate the CAA. After consulting with the SCRS Chair, Secretariat and working group chairs, it was decided that the best course of action was for the western evaluation team to reconstruct the CAS themselves and reproduce the corresponding CAA estimates using the same code employed by the Secretariat (Ageit_BFT_ver4 *R* script). These analyses are documented in a separate paper (SCRS/2014/172).

The output from the R-Script AgeIT_BFT_ver4 was also used to generate partial CAA corresponding to the indices of abundance used in the assessment following the restrictions on sizes and month specified in **Table 7**. The final CAA and partial CAA matrices are presented in SCRS/2014/172 and are also shown with the other inputs to the VPA in **Appendix 5**.

4.3 Relative abundance estimates

4.3.1 Relative abundance Indices and fishery indicators – East

During the data preparatory meeting (in 2014), several CPUE indices were presented and discussed. While detailed information about them can be found in the report of the data preparatory meeting, this section includes a summary of the available indices as well as any new information and discussion raised during the assessment meeting.

Document SCRS/2014/054 reported two indices of the Bay of Biscay baitboat fishery (BB), a long term age aggregated index, from 1952 to 2007, based on trip information, and a new age-aggregated index for the most recent period, 2000-2013, based on a fine scale database that incorporates daily logbooks, trip and VMS information. The effects of regulations on the CPUE are described and considered in the analysis, as well as technological and environmental variables. Both indices show similar trends in the overlapped timeframe. The main challenge to update this index was due to the fact that the Spanish baitboats sold their quota during their last two years. This was overcome by including the French baitboat fleet, although noticing that the amount of catch of the French fleet is much lower than that from Spain. The selectivity of the fleet was also affected by the 8kg minimum size regulation that entered into force in 2007. This justified splitting the index into three periods (1952-1963, 1964-2006, and 2007 onwards) to use in the VPA, as done in the 2012 assessment. And it was considered the possibility to, as part of the sensitivity analyses, drop the last two years of the series.

Document SCRS/2014/045 provided abundance indices of bluefin tuna from the Japanese longline fishery in the Northeast Atlantic through 2014 fishing year (FY). Abundance index in the Northeast Atlantic showed a steep increasing trend since 2009FY, and the size of bluefin tuna caught showed a continued contribution of the 2003 strong year class. The document also provided the indices in the Northeast Atlantic split into two periods with break at the 2010FY. The reason for the consideration to split it was due to rapid changes observed in the fishing patterns of the fleet, concentrating the activity in the Northeast Atlantic since 2009 which corresponds to 2010FY. However, during the data preparatory meeting in May 2014, the Group noted that there is an overlap of the areas and months fished throughout the time period covered by the seriesand, therefore, the CPUE standardization model should be able to work well even after a reduction in the number of observations. Moreover, estimated time*area effects were relatively small. At the data preparatory meeting, the Group concluded that splitting the CPUE series was not warranted and it recommended using the continuous series for the base case (as it was done in the 2012 assessment). During the assessment meeting, there was additional discussion about the split in the Japanese longline index in the Northeast Atlantic. The Group decided not to change the decision of the data preparatory workshop to use the complete index, however some concerns were raised that the index catchability might still be affected by changes in fishing practices related to the imposition of IQs. Thus, a model run where this index was split in 2010 was included as a sensitivity run. The group strongly emphasized that, due to the decreased number of operations by the 2003 strong year class under the current substantially reduced quota, it became more difficult to continue to provide reliable standardized CPUE series from the Japanese longline, which must be one of the most important abundance indices for the stock assessment.

Document SCRS/2014/060 presented relative abundance indices of bluefin tuna caught by the Moroccan and Spanish traps in the area close to the Strait of Gibraltar were estimated for the period 1981- 2013. The Group discussed that the high CPUE value estimated for 2013 might be due to large catches of the 2003 strong year class. In this document, only information from the Moroccan traps was included for the last year of the time series (2013), because scientific monitoring of the Spanish trap fishing activity could not be carried out in 2013. In the case of the Moroccan traps, it was pointed out that the information on the number of bluefin tuna released from the traps is self-reported information by trap operators. The Committee strongly requests ensuring the access to Spanish traps for coming years to be able to maintain the integrity of the joint Spanish-Morocco trap index.

During the assessment meeting, a new document (SCRS/2014/168) was presented where the relative abundance index of Bluefin tuna caught by the Moroccan traps in the Atlantic area close to the Strait of Gibraltar was updated up to 2014. The annual standardized index showed a remarkable increase since 2012. The model was based on catch rather than cpue because the duration of the fishing season was pretty constant historically. However, since 2010, reduction of TACs shortened the fishing season. In order to try to keep a comparable length of the fishing season throughout the time series, fish that entered the traps after the quotas were completed and subsequently released were taken into account in the index computation. This partially compensated for the differences in fishing season durations in the last years. However, the Group acknowledged that in order to fully consider the issue, an alternative effort measure would need to be used in the future and/or the model would need to be based on cpue (e.g. catch per day).

The Group also acknowledged the existence of additional abundance indices for EBFT that could be used in future assessments. These include a fisheries independent juvenile abundance index derived from aerial surveys in the Gulf of Lions from 2000-2003 and 2009-2013, CPUE series of Italian traps for the period 1993-2010 (Addis et al. 2012), Portuguese traps for the period 1998-2013 (SCRS/14/046), Spanish purse seiner since 2000 (SCRS/2014/185) and finally a larval index (SCRS/2014/059) in the western Mediterranean for the period 2001-2005 and 2012. Additional information on the available abundance indices can be found in the data preparatory meeting report.

The CPUE series used for the tuning of the eastern VPA were (**Table 8** and **Figure 9**): Norwegian purse seine for ages 10+, Spain-Morocco trap combined for ages 6+, Morocco only trap series for ages 6+, Japanese longline North East Atlantic for ages 4+, Japanese longline East Atlantic and Mediterranean for ages 6+, and the Spanish baitboat index. Since this last index covered the period 1952-2011 during which changes in selectivity took place (especially during the most recent periods because of changes in management regulations), the Group decided to split it in three series: Spanish baitboat_1 (1952-1962, ages 5-6), Spanish baitboat_2 (1963-2006, ages 2-3) and Spanish baitboat_3 (2007-2011, ages 3-6).The definition of the base case as well as the different sensitivity runs based on different selection and/or specification of the CPUE series are detailed in section "Stock Assessment Methods-East".

4.3.2 Relative Abundance Indices– West

The same twelve indices were used for the 2014 update as were used in the last several assessments (**Table 9**). Nine of these indices were updated and presented at the 2014 bluefin data preparatory workshop and three of the indices were historical and not updated (**Figure 8**). In most situations the updated indices were very similar to indices used in the 2012 stock assessment, with the exception of a few key revisions (**Figure 9**). The specific formulations for the updated indices remained, for the most part, unchanged since the 2014 data preparatory workshop and therefore are only briefly described in the present report (see below). In two cases, notably the Canadian GSL and the U.S. Gulf of Mexico pelagic longline, there were reconsiderations that led to a sensitivity run that split the GSL index between 2006 and 2007 and to removing the early period of the split U.S. Pelagic longline index due the absence of information on PCAA for the early time period. These decisions are addressed in more detail below.

Document SCRS/2014/039 presented the two indices from the Canadian rod and reel, tended line, and harpoon fisheries from two areas, south west Nova Scotia (SWNS) and the southern Gulf of St. Lawrence (GSL). The updates to these indices were largely the same as in the 2012 assessment for the same time period. Recent trends indicate a decline in SWNS and a steep increase in the GSL. Explorations of the distribution of trips by day of year over time appear to reflect a change in fishing practice around 2007 where most of the trips in the year were concentrated in a very short time window (**Figure 10**). Starting in 2011 ITQs also were implemented which appeared to more evenly distribute effort over time. Some concerns were noted that these changes in the fishery may have led to changes in catchability for the GSL that may not have been accounted for by the index standardization. Hence a split in the index between 2006 and 2007 was proposed as a sensitivity run.

To estimate index selectivities for GSL and SWNS indices, the PCAA was derived by obtaining the partial catch at age specific to each region. Initially the 2014 Data Preparatory Workshop recommended using the available direct age composition from SWNS fishery, but as these data were not available for the entire time series, the PCAA had to be used. In addition the PCAA for the GSL index was expanded from ages 13-16+ to ages 8-16+.

Document SCRS/2014/055 presented three indices from the U.S. rod and reel fishery estimated with a negative binomial error assumption rather than the delta-Poisson assumption used in previous development of these indexes. Model diagnostics indicate improved model fit with the new error structure which led to some slight divergence from the 2012 indices. Two historic indices (US RR <145 and US RR >195) were not updated and remain the same as in previous assessments.

Document SCRS/2014/045 presented an updated index from the Japanese longline fishery for the Western North Atlantic. Initially the authors recommended a split of this index into two time periods after 2010 due to changes in fishing areas due to individual quotas ITQs. The Data Preparatory Workshop examined the estimated variances of the year*area random effects and found them to be small in comparison to the total residual variance and also that that the trends were very similar across the subareas. Therefore the trends for the standardized index would not be sensitive to the contraction of the fishery and the Data preparatory Workshop recommended keeping the CPUE series intact for the base case as was done in the 2012 assessment. The continuous index shows fairly substantial increases in the last three years.

Document SCRS/2014/058 presented an updated index of abundance of bluefin tuna constructed from logbook reports from the U.S. pelagic longline fishery in the U.S. Gulf of Mexico for the period 1987-2013. The index accounts for a change in catchability associated with a regulatory switch in 2011 to a ‘weak’ hook designed to release large BFT. A split in this index was recommended between 1991 and 1992 due to regulations implemented in 1992 that reduced the trip limit to one fish and that likely resulted in substantial changes in fishing practices that could not be modeled. The split of the US pelagic longline index between 1991 and 1992 required the assumption that the PCAA for the pre-1991 time period was the same as for 1992-2013. The recommendation from the analytical team was to remove the early part of the time series as this assumption of similar selectivity for the two time periods was a strong assumption.

Document SCRS/2014/057 presented a fishery independent index (GOM larval) derived from catch rates of larval Bluefin tuna in the Gulf of Mexico was used in the assessment (SCRS/2014/057). This index was calculated in similar manner as in 2012 and is used to proxy the spawning stock biomass.

Two other historical indices, one from the Gulf of Mexico (SCRS/2002/012) and another based on tag returns (SCRS/2002/012) were not extensively discussed and were retained in their original forms.

There was much discussion regarding the divergent trends in the indices and the potential influences of regulations upon the indices. The group discussed different weighting methodology that could be used to deal with conflicting signals in these indexes or to assist in interpreting CPUE trends. However, there was a general agreement that this differential weighting would be difficult to achieve and that the indices should be equally weighted consistent with the update nature of this assessment.

4.4 Tagging

Several advances in tagging field methods, new movement observations and analytical methods were presented, discussed and considered for future stock assessments of Atlantic bluefin tuna. Research papers included advances in conventional tags, electronic tags and natural tags (parasites and otolith chemistry), as well as analyses of tagging information to explore the implications of stock mixing. The continued advancement and application of tagging contributes to our understanding of movement and stock mixing.

A customized device was developed to tag 57 bluefin tuna via SCUBA while video recording the specimen to derive an estimate of fish length (SCRS/2014/139). Similar methodology was developed to measure and tag 70 spawning bluefin tuna in the Tyrrhenian Sea by divers (SCRS/2014/189). Several conventional tag types were tested, and length was derived using an artificial neural network approach with +/- 10cm measurement error.

A tagging program in the Adriatic Sea caught bluefin tuna in purse seines and held them in cages for a 7 to 10 day recovery period before re-capturing them by rod and reel or handline for tagging (SCRS/2014/161). A total of 1169 juvenile bluefin were tagged with several types of conventional and electronic tags at a rate of 233 per day. A cradle was developed to measure length and weight and for surgical attachment of electronic tags. Tagging-induced injuries were evaluated and were most prominent around the mouth of the fish. Most electronically tagged fish stayed within the Adriatic, but one individual moved to the central Mediterranean.

A tagging program in the Strait of Gibraltar tagged 2671 bluefin tuna with "spaghetti" and "double barb" tags, and 53% were double-tagged with both tag types (SCRS/2014/136). Six specimens were also tagged with “Mini-PAT” pop-up satellite tags. Most of the 33 recaptures to date were recovered in the tagging area.

A review of pop-up satellite (PSAT) tags included information from 555 PSAT tags deployed on bluefin tuna using five tag models from 1997 to 2012 (SCRS/2014/178), and performance of tags was highly variable. PSATs are still expensive, have multiple sources of error, poorly resolved data, evolving hardware and confounded interpretations. The review recommends robust experimental design of tag release, transparent and open source software, reduction in size and cost, innovation in capability, and integrated data repositories.

An electronic tagging program deployed 130 electronic tags on adult and juvenile bluefin from 2008 to 2013 in the western and central Mediterranean and off the Atlantic coast of Morocco (SCRS/2014/184). Two behavioral patterns (migratory and resident) were observed. None of the apparent resident contingent left the Mediterranean during the tracking period. Migrants moved from the Mediterranean Sea to the North Atlantic, with one fish crossing the stock boundary to the Grand Banks. None of the tagged fish moved to the eastern Mediterranean basin.

A telemetry based method for simulating individual based movements was demonstrated for Atlantic Bluefin tuna in support of operational modeling and spatially explicit stock assessments (SCRS/2014/177). The simulation model uses parameters derived from movements and positional uncertainty from groups of tagged individuals. Movement matrices constructed from size based simulations may be used directly in operational models already in use. Inclusion of tagging data from recent Eastern Atlantic and Mediterranean tagging efforts would facilitate mixing rate comparisons and provide a more robust estimate of population based movement metrics for stock assessment use. There was some concern about contamination of the sample of fish used to derive movement patterns of the western spawning group by eastern fish tagged in the west. This concern may be resolved by accessing genetic information or excluding fish tagged in mixing areas. The group also suggested sensitivity analyses to assess the influence of some modeling decisions such as temporal resolution.

A simulation model was used to explore the consequences of bluefin tuna population structure and movement on stock composition and the perception of stock abundance (SCRS/2014/170). Alternate model settings were considered, including using different movement model parameterizations and two prevailing assumptions of recruitment for the western population. The spatial and temporal distribution and relative abundance of eastern and western populations was sensitive to assumptions of recruitment regime and population movement, because they imply different spatio-temporal distributions of the resource and exposure to different fishing mortalities. The spatial resolution of the model was discussed as well as the spatial-temporal resolution of movement patterns in the model. The current framework represents a model of intermediate complexity which does not represent the full spectrum of complexity in movement patterns.

5. Methods and other data relevant to the assessment

The work plan for 2014 stipulated that the stock assessment should focus on updating the analyses conducted in 2012 that were used to provide management advice (SCRS 2014). Nevertheless, several methodological papers were presented in the spirit of improving future assessments.

5.1 Methods – Eastern Atlantic and Mediterranean stock

5.1.1 VPA Specifications applied to the East Atlantic and Mediterranean stock

Because the 2014 stock assessment was an update of the 2012 stock assessment, the Group ran the same model, i.e. ADAPT VPA (as implemented in VPA-2box), with the most possible similar technical specifications and new updated data in 2014. The Group started the analyses with 2012 Base case to confirm the Run 2 from the 2012 assessment, which was used as the basis for the 2012 scientific advice (see **Table 10**). Runs named 2012 Base case updated and Update1 are similar to the 2012 Run 2 but used the updated data up until 2011 and 2013, respectively. During the update process, the convergence problem was found, hence the global minimum was searched in all runs by using 100 different random seed numbers which used to produce random initial parameters of minimization procedure. The agreed set of runs is specified in **Table 10**.

The continuity run (Run 5 in SCRS/2014/113) of the 2012 assessment was conducted with catch-at-age data for the 1950-2013 years, and the Group agreed to use this run for the basis of 2014 assessment. This run includes the following CPUE indices (see Section 4): Spanish-Moroccan trap (1981-2013, ages 6+), Japanese longline in the East Atlantic and Mediterranean (1975-2009, ages 6+), Norwegian purse seine (1955-1979, ages 10+), Japanese longline in the North East Atlantic (1990-2013, ages 4+), and Spanish baitboat. The historical index was used to calibrate the 1952-1962 and 1963-2006 periods, and the newest index for 2007 onwards. After the further discussions on the CPUEs by the Group (see Section 4), it was decided to remove 2013 value in the Spanish-Moroccan trap index.

The specifications remained the same as in 2012. A 3-year constraint on vulnerability (sd=0.5, see SCRS/2008/089 for details) and a 2 year constraint on recruitment (sd=0.5) were applied (for details see the VPA2-box manual available at the ICCAT software catalog). All CPUE indices were equally weighted and terminal year Fs were estimated for ages 1 to 9. The F-ratios were fixed as in 2010 and 2012, i.e. equal to 0.7 over 1950-1969, equal to 1 over 1970-1984, equal to 0.6 over1985-1994 and equal to 1.2 from 1995 onwards.

The natural mortality vector remains the same as the one used for the East stock since 1998, i.e., an age specific but time invariant vector (0.490, 0.240, 0.240, 0.240, 0.240, 0.200, 0.175, 0.150, 0.125, 0.100 for ages 1 to 10, respectively).

A suite of different specifications were investigated to test the sensitivity of the VPA to the choice of the CPUE series. Run Update1_Split_JP was similar to Run Update1 but split Japanese longline North East Atlantic index into two periods 1990-2009 and 2010-2013 (SCRS/2014/045). Run Update1_2yrBB was similar to Run Update1 but they excluded the last 2 years in Spanish baitboat index. Run Update1 aerial was similar to Run Update1 but incorporated the aerial survey index. Run CR_Split_JP explores the sensitivity of Run Update1 both to split Japanese longline North East Atlantic index and removing last 1 year in Spain-Morocco trap combined index. The Group additionally explored Run CR_Mo_TP which was similar to Run Update1 but used Moroccan trap CPUE for ages 10+ instead of Spanish-Moroccan combined one (see Section 4).

Furthermore, a suite of different specifications were investigated to test the sensitivity of the VPA based on the CR, which have been explored in the past assessments. In Run CR_est_Fratio_v1, the F-ratios were estimated annually (sd=0.2, for details see VPA2-box Manual at the ICCAT software catalog). The F-ratio in Run CR_est_Fratio_v2 was set to be equal to the results of catch-curve analysis (SCRS/2014/115). Finally, Run CR_+Group_16 considered an older plus group (Age 16+) with fixed F-ratios (=1).

The continuity run for the basis of the 2014 assessment considered two catch scenarios, i.e., the reported and inflated catch scenario. The inflated catch scenario uses an inflated CAA in the same way as done in the 2008, 2010, and 2012 assessments (i.e., catch raised to 50,000 tonnes from 1998 to 2006 and to 61,000 t in 2007; no inflated catch from 2008 to 2013).

In addition to all runs for the update assessment, the Group tried to explore the preliminary benchmark run (CR_New_CAA) used fully revised CAS and CAA with the same specification of the continuity run. However, the Group could not fully review the results of the pilot assessment because the Group spent most of the time at the meeting for the updated assessment in the short time period. Therefore the results will be further investigated in the future meetings.

5.2 Methods – West

5.2.1 VPA applied to the West Atlantic

Tuned virtual population analyses (VPA) were conducted using the VPA-2BOX software featured in the ICCAT Software Catalog. The parameter specifications used in the 2014 continuity and base VPA assessments were identical to those used in the 2012 base-case assessment. The same data sets were used; although in a few cases the indices of abundance were computed somewhat differently than in 2012 (see the Data Preparatory Meeting Report in 2014). This section reviews the details of these specifications. The reader may refer to **Table 11** for a summary of the parameter specifications for the VPA runs and **Table 7** for the specifications for the partial CAA related to indices of abundance, and for a list of revisions from the continuity to the revised base VPA.

-General specifications

The oldest age class represents a plus group (ages 16 and older) and the fishing mortality rate (F) on that age is specified as the product of the fishing mortality rate on the next younger age (F_{15}) and an 'F-ratio' parameter that represents the ratio of F_{16} to F_{15}. For the 2010, 2012 and the 2014 models, the F-ratio was pre-specified at 1.0 for the entire period as there is no reason to expect the selectivity to differ on fish age 15 and older (growth is relatively slow at this age and all animals are fully mature).

The fishing mortality rates for each age in the last year of the VPA (except the oldest age) were estimated as free parameters, but subject to a constraint restricting the amount of change in the vulnerability pattern during the most recent three years with a standard deviation of 0.5 (see SCRS/2008/089 for more details).

The indices of abundance were fitted assuming a lognormal error structure and equal weighting (i.e., the coefficient of variation was represented by a single estimated parameter for all years and indices). The catchability (scaling) coefficients for each index were assumed constant over the duration of that index and estimated by the corresponding concentrated likelihood formula.

The natural mortality rate (M) was assumed age-independent ($M=0.14\ yr^{-1}$) as in previous assessments. The maturity vector used in prior assessments assumed ages 1 to 8 were immature and ages 9 and older were fully mature.

-Detailed specifications for the 2014 base case and alternative runs

This section details all the model settings examined during the assessment. Note that Run 4 (below) was chosen by the Group as the base case because it most closely repeated the specifications of the base model from the 2012 assessment while still accommodating all the modifications recommended during the 2014 ICCAT Bluefin Data Preparatory Meeting.

- Continuity run 0: This run most strictly adhered to the specifications of the 2012 base assessment with the updated data in 2014, including CAA, partial CAA, weight-at-age, and abundance indices. There were some minor changes relating to the indices of abundance: 1) U.S. RR indices were calculated using a negative binomial error distribution assumption instead of the delta-Poisson assumption (SCRS/2014/055), and 2) U.S. pelagic longline index in the Gulf of Mexico was adjusted by the effect of a 'weak hook' introduced in 2011 (SCRS/2014/058). Note that this run used the 'continuous' version of the U.S. pelagic longline index, i.e., without 'splitting' the series in 1992 (see description of Run 3).
- Run 1: Like run 0, but replaced the partial CAA for the Canadian Gulf of St. Lawrence and SW Nova Scotia indices with the spatially explicit filtering to more appropriately match data used in the standardization of the indices (see **Table 7**)
- Run 2: Like run 1, but Canadian Gulf of St. Lawrence and SW Nova Scotia indices were considered indices for ages 8-16+ (13-16+ in prior assessments), and for ages 5-16+ (8-14 in prior assessments), respectively based on otolith aging results presented during the Data Preparatory Meeting.
- Run 3: Like run 2, but 'split' U.S. pelagic longline index into two periods 1987-1991 and 1992-2013. The Data Preparatory Working Group recommended that this index be split owing to important management regulations that occurred in 1991. After a review of available partial CAA information, it was determined that complete size data were not available for the Gulf of Mexico for the years prior to 1992, and therefore that accurate partial CAA could not be created for those years. Therefore this run fixed the selectivity of the early part of the index, 1987-1991 at the estimated selectivity for the U.S. pelagic longline index from Run 2 (see also Run 4).
- Run 4: Like run 2, but did not use the early period (1987-1991) from the newly developed 'split' U.S. pelagic longline index. This run represented the base model.
- Runs 5-16: Jack-knife sensitivity analyses. The influence of the various indices of abundance on the base case model results were examined by removing one index at a time, running the VPA with the same model specifications, and comparing various reference statistics.
- Runs 17: A retrospective analysis was conducted for the base case model (run 4) by sequentially removing inputs of catch and abundance indices in annual increments, back to 2008.
- Run 18: Sensitivity analysis on Canadian Gulf of St. Laurence index. The influence of the 2010 data point for the Gulf of St. Lawrence on the base case model results was examined by including it in the data file.
- Run 19: Sensitivity analysis on natural mortality. The influence of the natural mortality on the base case model results was examined by assuming the estimated mortality-at-age of the eastern stock (age-dependent) as opposed to constant natural mortality of 0.14.
- Runs 20-21: Sensitivity analyses on maturity schedule. The influence of two maturity schedules on the base case model results was examined by assuming a) the estimated early maturity-at-age of the eastern stock as well as b) a late maturity-at-age of fish 9 to 16 (0% at age 8, increasing logistically to 100% at age 16 as described in SCRS/2010/018).
- Run 22: Sensitivity analysis on the Gulf of Mexico larval survey partial CAA. The partial CAA of the larval index was set equal to the maturity schedule from the base model.
- Run 23: Sensitivity analysis on the terminal F parameter starting values. The VPA was parameterized to estimate terminal Fs instead of abundances, constrained between 0.001 and 4 with a starting value of 0.2.
- Run 24: Sensitivity analysis on the F-ratio parameter assumptions. The base model fixed the ratio of fishing mortality on the plus group (ages 16+) equal to the annual estimates of age 15. This analysis fixed only the F-ratio on the first year equal to 1, and estimated the F-ratio for each year afterwards using a random walk with a deviation parameter = 0.6.
- Run 25: Alternative CAA and indices partial CAA estimation using a preliminary, average age-length key based on aged fish from otoliths collected between 2009 and 2012. This key was used to age fish greater than 98cm and the cohort slicing method from the AgeIt_BFT_Ver4 program was used for fish less than 99 cm. Consistent with the base VPA, a plus group at 16 and older was assumed. Further

details follow in Section 5.2.4.

- Run 26: Sensitivity analysis splitting the Canadian Gulf of St. Lawrence index into two periods, 1981-2006 and 2007-2013, to account for a potential change in catchability and selectivity of the fishery (see Section 4.3.2).

5.2.2 Alternative Assessment Models Applied to the West Atlantic Stock

Two alternative stock assessment models were presented for western Atlantic bluefin tuna: a statistical catch-at-length model (SCAL, see SCRS/2014/188 and SCRS/2014/195) and a non-equilibrium surplus production model (ASPIC version 5.34, see SCRS/2014/183). The catch-at-length model loosened the assumption that the age structure of the catch is known without error and avoids the need to infer age from size using cohort slicing. The surplus production model is much simpler than either the VPA or SCAL, greatly reducing the number of parameters that must be estimated, but at the expense of ignoring age-dependent processes. The authors of these two documents indicated the results were still preliminary, but the Group considered them to be potential useful tools for alternative interpretations of the data.

5.2.3 Age length key development.

As a preliminary step towards incorporating direct ageing information and improved biological information obtained during the GBYP, a VPA sensitivity run was conducted using a static (rather than year-specific) age-length key (ALK) (**Figure 11**). Noting that the eventual goal is to obtain year-specific ALKs, this VPA run represents a bridge between the current age-slicing and a dynamic ALK. As such it may be useful to evaluate the potential sensitivities of the VPA to the use of an ALK. The age-length key was obtained from direct otolith readings of 1070 fish ranging in size between 51 and 311 cm, collected between 2009 and 2012 (**Figure 12**). The fish were aged using aging protocols evaluated in SCRS/2014/038.

6. Stock status results

6.1 Stock status – East

6.1.1 VPA results

The update of the 2012 Base Case, using updated CAA (that only includes some changes in 2011, especially at ages 2 and 3) CAA, updated Partial CAA (PCAA) and updated CPUE led to strong differences in comparison to the 2012 Base Case, especially regarding the amplitude of the recovery of the SSB. The SSB indeed reached around 300,000T in the 2012 Base case against about 520,000T with the update of this run (**Figure 13**). Several investigations have been made to understand the causes of this important difference and appear to be firstly due to the small changes in the CAA and secondarily to the parameters convergence procedure. In other words, the amplitude of the SSB recovery is very sensitive to slight changes in the CAA and technical assumptions, indicating strong instability of the VPA.

The update of the 2012 base case (run Update 1) was carried out using the data updated up to 2013 and the parameter specifications described in **Table 11**. The technical specifications and CPUE data used are very close to those used in the base run in the 2012 assessment. Note however that the Spanish-Moroccan trap CPUE is not exactly an updated series of the one used in 2012, as there is no Spanish trap data since 2012 (See CPUE section). As, the Group decided to use the continuity run as close as possible to the 2012 Base Case, this run include the same CPUE time series updated until 2013, except for the trap one that truncated up until 2012.

In the Continuity Run (CR) for the basis of the 2014 assessment, the outputs of the VPA are close to those of the 2012 Base Case. F for the youngest ages (i.e. 2 to 5) displayed a continuous increase until the late 1990s and then showed a sharp decline to reach very low levels since the late 2000s (**Figure 14**). This result was not surprising as the reported catch at ages 2 to 3 have been reduced dramatically (i.e. being about 10% or less of what they were prior to 2007) in the recent years in response to the new minimum size regulations implemented in 2007. All the other runs displayed similar results for F at ages 2-5.

The fishing mortality for large bluefin tuna (F10+) in CR showed an initial decline corresponding to the decline of the Norwegian purse seine and trap fisheries in the early 1960s and a latter increase due to the development of the Mediterranean purse seine fisheries since the mid-1980s. The highest F on ages 10+ occurred from the mid-1990s to mid-2000s to reach high values (about 3 times M for these ages). Since

2008, there is a rapid decrease in F10+, as already noted in the 2010 and 2012 stock assessments (**Figure 14**). This decrease seems to result from the substantial decrease in the reported catch for older fish since 2008 (that even accelerated over the last four years). This strong decline was confirmed by the retrospective analyses (**Figures 15** and **16**) and is in agreement with the catch curve analyses performed in 2012 and updated in 2014 (see SCRS/2012/029, SCRS/2014/115).

In the CR, the SSB peaked over 300,000 t in the late 1950s and early 1970s, followed by a decline to about 150,000 t. From the late 2000's onward, SSB exhibits a tremendous increase up to 585,000 t (**Figures 14**). However, the update of the 2012 Base Case until 2011 showed that the amplitude (ie value of the SSB in the terminal year) varies a lot according to small changes in the CAA or technical assumptions. Therefore, such a tremendous increase must be taken with caution. Recruitment (age 1) at the start of the time series varied between 2 and 6 million fish, dropped to around 1 million fish during the early 1960s, followed by a steady increase towards maximum values in the 1990s and early 2000's. Because of operational changes of the last three last years, it was no longer possible to reliably estimate recent recruitment from the catch-at-age analysis and data for the last three year classes are not shown (**Figures 14**). However, the local index of recruitment in the Gulf of Lions estimated by aerial surveys might imply higher recruitment over the recent period (SCRS/2012/124). The stock and recruitment relationship was described in **Figure 49**.

The CR was further investigated using an inflated CAA in the same way as it was done in the 2012 assessment (i.e., catch raised to 50,000 t from 1998 to 2006 and to 61,000 t in 2007, but no inflation of the reported catch was used since 2008). The results of the runs with the inflated catch were similar to those of the reported catch, except for the SSB trajectories (**Figures 14**). In the run using the reported catch, the SSB trend over 1975-2005 displayed mostly a steady decline followed by an increase since the late 2000s while the inflated catch scenario displayed a steep decline over 1975-1985 followed by a stabilized level of SSB when landing reached historical highest between 1985 and 2005 and an increase since then. The spawning biomass was approximately the same in 2013 in the reported and inflated catch scenarios. These results are also in agreement with those from the 2012 stock assessment.

The Group also examined the results of a sensitivity analysis to the data and parameters used to examine some potential effects of structural uncertainties unaccounted in the CR (i.e. assumptions about the choice of the CPUE series, inflated and reported catch, F- ratios, terminal ages, and recruitment, see **Table 7** and **Figures 17-19**). Changing the F-ratios led to a different perception of the stock status, a result which has been also reported in the 2010 and 2012 stock assessments (**Figure 18**). In general, all the sensitivity runs confirmed the strong in Fs and the rebuilding of the stock in recent years, but the speed and amplitude of the increase in SSB remain sensitive to technical assumptions, such as the F-ratios, slight changes in CAA and the choice of the CPUE series, as this was already the case in the 2012 stock assessment (**Figures 17 and 18**). For instance, only the split of the Japanese long-line index in the recent years induces a change of the level of the SSB in the terminal of about 20%. The most optimistic runs, such as the CR or CR_+Group16, led to a final SSB that is the double than the historical peak while other runs, such as CR_est_Fratio, led to a final SSB at the level of the historical peak (**Figure 18**).

Inspection of the diagnostic indeed identified various problems with the runs, particularly, as stressed in previous assessments, due to the quality of the data. For example the lack of cohort signal in the CAA (SCRS/2014/115) and the difficulty of the CPUE indices in tracking recent changes in ABFTE abundance due to management that directly has affected catch, effort and selectivity-at-age in the fisheries (see CPUE section). The poor quality of data translates into high sensitivity of the VPA to technical assumptions and minor changes to and noise in the CAA and CPUE indices.

The bootstrap was used to estimate uncertainty for each run. However, the bootstrap is also important in identify highly correlated or ill-defined parameters and lack of model convergence (SCRS/2014/072). The statistical assumptions must be borne in mind, i.e. in the bootstrap successive observations in a time series of data are assumed not to be correlated and to come from an independent identically distribution (iid). These assumptions are unlikely to be exactly true, and their violation (through for example the presence of positive auto-correlation) probably mean that results are biased and so underestimated uncertainty and risk. About 40% of boostraps were removed from the kobe phase plots and strategy matrices when a simulation had been identified as bad. The criteria for a bad simulation was if any parameters hit bounds, negative stock sizes were predicted or the objective function substantially different from the best fit to the original data.

The fits to the available CPUE indices continue to be poor. This was also the case in the past assessments, with heavy temporal trends in the residuals for most of the CPUE indices. This is especially the case for the Spanish

Bait Boat CPUE due to recent management regulations that have changed the selectivity of this fishery. The residual patterns remained relatively constant over all the different runs (**Figure 20**). The observed and expected values are plotted against each other in **Figure 21**; these allow a quick check of which indices are correlated with the population estimates, the black line is the Y=X line and the blue line a linear regression fitted to the data, if an index agrees closely with the VPA results then the blue and black lines will coincide. None of the CPUE indices showed a good fit, except the Japanese CPUE index in the last years, but this index only includes four points. As the bootstrap procedure resampled the residuals from the fits to the (CPUE), this poor fit also strongly affects the projections (see below and SCRS/2014/072).

The retrospective analysis for the VPA was conducted back to 2008. Retrospective patterns did not show any strong bias but significant variations in some cases (**Figures 15-16**). The highest uncertainties were observed on terminal estimates of fishing mortality at ages 2-5 and on the recruitment while estimates of F 10+ were more satisfactory for the different runs. This could reflect the difficulty of the CPUE indices to correctly take into account changes in the fisheries due the changes in management regulations, which created higher uncertainties for those ages. Note also that reported catch at age 1 has been very low since 2008 and almost equal to zero since 2010, which affects the VPA performance. The Committee noted that this is the first assessment to estimate extraordinarily large year classes in 2004-2007 (over 40% higher than the highest observed recruitments in the rest of the 64 year time series), and that these high estimates are driven mostly by the recent trends in the two fishery dependent indices for older fish. Therefore, caution is warranted until the very high estimates of recruitment for these year classes can be confirmed.

The Kobe plot shows the current stock status according to two reference points, the spawning biomass if the fishing mortality was equal to F0.1 (BF0.1) and fishing mortality (F0.1) (**Figure 22**). The lines are the medians of F/F0.1 and SSB/SSBF0.1 and correspond to the assumed recruitment level. The pattern of the trajectories was similar regardless the selectivity patterns selected but were highly dependent on the recruitment hypotheses. For all the scenarios and bootstraps, F in 2013 is clearly and significantly below F0.1 (**Table 12**). These results are in agreement with the 2012 stock assessment outputs and confirm that current exploitation rates are probably significantly below reference target. The perception of stock rebuilding continues to be dependent on the recruitment hypothesis, as it was in 2012 (**Figure 22**). In the low recruitment hypothesis, the stock would have fully recovered in 2013, as all the end points are in the green quadrant. Regarding the high recruitment hypothesis, the SSB appear below BF0.1 and the trajectories are mainly in the lower-left yellow quadrant (indicating that the stock was overfished, but not undergoing overfishing). The medium recruitment scenario is in between the high and low scenario, with approximately 1/4 of the end point in yellow quadrant and ¾ in the green one.

Estimates of the current stock status relative to MSY benchmarks led to the conclusion that *F2013* was below the reference target *F0.1*, as *F2013* /*F0.1* is about 0.40 for the reported catch scenario and 0.36 for the inflated catch scenario (**Table 13**). SSB was about 110 % of the biomass that is expected under a *F0.1* strategy using the reported catch (from 67% to 160% depending on the recruitment level hypothesis, **Table 13**). Under the inflated catch scenario, SSB was about 111% (from 55% to 174% depending on the recruitment level hypothesis) of the biomass that is expected under an *F0.1* strategy (**Table 13**). In other words, recent estimates of F and SSB indicate that the rebuilding plan would have fulfilled in 2013, i.e. *F2013* is largely under *F0.1* and *SSB2013* would be, in average, at reference level. However, the outputs of the VPA remain highly unstable due to poor fits and such outputs need to be confirmed by further analyses that would use other modeling approaches than the current VPA.

6.2 Stock status – West

This section summarizes the results from the VPA analyses described in **Section 5.2**. The input and output files of the VPA-2BOX software for the base VPA model (Run 4) are included as **Appendix 5**. The output report contains a complete description of the VPA results, including the matrix of estimated fishing mortality rates, abundance-at-age, stock biomass, recruitment, fits to indices, estimated index selectivities, F-ratios and F-at-ages in the terminal year.

6.2.1 Diagnostics

Fits to the indices of abundance for the 2014 base model (Run 4) are shown in **Figure 23** and compared to those of the 2012 base model in **Figure 24**. The fits to the relative abundance indices were similar between the 2012 base and 2014 base models, with a noticeable increase in model estimates for the Canadian Southwest Nova Scotia, U.S. rod and reel >177cm, and U.S. Gulf of Mexico longline indices (**Figure 24**).

The fits to indices from the jack-knife sensitivity analyses (where individual relative abundance indices were excluded one at a time) were similar to those of the base model (**Figure 25**), even when the most influential indices (Canadian GSL or US rod and reel > 177 cm) were removed. Fits to the indices for large fish (Canadian Gulf of St. Lawrence, Canadian Southwest Nova Scotia, U.S. rod and reel >177 cm, Japan longline Area 2, and U.S. Gulf of Mexico longline) generally showed an increase in recent years. This increasing trend was even more apparent when the U.S. rod and reel > 177 cm was dropped, as that index is the only one that suggested a decline in the abundance of older fish over the last decade. The increasing trend in the fits to the indices for large fish was less noticeable when the Canada Gulf of St. Lawrence index was dropped. Model fits were similar to the base model for most of the other sensitivity runs and are therefore not shown.

Histograms of the bootstrap estimates of 2013 stock status relative to maximum sustainable yield (MSY) from the base model run were constructed to examine the bias and normality of the distribution. For both the high and low recruitment scenario estimates of $F_{current}/F_{MSY}$, the median of the bootstraps tended to be lower than the point estimate, which implies that the point estimate may underestimate the true value. (**Figure 26**). Conversely, the bootstrap medians of SSB_{2013}/SSB_{MSY} tended to be slightly higher than the point estimate, implying that point estimate may somewhat overestimate the true value.

A retrospective analysis was conducted for the base run by sequentially removing inputs of catch and abundance indices in annual increments, back to 2008 (**Figure 27**). The long-term trend in estimated SSB was not highly sensitive to the retrospective removal of data; however, a systematic decrease in recent SSB was estimated as data were sequentially removed, particularly when the most recent two years of data were excluded. A retrospective analysis of the Canadian Gulf of St. Lawrence index jack-knife sensitivity demonstrated that the observed retrospective bias in the base VPA was a direct result of the recent estimates from that index, and that the retrospective bias pattern was not observed when the index was excluded (**Figure 28**). The estimated recruitment was less sensitive to the retrospective removal of data and showed no consistent pattern or evidence of a consistent bias. However, inclusion of the most recent data decreased the signal of the 2003 recruitment compared to the retrospective model runs. The retrospective results also show some variability in fishing mortality estimates for ages 5 to 9 (**Figure 29**), and in abundance estimates for ages 1 to 10 (**Figure 30**), but again with no consistent trends that indicate model bias.

6.2.2 Comparison of 2012 base model and 2014 VPA results

The 2014 continuity assessment and base model (run 4) are compared with the 2012 base assessment in **Figure 31**. The 2014 runs are consistent with previous analyses in that the SSB was estimated to decline sharply between 1970 and 1985, level off through the 1990s, and then begin increasing over the last decade (**Figure 31**). The estimated fishing mortality rate was very high during the 1970s, but decreased substantially during the following decade. Estimated fishing mortality fluctuated around 0.2 for the period from 1984 to 2005, with an observed decline since 2006. The fishing mortality rate on spawners (ages 9 and older) is estimated to have declined markedly since 2003, with the exception of 2006 when fishing mortality was estimated to be greater than 0.2. The estimates of recruitment (age 1) are highest for the early 1970‘s, fall sharply after 1975, and showed less annual fluctuation since that period. Relatively strong year-classes were estimated during 1988 and 2003, similar to results from previous assessments (e.g.. 2012).

Spawning stock biomass, recruitment, and fishing mortality estimates from the 2012 base, 2014 continuity, and 2014 base VPAs were similar from 1970 to the mid-1990s, but diverged for more recent years. In general, the base model (run 4) estimated a more rapid increase in SSB over the last decade compared to the previous assessment (26,600 mt in 2011 from the current base, 18,400 mt estimated for 2011 in the previous assessment) (**Table 14**, **Figure 31**), with correspondingly lower fishing mortality rates. The base model also estimated a higher recruitment level in 2004 (2003 yearclass) and 2003 (2002 year class) than was estimated during the 2012 assessment. The median trends and 80% confidence limits in spawning biomass, apical fishing mortality and recruitment are shown for the base model in **Figure 32**.

Comparisons between the 2014 continuity (Run 0), iterative revisions to the continuity (Runs 1, 2, and 3; described in **Section 5.2** and summarized in the following sentence), and the base model are summarized in **Figure 33**. The revision of the continuity to the base included: (1) modified partial CAA of the Canadian GSL and SWNS indices to be spatially explicit areas coinciding with the data used to construct the indices (**Table 9**); (2) expansion of the reference ages for the Canadian indices from ages 13-16 to ages 8-16 for the Gulf of St. Lawrence index, and from ages 8-14 to ages 5-16 for the Southwest Nova Scotia index; (3) splitting of the U.S. Gulf of Mexico longline index into two periods, 1987-1991 and 1992-2013 with the selectivity of the first period fixed at the estimated selectivity from Run 2; and (4) removal of the early period of the U.S. Gulf of Mexico longline index, 1987-1991. The base model included all modifications from iterations 1, 2, and 4. The SSB, apical fishing mortality and recruitment estimates were similar between the continuity, iterative revisions, and the base model, with the exception that splitting of the U.S. Gulf of Mexico longline index resulted in a noticeable increase in SSB. Recruitment in recent years showed little deviation across all model iterations (**Figure 33**).

6.2.3 Sensitivity Runs

The results of the jack-knife sensitivity analyses, in which indices were removed from the base model one at a time, are summarized in **Figure 34**. The Canadian Gulf of St. Lawrence and U.S. rod and reel > 177 cm indices were clearly the most influential of the indices. Both sensitivity runs resulted in an estimated increase in SSB in recent years, similar to the 2014 base model; however, exclusion of the Canadian Gulf of St. Lawrence indices resulted in a lower estimated SSB and noticeably flatter trend compared to the base model, and exclusion of the U.S. rod and reel >177 cm resulted in a higher estimated SSB than the base model.

A comparison of the various sensitivity run estimates to the base VPA is presented in **Figure 35**. Sensitivity runs that demonstrated a divergence in estimates of SSB from the base VPA included, age-dependent natural mortality (Run 19), alternative maturity schedule assumptions (Runs 20 and 21), catch-at-age estimation using an age-length key (Run 25), and splitting of the Canadian Gulf of St. Lawrence index (Run 26). Results from the maturity and natural mortality sensitivity analyses indicated that the estimates of SSB were sensitive to these assumptions. The assumption of early maturity (i.e. eastern Atlantic ogive with 50% maturity at age 4) resulted in greater estimated SSB over the entire time series and the assumption of late maturation (i.e. approximately logistic increase in maturity from 0% mature at ages 8 to 100% mature at age 16) resulted in decreased estimates of SSB compared to the base model (fully mature at age 9). The overall estimated long-term trend in SSB was not sensitive to the maturity schedule and the estimates of apical fishing mortality and recruitment were nearly identical across maturity sensitivity runs (**Figure 35**). Changing the natural mortality assumption from constant across ages to age-dependent mortality resulted in lower estimated SSB across the time series, and higher recruitment estimates (owing to the higher natural mortality rates assumed for young fish).

Aging of the catch-at-size using a preliminary average age-length key based on otolith-aged samples from the years 2009 to 2012 (**Table 15**, **Section 5.2.4**) resulted in a noticeable change in the pattern of estimated SSB in that the biomass in 1970 was estimated to be considerably lower, increased in the early period, and the long-term depletion trend was distinctly reduced compared to the base VPA (**Figure 35**). Application of the average age-length key also greatly reduced the recruitment estimates across the recent time period, particularly the 2003 age class, but did not decrease the recruitment signal for years prior to 1980. Other sensitivities, besides the natural mortality and age-length key, had little effect on recruitment estimates. Splitting of the Canadian Gulf of St. Lawrence into two period resulted in a reduced SSB trend over the last two decades compared to the base VPA (**Figure 35**), and comparison of the estimated selectivity patterns between the two time periods indicated a decrease in selectivity of ages 8, 9, 10, and 11, and increased selectivity of ages 13, 14, and 15 (**Figure 36**).

6.2.4 Stock status

A key factor in determining stock status is the estimation of the MSY-related benchmarks against which the current condition of the stock is measured. These benchmarks depend to a large extent on the relationship between spawning biomass and recruitment. Two alternative spawner-recruit hypotheses were explored, consistent with several prior assessments: the two-line (low recruitment potential hypothesis) and the Beverton and Holt spawner-recruit function (high recruitment potential hypothesis). The two-line model assumes recruitment increases linearly with SSB from zero to a maximum value (R_{MAX}) when SSB reaches the current carrying capacity (assumed to be lower than the historical carrying capacity observed during 1970 to 1975). Here the SSB threshold (hinge) was set at the average SSB during 1990-1995 (the period with the lowest estimated SSB), and R_{MAX} was calculated as the geometric mean recruitment during 1976-2010 (the recruitment estimates for the last three years were deemed unreliable). The Beverton and Holt function was fit to the SSB and recruitment estimates corresponding to the period 1971-2010. The fitted two-line (low) and Beverton and Holt (high) relationships are shown in **Figure 37**, along with a comparison of corresponding relationships from the previous assessment. The fitted curves are shown across an expanded range of SSB to demonstrate the difference in asymptotic properties of the Beverton-Holt model between the previous assessment and the current base VPA (**Figure 38**). The difference in the estimated stock recruitment relationship resulted in a decrease in the estimates of SSB at MSY compared to the previous assessment (2014 base VPA Beverton-Holt estimated steepness = 0.58, 2012 base VPA Beverton-Holt estimated steepness = 0.49).

Due to uncertainty in the estimation of the spawner-recruit relationship, reference points based on $F_{0.1}$ are presented in addition to F_{MSY} (consistent with the 2012 assessment). Note that $F_{0.1}$ is calculated as the fishing mortality rate corresponding to 10% of the slope of the yield-per-recruit curve at the origin; as such, it is calculated independently of the presumed spawner-recruit relationship. The spawning biomass corresponding to $F_{0.1}$, $SSB_{0.1}$, is calculated as the equilibrium level of spawning biomass achieved by fishing indefinitely at $F_{0.1}$ assuming either the high or low recruitment scenario.

Stock status was determined using the two-line (low recruitment potential) and Beverton-Holt (high recruitment potential) scenarios for the base model from 1970 to 2013 based on yearly estimates of F_{MSY} and SSB_{MSY} (**Figure 39**). The results under the two-line scenario suggest that the stock has achieved convention objectives since 1970 and that fishing mortality rates have also been at convention objectives since 1983. The results under the Beverton-Holt recruitment assumption suggest that the stock biomass has not achieved convention objectives since 1970 and the fishing mortality rates has not achieved convention objectives for most of the period of record with the exception of the most recent years, 2010 to 2013 when $F_{current}$ was estimated to be lower than F_{MSY} (**Figure 40**). The estimated trend in status of the stock since 1970, as well as the bootstrap estimates and median estimate for 2013 stock status are summarized for the two alternative recruitment hypotheses in **Figure 40**. A comparison of the base VPA estimates of stock status for both recruitment scenarios are compared to the influential jack-knife sensitivities (removal of the Canadian Gulf of St. Lawrence and the U.S. rod and reel >177cm) in **Figure 41**. The two jack-knife runs were included because their divergence from the base model helps to bracket the uncertainty in SSB and fishing mortality.

The two-line base model (low recruitment hypothesis) estimated recent F (geometric mean from 2010-2012) to be 0.36 F_{MSY} (0.28-0.43 at the 80% confidence level) (**Table 16**). In comparison, similar to the base VPA, the jack-knife sensitivity analyses resulted in estimates of F below F_{MSY}. Spawning stock biomass under the two-line recruitment hypothesis was estimated to be 2.25 SSB_{MSY} (1.92 to 2.68 confidence interval) and 1.27 $SSB_{0.1}$ (1.13 to 1.52 at the 80% confidence level) (**Table 16**). Under the Beverton and Holt recruitment hypothesis, recent F was estimated to be 0.88 F_{MSY} (0.64 to 1.08 at the 80% confidence level). Independent of the stock recruitment assumptions, current F relative to $F_{0.1}$ was estimated to be 0.60 (0.50 to 0.72 confidence interval). Spawning stock biomass under the Beverton and Holt recruitment hypothesis was estimated to be 0.48 of SSB_{MSY} (0.35 to 0.72) and 0.77 of SSB0.1 (0.58 to 1.04 at the 80% confidence level). A comparison of the estimated benchmarks to the estimated benchmarks from the previous assessment is presented in **Table 17**.

The results of this assessment do not capture the full degree of uncertainty in the population structure, assessments and stock projections. An important factor contributing to uncertainty is mixing between fish of eastern and western origin. Recent analyses have indicated that stock mixing occurs (empirical tag return information and otolith microchemistry) and that the stock assessment is sensitive to the stock mixing assumptions. Based on earlier work, the estimates of stock status can be expected to vary considerably depending on the type of data used to estimate mixing (conventional tagging or isotope signature samples) and stock mixing assumption. Research and data synthesis on stock mixing and modeling approaches have been recently undertaken and several papers were presented during the meeting. A stochastic, age-structured, stock-overlap simulation model was presented (SCRS/2014/170) that demonstrated the effects of seasonal migration, site fidelity, and recruitment on the perception of the eastern and western stocks, and potential bias in catch and index data. The simulation results were considered useful for identifying key model assumptions and research priorities for improving the assessment models and evaluating alternative management scenarios in the context of fish movement. A synthesis of regional stock mixing data based on otolith microchemistry was also presented (SCRS/2014/171), and provided estimates of proportions of eastern and western stock that could be used to allocate catches into stock components. Spatial and seasonal movement probabilities were presented based on a meta-analysis of satellite tagged bluefin (SCRS/2014/177) which provided a framework to derive transition matrices that could be used to estimate monthly transfer probabilities between stocks and regions. The group noted that coupled with the otolith microchemistry and genetic data, these techniques could provide a useful approach to move to an operating model for management strategy evaluation which incorporates stock-mixing models. Additional analyses and data integration needs to be done before these mixing models can be used operationally for management advice. Another important source of uncertainty is recruitment, both in terms of recent levels (which are estimated with low precision in the assessment), and potential future levels (the "low" vs "high" recruitment hypotheses which affect management benchmarks). Improved knowledge of maturity and mortality at age is needed which will also affect the estimates of yield-per-recruit and the perception of stock size and long-term trends. Two different treatments of the Canadian Gulf of St. Lawrence index (i.e., split and non-split) had a significant impact on the estimates of recent SSB. Therefore, it was agreed that further research on the Canadian Gulf of St. Lawrence index is also required to reduce uncertainties of the assessment results. The sensitivity run using the preliminary age-length key demonstrated the estimates of stock biomass and recruitment were sensitive to aging method, and further work to improve the empirical age-length key and its application is needed.

6.3 Stock status – West – Other methods

The results of the base VPA are compared with the alternative stock assessment models presented at the assessment workshop in **Figure 42**. The results of the statistical catch-at-length model (SCRS/2014/188 and SCRS/2014/195) showed good agreement in total estimated biomass (ages 1+) to the base VPA. Both models demonstrated a consistent pattern in stock biomass over the time series, including a decline in estimated biomass between 1970 and 1985, a period of relatively steady stock biomass between 1985 and 2005, and an increasing trend since 2005 (**Figure 42**).

The surplus production base model (SCRS/2014/183) estimated considerably less decline between the 1970 and the early 1980s, and an increasing trend in stock biomass since 1982 to near virgin biomass levels in the terminal year (87% virgin biomass in 2014) (**Figure 42**). The Group also recognized that the production model could be used to help understand the sensitivity of stock status estimates to the indices of abundance and suggested using likelihood profiles to identify which indices are most influential in the estimation of intrinsic population growth (r), carrying capacity (K), and benchmarks such as MSY. Several other suggestions were made, including to examine the full sensitivity of the results to starting biomass relative to K, the sensitivity to using numbers-based rather than weight-based indices of abundance, and creating a single index that better reflects the biomass trends of the entire stock (rather than using multiple indices that each reflect different age classes). It was also recommended that age-structured production models be explored to incorporate the age-specific dynamics of the stock and fisheries.

All three models indicate that the stock has been rebuilding in recent years. The Group noted that the SCAL and production model runs were preliminary and not ready to be considered as a basis for scientific advice.

7. Projections

7.1 Projections EBFT

7.1.1 Specifications.

Projections were carried out based on the VPA estimates for the run used for the CR. When projecting it is necessary to specify, biological parameters, selectivity patterns (including any modifications due to management measures that may be implemented), recruitment, and any modifications that may be made to circumvent the poorly estimated numbers-at-age for recent year classes from the VPA. As the current evaluation is an update, the projections were investigated similarly as it was done in 2012, i.e. using two historical catch levels (reported and inflated scenarios), the same three recruitment options (high recruitment being calculated over the 1990-2000 years, the medium one over the 1955-2006 years and the low one over the 1970-1980 years) and two selectivity patterns (geometric mean over the 2007-2009 years or over the 2009-2011 years from the CR, **Figure 43**).

Biological parameters were based upon the historical VPA values, i.e. natural mortality and proportion mature-at-age varied by age but were time invariant, while weights-at-age in the projections were derived from the average weights-at-age for ages 1 to 9 and the growth curve for the plus group (which allows changes in the mean of weight of the plus-group according to changes in the age composition due to the rebuilding/decline of the SSB). Since for the most recent year-classes in VPA numbers-at-age are poorly estimated, especially for the younger ages, the first 3 ages in the initial population vector (i.e. for 2011, 2012, and 2013) were replaced with a random value from the stochastic recruitment specifications. These values were then projected forward in time accounting for the observed catches and the assumed natural mortality at age. This results in changes to both the number at age in 2014 (i.e. the first projection year) and the fishing mortality-at- age for the replaced 3 year-classes.

The 12 projection scenarios based on the CR therefore comprised: (i) two historical catch levels (reported and inflated scenarios); (ii) three recruitment levels; and (iii) two selectivity patterns of the fisheries. These were run for the current quota (13,500 t) for comparison purposes. Subsequently projections with quotas ranging from 0-30000 t were conducted to create the Kobe matrix (**Tables 21-23**). Note however, that if the phase plots were based on the 12 projections scenarios, the Kobé matrices were only based on 6 projections scenarios (retaining only the selectivity pattern estimated from the updated assessment, as this was done in 2012.

7.1.2 Results

From the bootstraps analysis and the projections of the CR, the Group estimated the probability of the stock being in each of the Kobe phase plot quadrants from 2014 to 2022. The difference in the trajectories of the reported and inflated catch is a function of the selectivity patterns and the recruitment levels, and so also of the benchmarks. A Kobe pie chart was constructed to show the proportion of bootstraps that lay in the colored quadrant of the phase plot (**Figure 44**). Under constant current TAC (13,500t), the stock would have been already recovered in 2014 under the low and medium recruitment scenarios with higher 60% probability. Under high recruitment scenario, the recovery would be reached in 2019 (**Figure 44**). Current estimates also indicate that the rebuilding could be achieved by 2022 with TAC up to 30,000 t with higher 60% probabilities for the 3 recruitment scenarios (**Figure 44**). The Group, however, reiterates that it has little confidence in the Kobé 2 matrices outputs because of the poor fits of the VPA (see above) as well as unquantified uncertainties in the projections (especially future recruitment levels, current and future selectivity patterns).

7.2 Projections WBFT

7.2.1 Methods

As in 2012, the two recruitment scenarios discussed in **Section 5.2**: a low recruitment potential scenario (two-line model) that assumes average recruitment cannot reach the high levels from the early 1970s (ostensibly owing to some unknown change in the environment) and a high recruitment potential scenario that assumes the number of recruits is a Beverton and Holt function of the spawning biomass in the previous year, were considered. In past assessments of the stock, the working group indicated that there was no strong evidence to favor one scenario over the other and that the two scenarios provide reasonable (but not extreme) lower and upper bounds on rebuilding potential. The two alternative scenarios are presented as equally plausible, consistent with the prior assessment.

The projections for the western stock were based on the bootstrap replicates of the fishing mortality-at-age and numbers-at-age matrices produced by the VPA-2BOX software. Projections and benchmarks were computed for the Beverton and Holt (high) and two-line scenarios (low) to account for the uncertainty regarding the true form of the stock-recruitment relationship, consistent with the approach used during the 2012 assessment (see **Figures 37** and **38**). The Beverton-Holt stock-recruitment relationship was fitted to the estimates of SSB and recruitment for the 1970-2009 year-classes by means of maximum likelihood estimation (lognormal error structure). The extent of recruitment variability, σ_R, for each bootstrap replicate was equal to the maximum likelihood estimate (estimated within Pro-2box on a bootstrap by bootstrap basis). As in 2012, future recruitment was allowed to deviate from its expectation as a first-order multiplicative (lognormal) auto-correlated process. Generally, the lognormal structure is preferred because it does not admit negative recruitments, and because it allows the variance in recruitment to increase with its expectation. The autocorrelation parameter (ρ) was estimated to be equal to 0.418 for the base case.

The 2-line stock-recruitment relationship assumes a linear increase in recruitment from the origin to a “pivot” level of SSB above which recruitment is independent of SSB. The “pivot” spawning stock size is defined as the mean spawning stock size over 1990-95 (the period that includes the lowest estimates of spawner biomass). The constant level of recruitment is defined as the geometric mean recruitment over the years 1976-2010, a period over which recruitment showed less variation compared the full time series. Similar to the Beverton-Holt model, the 2-line stock recruitment relationship used a first-order auto-correlated process with the standard deviation (σ_R) estimated on a bootstrap by bootstrap basis and the autocorrelation parameter (ρ) estimated at 0.359.

The recruitment estimates from the VPA for recent years, 2011 to 2013, were replaced with mean predicted values of stock-recruitment model with associated standard deviation (for both low and high recruitment scenarios). Numbers and fishing mortality-at-age for ages 1-3 at the start of 2011 were therefore re-calculated by projecting these generated recruitments forward under the known catches-at-age. The projected partial recruitment (which combines the effects of gear selectivity and availability of fish by age) was calculated from the geometric mean values of fishing mortality-at-age for the years 2010-2012 (rescaled to a maximum of 1.0).

The average age of the plus-group at the start of the projections was computed from the observed average weight of the plus-group in the last year of the VPA by inverting the growth curve. The average age of the plus-group was then updated in subsequent years of the projection and the weight of the plus-group computed from the updated average age by use of the growth curve (as done in 2012). In this way, the average weight of the plus-group is allowed to increase with reductions in the fishing mortality rate. The projected catch for 2014 was assumed to be equal to the current total allowable catch (TAC) of 1,750 t [Rec. 12-02]. For years beyond 2014, projections were continued using various levels of constant catch with the restriction that the fully-selected (apical) F was constrained not to exceed 2 yr^{-1}.

Medium-term projections were conducted to cover the time of the rebuilding plan (2019) and extended to 2025. Projected SSB was expressed relative to the SSB associated with MSY and $F_{0.1}$ (i.e., SSB_{MSY}, $SSB_{0.1}$) for the appropriate recruitment scenario. SSB_{MSY} was used as a reference level for rebuilding because it is the target of the current rebuilding program. The reference point $F_{0.1}$ is often used rather than F_{MSY} by other stock assessment groups, particularly when the stock-recruitment relationship is poorly known. It should be noted that $F_{0.1}$ is calculated independent of an underlying stock recruitment relationship in VPA-2BOX, and in some cases $F_{0.1}$ can exceed F_{MSY} because of stock-recruitment relationship effects. The projected estimates of $SSB_{0.1}$ presented here assume the two alternative stock-recruitment prediction models.

7.2.2 Results

The recruitment expected at SSB_{MSY} was much lower under the two-line scenario (96,500 individuals) than with the Beverton-Holt scenario (210,000 individuals), with correspondingly lower estimates of MSY and SSB_{MSY}. However, the two-line and Beverton-Holt scenarios predict similar levels of recruitment when spawning stock sizes are low (i.e., SSB between 5,000 and 13,000 t).

Projections of SSB from the base VPA were made through 2025 under constant catches of 0 t to 3500 t in 100 t intervals, with an additional projection at the current TAC of 1,750 t [Rec. 12-02]. The associated benchmarks for the base case are given in **Table 19**. The results assuming low recruitment potential (**Figure 45**) indicate there is better than a 60% chance that the stock is currently at or above the convention objective (SSB_{MSY} = 12,900 t). Accordingly, there is less than a 50% chance of overfishing if catches are maintained at less than or equal to the maximum sustainable yield (2,650 t). The outlook under high recruitment potential is very different, indicating that the stock has 0.8% current probability of being at the convention objective (i.e. the stock is estimated to be overfished, but not experiencing overfishing).

The median estimates of projected SSB, SSB/SSB_{MSY}, F, F/F_{MSY}, F, $F/F_{0.1}$ and recruitment for the high and low recruitment scenarios are shown in **Figures 45** and **46** Under the low recruitment potential scenario, the current TAC will lead to the 2019 SSB (the terminal year of the rebuilding plan timeline) being higher than the estimated SSB for 2013. Constant catches at 2250 t would lead to no increase in the SSB in 2019 compared to 2013, while catches above 2250 t will result in the 2019 SSB being smaller than the 2013 SSB. The high recruitment potential scenario (**Figure 46**) suggests that the western stock will not rebuild by 2019 even with no catch (0 t), although the current TAC was estimated to have ended overfishing in 2010 and initiated rebuilding in recent years. At the current TAC of 1,750 t, the high recruitment scenario indicated that the stock is not expected to be rebuilt to SSB_{MSY} before 2025. The 60th percentile of projected SSB/SSBMSY and F/FMSY were also computed, and are illustrated in **Figure 47**. In general, the trends at the sixtieth percentile were similar to the median trend estimates.

Spawning stock biomass predictions were similar between the low and high recruitment scenarios for the period 2014 to 2019 (**Figure 48**). Comparison of results with the previous update assessment showed that the 2014 estimated stock biomass trajectory under the low and high recruitment scenarios is considerably higher than the results of the 2012 assessment. The 2014 assessment also indicated a higher level of SSB and SSB relative to MSY between 2014 and 2019. The projected stock status under the two recruitment scenarios resulted in different estimates of overfished status ($SSB < SSB_{MSY}$), but both scenarios indicated that the recent harvest levels were below the overfishing threshold ($F>F_{MSY}$).

The Kobe 2 Strategy Matrices are summarized in **Tables 18 to 20**. **Table 18** summarizes the probability that various constant catch policies will prevent overfishing. **Table 19** summarizes the probability that various constant catch policies will allow rebuilding under the low and high recruitment scenarios or maintain SSB above SSB_{MSY}, whereas **Table 20** summarizes the joint distribution ($SSB>SSB_{MSY}$ and $F<F_{MSY}$). The results presented in these matrices are consistent with those discussed above (**Figures 45** to **47**).

8. Recommendations

8.1 Research Recommendations

1) The Species Group recommends continuing the biological studies for bluefin tuna, specifically for improving the knowledge on its variability in distribution and behavior, complex population structure (by genetic, microchemistry and other advanced methodologies), mixing, and the age estimation of captures. These studies shall be conducted on a routine basis, because they are all extremely important for the stock assessment and for taking into account annual variability. Sampling throughout the stock distribution area is essential, particularly for those areas where samples are not available so far. The ICCAT GBYP framework is the tool for carrying out all these tasks over the entire ICCAT convention area.

2) Given the GBYP initiative to conduct enhanced biological sampling, and the work done to establish a reference collection of otoliths and create standard ageing protocols, the Group recommends that a central digital repository be established to contain the current reference collection data as well as future contributions from CPCs and other institutions. This database must contain the reference images, direct ages and associated metadata. Once established, the SCRS should request that this information be submitted on an annual basis.

3) Reliable evaluation of Atlantic bluefin tuna stock status is hindered by the lack (or low quality) of catch, catch/effort and size statistics over time for some of the major fleets. Effort to improve the temporal and spatial coverage for detailed size and catch-effort statistics of the main fisheries, especially in the Mediterranean, should be continued and even increased, using new technologies (e.g. stereoscopic camera for size data and VMS data for effort).

4) Given concerns raised regarding the conflicting trends in CPUE indices for Atlantic Bluefin tuna with regard to changing fishery, population density, oceanographic or regulatory dynamics, there is a need to evaluate how to deal with these factors. Considerations include, but are not limited to:
    - should indices be split or maintained when changes in catchability may have occurred
    - can changes in catchability be estimated within or external to models
    - how or should post-hoc corrections to indices be applied
    - can separate indices be combined (e.g. Gulf of St. Lawrence and U.S. rod and reel >177cm) into joint indices, or new indices (longlines)
    - can oceanographic covariates explain divergences in indices (e.g., Atlantic warm pool and SWO CPUE)
    - Can spatial habitat utilization maps determined from PSAT tagging or externally derived spatial abundance estimates (e.g. a mark-recapture estimate of abundance in the Gulf of St. Lawrence) be used to determine the fraction of the population 'seen' by an index.

8.2 Management Recommendations

8.2.1 East

In [Res. 09-06, 10-04, 12-03, and 13-07] the Commission established a total allowable catch for eastern Atlantic and Mediterranean bluefin tuna between 12,900 t and 13,500 t since 2010. Additionally, in [Rec. 09-06] the Commission required that the SCRS provide the scientific basis for the Commission to establish a recovery plan with the goal of achieving BMSY through 2022 with at least 60% of probability.

The Kobe matrices are presented indicating the probabilities of i) F<FMSY (**Table 21**) ii) SSB>SSBMSY (**Table 22**) and iii) (F<FMSY and SSB>SSBMSY) (**Table 23**) for quotas from 0 to 30,000 t for 2014 through 2022. Shading corresponds to the probabilities of being in the ranges of 50-59%, 60- 69%, 70-79%, 80-89% and greater or equal to 90%. It should be kept in mind, however, that the Kobe matrices cannot integrate some important sources of uncertainties that currently remain unquantified.

The implementation of recent regulations through [Recs. 13-07, 12-03, 10-04, 09-06, and previous recommendations] has clearly resulted in reductions in catch and fishing mortality rates, and in a substantial increase in the spawning stock biomass for the Continuity run and the 7 sensitivity analyses of the updated assessment. All CPUE indices show increasing trends in the most recent years. However, the Committee notes that the present assessment is an update of the 2012 assessment which relies only on a Continuity model and 7 sensitivity analyses. This update showed lack of the stability of VPA results to slight changes in data inputs and model specifications

In the light of the results of the updated assessment, there are continuing positive signs of the success of the rebuilding plan and the efficiency of the management measures taken by the Commission. Noting that the goal of achieving Bmsy (through 2022) with at least 60% probability might already have been, or will soon be reached, the Commission should consider adding a new phase to the current recovery plan.

The Committee noted that maintaining current TAC or moderately and gradually increasing over recent TACs under the current management scheme should not undermine the success of the rebuilding plan and should be consistent with the goal of achieving FMSY and BMSY through 2022 with at least 60% of probability. However, as the Committee was not able to provide the Commission with a robust advice on an upper bound for the TAC because of differing views about the implications of the uncertainties associated with the assessment, no agreement could be reached about the upper limit for such an increase that would not jeopardize the recovery of the stock. In equivalent situations, other scientific fora have similarly recommended moderate increases of the TAC, in applying the precautionary approach. To this end, and among other possible targets (e.g. F0.1, Fmax, etc.), a gradual increase (in steps over e.g. 2 or 3 years) of the catch to the level of the most precautionary MSY estimate would allow the population to increase even in the most conservative scenario (low recruitment scenario), noting the Commission's desire to maintain the stock in the green zone [13-07]. Nevertheless the SCRS scientists were not able to reach a consensus on the number of steps to complete the rebuilding plan, or on the management strategies.

Such stepped increases should be reviewed annually by the Commission on the advice of the SCRS (such reviews should consider stock indicators but would not necessarily extend to update stock assessment).

8.2.2 West

In 1998, the Commission initiated a 20-year rebuilding plan designed to achieve SSB_{MSY} with at least 50% probability. In response to recent assessments, the Commission recommended a total allowable catch (TAC) of 1,900 t in 2009, 1,800 t in 2010 [Rec. 08-04] and 1,750 t in 2011, 2012,2013 and 2014 [Rec. 10-03, Rec. 12-02, 13-09].
The 2014 assessment indicates similar historical trends in abundance as in previous assessments, but a more rapid increase in recent years. The strong 2002/2003 year classes and recent reduction in fishing mortality have contributed to this in recent years.

Future stock productivity, as with prior assessments, is based upon two hypotheses about future recruitment: a 'high recruitment potential scenario" in which future recruitment has the potential to achieve levels that occurred in the early 1970s and a "low recruitment potential scenario" in which future recruitment is expected to remain near present levels (even if stock size increases). The results of this assessment have shown that long term implications of future biomass are different between the two hypotheses and the issue of identifying one of these two hypotheses, or an alternative one, as being the more realistic remains unresolved.

Probabilities of achieving SSB_{MSY} within the Commission rebuilding period were projected for alternative catch levels (**Figures 45-47**). The "low recruitment potential scenario" suggests that spawning biomass is currently above SSB_{MSY}, whereas the "high recruitment potential scenario" suggests that SSB_{MSY} has a very low probability of being achieved within the rebuilding period. Despite this large uncertainty about the long term future productivity of the stock, under either recruitment scenario catches of less than 2,250 t are estimated to allow the spawning biomass to be at or above current levels by 2019 (with 50% probability) and this level of catch should not be exceeded. Maintaining catch at current levels (1,750 t) is expected to allow the spawning biomass to increase more quickly, which may help resolve the issue of low and high recruitment potential.

Should the Commission decide to have a scientific research quota (such as proposed in SCRS/2013/200, SCRS/2013/203) then that quota should be included within a TAC that is consistent with the scientific advice above. The Committee notes continued stock growth will increase ability to discriminate between alternative recruitment hypotheses.

9. Responses to the Commission

9.1 Continue to explore operationally viable technologies and methodologies for determining the size and biomass at the points of capture and caging and evaluate the BFT pilot studies to estimate both the number

and weight of bluefin tuna at the point of capture and caging using stereoscopical systems, Rec.[13-07] paragraph 88

Background: *[Rec. 13-07] paragraph 88 requests CPCs to provide to the SCRS data and information collected under pilot studies implemented to better estimate both the number and weight of bluefin tuna at the point of capture and caging including through the use of stereoscopical cameras systems or alternative techniques that provide the equivalent precision and shall cover 100% of all cagings in order to refine the number and weight of the fish in each caging operation. The SCRS shall continue to explore operationally viable technologies and methodologies for determining the size and biomass at the points of capture and caging and report to the Commission at the 2014 annual meeting.*

In 2014 six flags started submitting size and weight measures of bluefin tuna at caging operation using stereo camera video systems. However the data submitted did not include technical specifications on the operation and software used. Document SCRS/2014/141 summarized size distribution of the data provided and compared the modal distributions to back-calculated harvest size data from previous years (2010-2013). Differences were found between the density and size frequency distributions by flag and it was not possible to determine if these differences reflect differences in the catches of different years or in the methodologies related to back-calculating catch at size from harvest data.

The Group recommended that procedures for the use of the stereo camera, calibration and estimation of size from video recording be standardised and made available to the SCRS. It was also requested that the Secretariat provide a standard electronic format for data submission to the CPCs.

The Group also recommends reviewing and providing appropriate conversion factors to estimate weight based on the size measures. Finally the Group recommends use of the stereo camera measurements to validate methods that use size and weight at harvest data for estimation of size frequency of bluefin catch destined to farms. New results including area/time specific relationships will be presented during the next data preparatory group.

9.2 Evaluate the BFT national observer programmes conducted by CPCs to report the Commission and to provide advice on future improvements, Rec.[13-07] paragraph 90

Background: *[Rec. 13-07] paragraph 90 requests CPCs to provide to the SCRS data and information collected under each CPC's observer programme in accordance with requirements and procedures to be developed by the Commission by 2009 taking into account CPC confidentiality requirements.*

The Commission calls the SCRS to report on the scientific aspects of the programme. The report shall include:

- *The coverage level achieved by each CPC.*
- *A summary of the data collected and any relevant findings associated with those data.*
- *Recommendations to improve the effectiveness of CPC observer programmes.*

In accordance with Recs. 12-03 and 13-07, data collected under the national bluefin tuna observer programmes has been submitted to the Secretariat. No format has been developed for this data submission as of yet, although potentially the general observer data collection forms developed and presented to the Sub-Committee on Ecosystems in 2014 could be used. As such several CPCs have submitted data describing their observer programmes (using statistical from CP45), but not the actual data collected by them. Should the newly developed observer forms be adopted for bluefin tuna observer programmes as well, this problem may be resolved and the Committee will be able to provide a more detailed response to the Commission.

9.3 Provide updated BFT growth rates tables based in the information from BCDs and other submitted data, Rec.[13-07], paragraph. 98

Background: *[Rec. 13-07] paragraph 98 requests the SCRS to review information from BCDs and other submitted data and further study growth rates so as to provide updated growth tables to the Commission by the 2014 annual meeting.*

Harvest data from over 130,000 caged bluefin were analysed in document SCRS/2014/162 to estimate maximum potential growth factors in farms (not any specific farm). The document presents possible proxies of "maximum" growth, based on the probability distribution of variance of weight at size, from 3 alternative statistical models, using the 75% percentile of the cumulative density functions. These estimated proxies were compared to the current maximum growth table adopted by the SCRS in 2010. Two of the estimated proxies were found to be lower. This analysis confirmed that farming increases the weight compared to similar sized wild fish and indicated that there were seasonal effects on growth. However, it was concluded that the differences between the growth proxies and the current growth table should be further reviewed and evaluated before an updated growth table can be submitted to the Commission.

9.4 Review the technical specifications of the use of stereoscopic cameras systems as defined in Rec. [13-08]

Background: *[Rec. 13-08] paragraph 6 requests the SCRS to review the technical specifications of the use of stereoscopic cameras systems as defined in paragraphs 1 to 5 of this recommendation. The SCRS shall also provide any recommendations to improve the system.*

Six CPCs submitted in 2014 size and weight data from measures at caging operations using stereoscopic cameras systems. However information on the specific details of the technical specifications of the stereoscopic cameras systems used was not provided. Therefore, the Committee was not able to review or compare the specification provided in Rec. [13-08]. The Committee recommends that CPCs using stereoscopic cameras systems do provide to the Secretariat the specification of their applications including:

- Logistic settings of the cameras between the holding cage and transferring nets.
- Specifics of the cameras, distance, video recording specification, count and size determinations specifics.
- Software and settings for converting digital images and measures to actual size equivalent measure, as well as conversion factors for weight.

These specifications should be provided in conjunction with the size and weight data submitted. A preliminary review of the stereoscopic camera data collected and submitted is provided in SCRS/2014/141.

9.5 Provide answer to the requests from the 2nd WG WBFT Fisheries Managers and Scientists

One of the objectives of the Science and Manager meeting in Prince Edward Island, Canada, was to explore options/proposals for the development of new fishery independent indices of abundance and the improvement of existing bluefin tuna indices. In this context Japan proposed a longline CPUE survey in the intermediate area of three nations' fishing grounds. To complement this enhanced survey, the SCRS discussed the potential for a new index comprised of combined existing CPUE data from the Japanese, Canadian, and U.S. fleets operating in the northwest Atlantic. The combined index would require access to set-by-set data from the respective CPC. There was general consensus that such a CPUE index could make a significant contribution to the future WBFT stock assessment. The SCRS recognized the potential obstacles that might arise due to the data confidentiality rules of the different CPCs. However, the SCRS also agreed that possible venues to estimate the combined CPUE using set-by-set data should be explored (recognizing the confidentiality requirements of each CPC), and it strongly encouraged Japan, Canada, and U.S. scientists to collaborate in the development of a new index. It was suggested to start the collaborative work using the existing aggregated data which has no confidentiality constraints while pursuing options for bringing together higher resolution data. To achieve this objective it was recommended that a small working group with 1-2 scientific representatives from Canada, Japan, Mexico and the USA be established (in 2015) to investigate approaches for combining raw catch/effort data for CPUE from each country into a new index (or indices) of abundance for western Atlantic BFT.

A number of proposals were presented on the development of new fishery (dependent and independent) indices of abundance and the improvement of existing indices for bluefin tuna at the meeting of the Working Group of Fisheries Managers and Scientists, Charlottetown, PEI. It was recommended that the results of this work and that the novel proposals be presented to the SCRS in September 2014 for review and evaluation. Unfortunately, given the time commitment required for an update assessment of both the eastern and western stocks, insufficient time was available to review the specific details of each proposal. A general evaluation matrix was developed (**Tables 24** and **25**) and the criteria for each proposal formulated by the proponent CPC. It should be noted that each of the proposals were vetted through their national scientists and the Science/Managers workshop, as such each has scientific merit to address a variety of issues and would make a valuable contribution to the western BFT stock assessment. The SCRS generally agreed that these projects could contribute to the development of new indices and improvements to the old, and supports the further development of formal proposals by the CPCs for the proposals which require scientific quota or funding from the Commission. However, the projects were not rated for priority or benefit.

The 2nd Meeting of the WG WBFT Fisheries Managers and Scientists also made the following requests:

Provided that it does not interfere with the current work program of the SCRS deriving from previous decisions of the SCRS and the Commission, the WG requests the SCRS to:

1) Consider the proposal from Canada to employ the surplus production model in association with the update of stock assessment in 2014.

2) As part of the 2014 update assessment of western Atlantic bluefin tuna, provide guidance on a range of fish size management measures for western Atlantic bluefin tuna and their impact on yield per recruit and spawner per recruit considerations. The SCRS should also comment on the effect of fish size management measures on their ability to monitor stock status.

3) Provide to the 2014 Commission meeting for its consideration: A range of potential interim target reference points based on levels expressed in the percentage of currently estimated spawning stock biomass taking into account relevant factors including, but not limited to, the estimated speed of increase of the spawning stock biomass, levels of recent recruitment, and the level corresponding to a biomass enabling the SCRS to determine if there is an applicable recruitment scenario for the western Atlantic bluefin tuna stock. A Strategy Matrix to achieve these interim target reference points; a limit reference point, taking into account the historically lowest level of spawning stock biomass; a Strategy Matrix to avoid dropping below the interim limit reference point.

The Committee did not have sufficient time to fully address all of these requests, but offers the following responses until the matters can be considered more adequately.

1) The second meeting of the Working Group of Fisheries Managers and Scientists in Support of the WBFT Stock Assessment requested that the Working Group on bluefin tuna consider a proposal from Canada to employ a surplus production model in association with the update stock assessment in 2014, provided it did not interfere with the current work plan. The SCRS agrees that it is useful to evaluate all methods appropriate for the available data and life history of the species in question, which in some cases may include production models. However, the SCRS expressed concern that the Commission was prescribing which methods the SCRS should employ. Nevertheless, in support of the Commission's request, the Group reviewed document SCRS\2014\183. The Group did not reach a consensus on the merits of using production models of the kind discussed in SCRS/2014/183 to provide scientific advice on the status of Atlantic bluefin tuna. It was pointed out that such production models ignore information on the size or age structure of the catch and assume that all age classes are equally vulnerable to the fishery (which is clearly not the case for Atlantic Bluefin tuna). However, it was also noted that past working Groups have explored the use of age-structured production models and that it might be worth exploring those approaches again. The Group agreed that the surplus production model might be useful as a possible management procedure tested in a management strategy framework.

2) The Committee was unable to conduct any new bluefin tuna yield per recruit analysis to address this particular question during the 2014 stock assessment meeting due to time constraints and, therefore, it reiterates the response provided to the Commission in 2012 (paragraph below). The Committee indicated that, if time permits, it will evaluate the impact of adopting alternative larger size limits that take into consideration the age of maturity of western bluefin tuna, on the yield per recruit and spawner per recruit during 2015.

   The Committee recalls that in 2012 it reviewed yield-per-recruit calculations using various selectivity patterns by gear based on the 2010 assessment results and for decreased selectivity pattern by up to 40% for ages 1 to 6 for the whole fishery based on the 2012 assessment results. The Committee recognized that Y/R and SSB/R could be improved by changing the selectivity pattern (decreasing the selectivity of ages 1-6 by 40% resulted in only modest improvements), but this would imply allocation changes with implications beyond strict Y/R and SSB/R considerations. In addition, the Committee was concerned that such changes in selectivity would affect the availability and utility of indices of stock sizes currently used in the assessment. Furthermore, regulations to decrease the catches of ages 1 to 6 bluefin tuna may have unintended negative consequences such as increased discard mortality, which may be difficult to monitor, and changes due to reallocation of effort which may be difficult to predict.

3) The target spawning stock biomass for western Atlantic bluefin tuna is currently based on the level that would support MSY (SSB_{MSY}), with the goal of attaining this target by 2019 (Rec. 98-07). The calculation of MSY and SSB_{MSY} is dependent upon assumptions about the underlying stock-recruitment relationship; the SCRS currently provides management advice assuming two alternative stock recruitment scenarios which are broadly divergent in their estimates of SSB_{MSY} for Atlantic bluefin tuna. Therefore it is difficult to implement Harvest Control Rules using MSY based reference points. There are several potential candidates for an interim target reference point that can serve as a proxy for MSY-based targets, but do not require any assumptions about the stock-recruitment relationship. One that has been suggested for bluefin tuna in the past is $F_{0.1}$ (a fishing mortality rate based on yield per recruit considerations) and the associated biomass target $SSB_{F0.1}$. In some cases $SSB_{F0.1}$ has been derived using an assumed stock-recruitment relationship, however one could also simply assume that future levels of recruitment in the near-term are likely to be similar to estimates of recruitment from the recent past and treat the resulting calculation of $SSB_{F0.1}$ as an interim (short term) target that would be updated with each assessment. Other proxies such as spawning potential ratio (SPR) have been used for other fisheries, although determination of which level of SPR that is appropriate requires some additional work.

ICCAT has no official definition of a limit reference point. As part of Harvest Control Rules, a limit reference point (LRP) is intended to restrict harvesting so as to avoid highly undesirable states of the stock, such as recruitment overfishing, from which recovery could be irreversible or slowly reversible. LRPs can be set based on fishing mortality rates or related to biomass levels; in this case, it is interpreted that the Commission is referring to biomass related LRP. In the context of recent discussions of harvest controls within the SCRS, and for this response, a biomass related LRP is defined as a boundary (e.g. in terms of absolute or relative biomass levels, spawning potential ratios (SPR), etc.) which, if crossed, would require the cessation of harvesting until the stock has recovered to a level above the LRP. Additional Harvest Control Rules can be put in place to work in conjunction with the LRP to avoid falling below the LRP with high probability. Note that LRPs need to be considered in conjunction with related management measures as some of the possible LRPs referred to here are used in other RFMOs, but not necessarily as a point where the cessation of harvesting is required. It was also pointed out that the LRP paradigm effectively assumes that stock status is known exactly, whereas in reality this is subject to uncertainty, which leads to problems in making recommendations on this basis; a primary purpose of MSE approaches is to avoid these problems.

For the western bluefin tuna stocks, it is preferable to base the LRP on parameters which are not dependent upon a particular stock recruitment scenario. Options for limit reference points include:

- Biomass levels considered necessary to avoid recruitment overfishing, to preserve genetic diversity, ensure spawning success and/or maintain robustness to changes in environmental conditions, etc. These can be absolute or relative.
- SSB levels based on historical estimates.
- SPR (spawning potential ratios).
- Values of directly “observable” quantities such as (preferably fishery-independent) abundance indices which are independent of the assumptions associated with assessments.

As an example, an interim limit reference point of SPR (e.g. 20%, 30%, 40%) could be used for the western bluefin tuna stock. In such a case, were the Commission to adopt a set of Harvest Control Rules that incorporated this LRP, if the SPR (calculated, for example, from the ratio of the fished spawning stock biomass per recruit [SSBR] to the unfished SSBR) should fall below the prescribed level, fishing on the stock should cease until the SPR is once again greater than that level. A measure like $F_{0.1}$ could also be considered as a fishing mortality limit reference point, with a target reference point set as some fixed percentage of $F_{0.1}$.

The Committee reviewed results based on simulation modeling (SCRS/2014/145) which indicate that setting adequate target F levels with a Harvest Control Rule for eastern BFT could increase long-term harvest, permit greater stability in annual TACs, and maintain low probabilities of recruitment overfishing. However, the Committee previously identified some limitations in this approach and recommended further analyses. Management strategy evaluations (MSE) can help characterize the relative performance of specific reference points in regards to achieving management objectives and the risk of stock levels falling below defined reference points (limits and thresholds) for a series of target reference points under specific Harvest Control Rules (HCR), similar to those conducted for the eastern BFT may help to characterize the relative performance of specific target reference points. The Committee noted the GBYP program is well-along in developing a framework for conducting MSEs for Atlantic bluefin tuna. Further guidance from the Commission is required in order to define these target reference points, as they may be dependent on such criteria as the desired probability for maintaining stocks in a not-overfished, non-overfishing status (e.g. an appropriate percentage of F_{MSY}), or for avoiding stock collapse. In general, it must be remembered that MSE effectively integrates over the range of alternative plausible assessments and does not relate straightforwardly to reference points as defined in the "best assessment" paradigm; instead MSE focuses on trade-offs between attainment of often conflicting objectives, as expressed in terms of performance statistics.

Due to time constraints, the SCRS could not prepare Strategy Matrixes for each example of the reference points.

10. Other matters

No other matters were discussed.

11. Adoption of the report and closure

The report was adopted.

The Chairmen thanked the participants for their hard work and the meeting was adjourned.

References

Rooker JR, Secor DH, DeMetrio G, Schloesser R, Block BA, Neilson JD (2008) Natal homing and connectivity in Atlantic bluefin tuna populations. Science 322:742-744

Table 1. Task I catch data (t) of Atlantic northern bluefin tuna (*Thunnus thynnus*) by major area, gear and flag (as used in the BFT stock assessment, 2014-07-01). The last column (2013*) shows Task 1 catches for 2013 as available during the SCRS.

			1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2013*
TOTAL			23819	26027	29349	34131	36635	48853	49711	53320	49489	42375	35228	36541	37390	37089	33469	33505	37602	32501	36154	25849	21730	13024	11781	12606	14609	14817
BFT-E			21061	23247	26429	31849	34268	46740	47285	50807	47155	39718	32456	33766	34605	33770	31163	31381	35845	30689	34516	23849	19751	11148	9774	10852	13133	13333
	ATE		5433	6040	6556	7619	9367	6930	9646	12663	13539	11376	9628	10528	10086	10347	7362	7410	9036	7535	8037	7645	6684	4313	3984	3834	4117	4159
	MED		15628	17207	19872	24230	24901	39810	37639	38144	33616	28342	22828	23238	24519	23424	23801	23971	26810	23154	26479	16205	13066	6835	5790	7019	9016	9173
BFT-W	ATW		2759	2780	2920	2282	2367	2113	2425	2514	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1876	2007	1754	1476	1484
Landings	ATE	Bait boat	1971	1693	1445	1141	3447	1980	2601	4985	3521	2550	1492	1822	2275	2567	1371	1790	2018	1116	2032	1794	1260	646	636	282	236	236
		Longline	962	1496	3197	3817	2717	2176	4388	4788	4534	4300	4020	3736	3303	2896	2750	2074	2713	2448	1706	2491	1960	1194	1157	1166	1154	1192
		Other surf.	1020	562	347	834	1548	932	1047	646	511	621	498	703	712	701	560	402	1014	1047	502	187	298	143	36	48	142	145
		Purse seine	0	54	46	462	24	213	458	323	828	692	726	1147	150	884	490	1078	871	332	0	0	0	1	0	0		2
		Sport (HL+RR)	2	1	0	0	0	0	0	0	162	28	33	126	61	63	109	87	11	4	10	6	2	23	19	25	21	21
		Traps	1478	2234	1522	1365	1631	1630	1152	1921	3982	3185	2859	2996	3585	3235	2082	1978	2408	2588	3788	3166	3164	2307	2137	2311	2564	2564
	MED	Bait boat	0	25	148	158	48	0	206	5	4	11	4	0	0	1	9	17	5	0	0	0	38	0	0	0	9	9
		Longline	1121	1026	2869	2599	2342	7048	8475	8171	5672	2749	2463	3317	3750	2614	2476	2564	3101	2202	2656	2254	1344	875	869	585	605	605
		Other surf.	3289	1212	1401	1894	1607	3218	1042	1197	1037	1880	2976	1067	1096	990	2536	1106	480	301	699	1022	0	275	223	26	71	71
		Purse seine	9450	11250	13245	17807	19297	26083	23588	26021	24178	21291	14910	16195	17174	17656	17167	18785	22475	20020	22952	12641	11395	5057	4293	6094	7911	8069
		Sport (HL+RR)	457	1552	738	951	1237	2257	3556	2149	2340	1336	1622	1921	1321	1647	1392	1340	634	503	78	137	146	346	226	177	189	189
		Traps	1311	2142	1471	821	370	1204	772	601	385	1074	852	739	1177	515	221	159	115	129	95	152	144	281	165	125	222	222
	ATW	Longline	698	739	894	674	695	539	468	547	382	764	914	858	610	729	186	644	425	565	420	606	366	529	743	478	467	474
		Other surf.	755	536	578	509	406	307	384	432	293	342	281	284	202	108	140	97	89	85	63	82	121	126	148	117	121	122
		Purse seine	385	384	237	300	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	0	2	29	29
		Sport (HL+RR)	786	1004	1083	586	854	804	1114	1029	1181	1108	1124	1120	1649	2035	1398	1139	924	1005	1023	1130	1251	1009	887	917	707	707
		Traps	1	2	0	1	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	11
Discards	MED	Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	9
	ATW	Longline	119	115	128	211	88	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	202	224	127	127
		Other surf.	14	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Purse seine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	14
		Sport (HL+RR)	0	0	0	0	0	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0		
Landings	ATE	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		China PR	0	0	0	0	0	0	0	0	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36	36		38
		Chinese Taipei	109	0	0	0	6	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0		**0**
		EU.Denmark	0	0	0	0	37	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.España	3565	3557	2272	2319	5078	3137	3819	6174	6201	3800	3360	3474	3633	4089	2138	2801	3102	2033	3276	2938	2409	1483	1483	1329	1553	1553
		EU.France	460	510	565	894	1099	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135	148	223	223
		EU.Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.Ireland	0	0	0	0	0	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4	10	13	13
		EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.Portugal	3	27	117	38	25	240	35	199	712	323	411	441	404	186	61	27	79	97	29	36	53	58	180	223	235	235
		EU.Sweden	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.United Kingdom	0	0	0	0	0	0	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0		
		Faroe Islands	0	0	0	0	0	0	0	0	0	67	104	118	0	0	0	0	0	0	0	0	0	0	0	0		
		Guinée Rep.	0	0	0	0	0	330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		4
		Iceland	0	0	0	0	0	0	0	0	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	4
		Japan	838	1464	2981	3350	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1128	1128
		Korea Rep.	0	0	0	0	0	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	0	0		**0**
		Libya	0	0	0	312	0	0	0	576	477	511	450	487	0	0	0	0	0	47	0	0	0	0	0	0		
		Maroc	451	408	531	562	415	720	678	1035	2068	2341	1591	2228	2497	2565	1797	1961	2405	2196	2418	1947	1909	1348	1055	990	960	960
		NEI (ETRO)	6	74	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		NEI (Flag related)	0	0	85	144	223	68	189	71	208	66	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Norway	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0		0
		Panama	0	0	0	0	0	1	19	550	255	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0		
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	93	118	0	0	0	0	0	0	0	0	0	0	0		
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		

	MED	Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	9	9
		Algerie	820	782	800	1104	1097	1560	156	156	157	1947	2142	2330	2012	1710	1586	1208	1530	1038	1511	1311	0	0	0	69	244	244
		China PR	0	0	0	0	0	97	137	93	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Chinese Taipei	0	0	0	0	328	709	494	411	278	106	27	169	329	508	445	51	267	5	0	0	0	0	0	0		**0**
		EU.Croatia	0	0	1418	1076	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	384
		EU.Cyprus	10	10	10	10	14	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10	18	17	17
		EU.España	1645	1822	1392	2165	2018	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	942	942	1064	948	948
		EU.France	4434	4713	4620	7376	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10157	2670	3087	1754	805	791	2191	2191
		EU.Greece	182	201	175	447	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172	176	178	178
		EU.Italy	4317	4110	3783	5005	5328	6882	7062	10006	9548	4059	3279	3845	4377	4628	4973	4686	4841	4695	4621	2234	2735	1053	1783	1788	1938	1938
		EU.Malta	29	81	105	80	251	572	587	399	393	407	447	376	219	240	255	264	346	263	334	296	263	136	142	137	155	155
		EU.Portugal	0	0	278	320	183	428	446	274	37	54	76	61	64	0	2	0	0	11	0	0	0	0	0	0		**0**
		Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64		77
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0		**0**
		Israel	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Japan	127	172	85	123	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	0	0		
		Korea Rep.	0	0	0	0	0	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	0	0		80
		Libya	84	328	370	425	635	1422	1540	812	552	820	745	1063	1941	638	752	1300	1091	1280	1358	1318	1082	645	0	756	929	929
		Maroc	295	1149	925	205	79	1092	1035	586	535	687	636	695	511	421	760	819	92	190	641	531	369	205	182	223	309	309
		NEI (Flag related)	0	0	0	0	0	427	639	171	1066	825	140	17	0	0	0	0	0	0	0	0	0	0	0	0		
		NEI (MED)	757	360	1799	1398	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		NEI (combined)	0	0	0	0	0	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	0	0		
		Panama	0	74	287	484	467	1499	1498	2850	236	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Serbia & Montenegro	0	0	0	0	0	0	2	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0		
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	0	34	0	0		**0**
		Tunisie	661	406	1366	1195	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	2622	2679	1932	1042	852	1017	1153	1153
		Turkey	1707	2059	2459	2817	3084	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	551
		Yugoslavia Fed.	560	940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	ATW	Argentina	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0		
		Brazil	2	1	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	1		5
		Canada	619	438	485	443	459	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474	477	480	480
		Chinese Taipei	20	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Cuba	0	0	0	0	0	0	0	0	0	0	0	0	0	74	11	19	27	19	0	0	0	0	0	0		
		EU.Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		**0**
		EU.United Kingdom	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0	0		0
		Japan	468	550	688	512	581	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	317
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	0	0		**0**
		Mexico	0	0	0	0	0	4	0	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	51	20	23
		NEI (ETRO)	30	24	23	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		NEI (Flag related)	0	0	0	0	0	0	0	2	0	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0		
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Panama	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Sta. Lucia	2	14	14	14	2	43	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		U.S.A.	1483	1636	1582	1085	1237	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738	713	518	518
		UK.Bermuda	0	0	0	0	0	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0		1
Discards	MED	Albania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		EU.Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	5	5
		Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	4
		Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0
	ATW	Canada	14	0	0	0	0	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36	17		**0**
		Japan	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1		**0**
		U.S.A.	119	115	128	211	88	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	166	206	141	141

Updates/corrections to Task 1 (2013 only) provided after 2014-09-29 (Ghana, China PR and EU-France) were not included in the table.

Table 2. Catch (Task I) for West BFT (dark shade) and corresponding table of size/CAS information (light shade) to generate CAS and CAA for 2010-11. Highlighted lines shows SZ/CAS substitutions

t1Yr	t1FlagN	tIFleetC	t1GearG	t1Gear	t1Stock	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2011	China PR	CHN	LL	LL	ATE	35.92868	2011	China PR	CHN	LL	LL	ATE	34.63415024	244	142-251	2010655738	141.9	0	raise
2011	EU.España	EU.ESP	BB	BB	ATE	39.875	2011	EU.España	EU.ESP	BB	BB	ATE	39.47780945	1174	85-254	116.6056218	33.6	1	re-raise
2011	EU.España	EU.ESP	HL	HAND	ATE	18.9374	2011	EU.España	EU.ESP	HL	HAND	ATE	19.38250007	107	155-269	217.6401869	181.1	1	re-raise
2011	EU.España	EU.ESP	TP	TRAP	ATE	901908	2011	EU.España	EU.ESP	TP	TRAP	ATE	7719997764	4293	110-284	217.0026788	179.8	1	re-raise
2011	EU.España	EU.ESP-ES-C/	BB	BB	ATE	52.67098	2011	EU.España	EU.ESP-ES-C/	BB	BB	ATE	56.99341757	326	176-271	215.96728	174.9	1	re-raise
2011	EU.España	EU.ESP-ES-C/	BB	BB	ATE	469.8625	2011	EU.España	EU.ESP-ES-C/	BB	BB	ATE	4712806469	15023	74-210	113.8155663	31.4	1	none
2011	EU.France	EU.FRA	BB	BB	ATE	73.503	2011	EU.España	EU.ESP-ES-C/	BB	BB	ATE	4712806469	15023	74-210	113.8155663	31.4	1	sub-raise
2011	EU.France	EU.FRA	LL	LL	ATE	32.1932	2011	EU.España	EU.ESP	HL	HAND	ATE	19.38250007	107	155-269	217.6401869	181.1	1	sub-raise
2011	EU.France	EU.FRA	TW	MWT	ATE	28.421	2011	EU.France	EU.FRA	TW	MWT	ATE	2.981456977	36	81-244	1616388889	82.8	1	re-raise
2011	EU.Ireland	EU.IRL	TW	MWTD	ATE	4.39	2011	EU.Ireland	EU.IRL	TW	MWTD	ATE	0.432036074	3	198-205	202.8333333	144.0	0	raise
2011	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	179.919	2011	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	1518225587	1192	114-259	192.6744966	127.4	0	raise
2011	Iceland	ISL	TW	MWT	ATE	2.062	2011	Iceland	ISL	TW	MWT	ATE	1903861909	12	192-227	209.0833333	158.7	0	raise
2011	Japan	JPN	LL	LLHB	ATE	1088.824	2011	Japan	JPN	LL	LLHB	ATE	1072.966631	7679	149-277	200.3525944	139.7	1	none
2011	Maroc	MAR	TP	TRAP	ATE	1055	2011	Maroc	MAR	TP	TRAP	ATE	889.0700562	4331	145-294	227.8717386	205.3	1	re-raise
2012	China PR	CHN	LL	LL	ATE	36.036	2012	Japan	JPN	LL	LLHB	ATE	1077.485637	6887	157-253	208.0367366	156.5	1	sub-raise
2012	EU.España	EU.ESP	BB	BB	ATE	25.2329	2012	EU.España	EU.ESP	BB	BB	ATE	26.05459629	386	100-244	149.119171	67.5	1	re-raise
2012	EU.España	EU.ESP	HL	HAND	ATE	25.3363	2012	EU.España	EU.ESP	HL	HAND	ATE	26.87049516	165	125-264	209.6212121	162.9	1	re-raise
2012	EU.España	EU.ESP	TP	TRAP	ATE	1105.98	2012	EU.España	EU.ESP	TP	TRAP	ATE	890.828387	5576	115-304	206.51901	159.8	1	re-raise
2012	EU.España	EU.ESP-ES-C/	BB	BB	ATE	37.764	2012	EU.España	EU.ESP-ES-C/	BB	BB	ATE	37.43067224	194	154-251	223.4123685	193.2	1	none
2012	EU.España	EU.ESP-ES-C/	BB	BB	ATE	134.3945	2012	EU.España	EU.ESP-ES-C/	BB	BB	ATE	135.0427314	4166	94-204	119.7955424	32.4	1	none
2012	EU.France	EU.FRA	BB	BB	ATE	84.856	2012	EU.España	EU.ESP-ES-C/	BB	BB	ATE	135.0427314	4166	94-204	119.7955424	32.4	1	sub-raise
2012	EU.France	EU.FRA	LL	LL	ATE	27.2152	2012	EU.España	EU.ESP	HL	HAND	ATE	26.87049516	165	125-264	209.6212121	162.9	1	sub-raise
2012	EU.France	EU.FRA	TW	MWT	ATE	35.5649	2012	EU.France	EU.FRA	TW	MWT	ATE	17.41296216	221	65-295	158.9162896	78.8	1	re-raise
2012	EU.Ireland	EU.IRL	TW	MWTD	ATE	10.423	2012	EU.Ireland	EU.IRL	TW	MWTD	ATE	0.752890718	11	80-203	149.3181818	68.4	0	raise
2012	EU.Portugal	EU.PRT-PT-M	LL	LLHB	ATE	7.526	2012	Japan	JPN	LL	LLHB	ATE	1077.485637	6887	157-253	208.0367366	156.5	1	sub-raise
2012	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	215.38	2012	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	213.367328	1384	140-341	206.0794798	154.2	0	none
2012	Iceland	ISL	LL	LL	ATE	2.663	2012	Iceland	ISL	LL	LL	ATE	2.46537879	16	202-226	207.375	154.1	1	re-raise
2012	Iceland	ISL	UN	UNCL	ATE	2.406	2012	Iceland	ISL	LL	LL	ATE	2.46537879	16	202-226	207.375	154.1	1	sub-raise
2012	Japan	JPN	LL	LLHB	ATE	1092.599	2012	Japan	JPN	LL	LLHB	ATE	1077.485637	6887	157-253	208.0367366	156.5	1	none
2012	Maroc	MAR	TP	TRAP	ATE	990	2012	Maroc	MAR	TP	TRAP	ATE	936.3114358	4795	165-284	223.972367	195.3	1	re-raise
2013	EU.España	EU.ESP	BB	BB	ATE	24	2013	EU.España	EU.ESP	BB	BB	ATE	24.20005813	493	100-209	137.2667343	49.1	1	none
2013	EU.España	EU.ESP	HL	HAND	ATE	21	2013	EU.España	EU.ESP	HL	HAND	ATE	20.29101786	134	110-259	202.5746269	151.4	1	re-raise
2013	EU.España	EU.ESP	TP	TRAP	ATE	1370	2013	EU.España	EU.ESP	TP	TRAP	ATE	1485.810201	8811	100-304	2116283623	168.6	1	re-raise
2013	EU.España	EU.ESP-ES-C/	BB	BB	ATE	139	2013	EU.España	EU.ESP-ES-C/	BB	BB	ATE	133.6069902	678	160-281	224.9748033	197.0	1	re-raise
2013	EU.France	EU.FRA	BB	BB	ATE	74	2013	EU.France	EU.FRA-FR	BB	BB	ATE	9	134	77-264	148.0671642	66.6	0	raise
2013	EU.France	EU.FRA	LL	LL	ATE	26	2013	EU.España	EU.ESP	HL	HAND	ATE	20.29101786	134	110-259	202.5746269	151.4	1	sub-raise
2013	EU.France	EU.FRA	TR	TROL	ATE	3	2013	EU.France	EU.FRA-FR	BB	BB	ATE	9	134	77-264	148.0671642	66.6	0	sub-raise
2013	EU.France	EU.FRA	TW	MWT	ATE	120	2013	EU.France	EU.FRA-FR	TW	MWT	ATE	7.262461723	24	200-314	254.75	302.6	0	raise
2013	EU.Ireland	EU.IRL	TW	MWTD	ATE	13	2013	EU.Ireland	EU.IRL	TW	MWTD	ATE	0.504876413	5	155-198	178.1	101.0	1	re-raise
2013	EU.Portugal	EU.PRT-PT-M	SU	SURF	ATE	1	2013	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	227.0559258	1474	98-279	205.2496608	154.0	0	sub-raise
2013	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	233	2013	EU.Portugal	EU.PRT-PT-M	TP	TRAP	ATE	227.0559258	1474	98-279	205.2496608	154.0	0	raise
2013	Iceland	ISL	TW	MWT	ATE	4	2012	Iceland	ISL	LL	LL	ATE	2.46537879	16	202-226	207.375	154.1	1	sub-raise
2013	Japan	JPN	LL	LLHB	ATE	1128	2013	Japan	JPN	LL	LLHB	ATE	1112.580768	7033	156-274	208.609992	158.2	1	re-raise
2013	Maroc	MAR	TP	TRAP	ATE	960	2013	Maroc	MAR	TP	TRAP	ATE	900.7285568	4311	175-304	229.3789144	208.9	1	re-raise

Table 3. Catch (Task I) for East BFT (dark shade) and corresponding table of size/CAS information (light shade) to generate CAS and CAA for 2010-11. Highlighted lines shows SZ/CAS.

t1Yr	t1FlagN	t1FleetC	t1GearG	t1Gear	t1Stock	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2011	Canada	CAN	HP	HP-E	ATW	30.184	2011	Canada	CAN	HP	HP-E	ATW	32	106.3948695	164-288	237.7	298.6469017	1	re-raise
2011	Canada	CAN	LL	LL-surf	ATW	36	2011	Canada	CAN	LL	LL-surf	ATW	77.20012499	503	137-281	193.2033738	153.6	1	sub-raise
2011	Canada	CAN	LL	LL-surf	ATW	76.063	2011	Canada	CAN	LL	LL-surf	ATW	77.20012499	503	137-281	193.2033738	153.6	1	re-raise
2011	Canada	CAN	RR	RR	ATW	294.464	2011	Canada	CAN	RR	RR	ATW	302.8471045	1150	145-290	229.7399352	263.4	1	re-raise
2011	Canada	CAN	TL	TL	ATW	30.429	2011	Canada	CAN	TL	TL	ATW	3107335135	141	168-275	217.0120197	220.1	1	re-raise
2011	Canada	CAN	TP	TRAP	ATW	26.259	2011	Canada	CAN	TP	TRAP	ATW	26.24043107	96	138-285	240.1854733	274.3	1	none
2011	Canada	CAN	TR	TROL	ATW	16.346	2011	Canada	CAN	TR	TROL	ATW	16.32991885	47	217-287	256.4565217	347.0	1	none
2011	Japan	JPN	LL	LLHB	ATW	577.579	2011	Japan	JPN	LL	LLHB	ATW	579.8988584	4890	117-278	174.6315501	118.6	1	none
2011	Mexico	MEX	LL	LL	ATW	13.501	2011	Mexico	MEX	LL	LL	ATW	18.84928454	55	171-350	253.3	342.7	0	raise
2011	U.S.A.	USA-Com	HL	HAND	ATW	0.866	2011	U.S.A.	USA-Com	HL	HAND	ATW	0.955234032	5	179-245	212.7	1910	1	*
2011	U.S.A.	USA-Com	HP	HARP	ATW	70.101	2011	U.S.A.	USA-Com	HP	HARP	ATW	80.44587394	566	159-286	194.2879859	142.1	1	*
2011	U.S.A.	USA-Com	LL	LL	ATW	166.2331	2011	U.S.A.	USA-Com	LL	LLD	ATW	133.2219154	876	120-282	192.6128575	152.1	1	*
2011	U.S.A.	USA-Com	LL	LL	ATW	75.17	2011	U.S.A.	USA-Com	LL	LL	ATW	712453129	360	162-277	215.5722222	197.9	1	*
2011	U.S.A.	USA-Com	RR	RR	ATW	418.561	2011	U.S.A.	USA-Com	RR	RR	ATW	465.7411408	2457	150-294	207.513431	189.6	1	*
2011	U.S.A.	USA-Rec	RR	RR	ATW	173.372572	2011	U.S.A.	USA-Rec	RR	RR	ATW	723.441954	8534	75-270	151361525	84.8	1	*
2012	Canada	CAN	HP	HP-E	ATW	30.7	2012	Canada	CAN	HP	HP-E	ATW	3189093848	106	165-284	2414353767	3016	1	re-raise
2012	Canada	CAN	LL	LL-surf	ATW	16.6	2012	Canada	CAN	LL	LL-surf	ATW	49.06359387	334	147-272	190.2851813	146.9	1	sub-raise
2012	Canada	CAN	LL	LL-surf	ATW	48.249	2012	Canada	CAN	LL	LL-surf	ATW	49.06359387	334	147-272	190.2851813	146.9	1	re-raise
2012	Canada	CAN	RR	RR	ATW	346.784	2012	Canada	CAN	RR	RR	ATW	359	1389	155-298	228.2	258.3	1	re-raise
2012	Canada	CAN	TL	TL	ATW	34.208	2012	Canada	CAN	TL	TL	ATW	34.73469209	129	172-281	232.6833685	269.7	1	re-raise
2012	Canada	CAN	TP	TRAP	ATW	16.575	2012	Canada	CAN	TP	TRAP	ATW	16.57631588	75	148-289	222.0776514	2210	1	none
2012	Japan	JPN	LL	LLHB	ATW	289.179	2012	Japan	JPN	LL	LLHB	ATW	295.1880867	1805	123-288	195.8043927	163.5	1	none
2012	Mexico	MEX	LL	LL	ATW	11	2012	Mexico	MEX	LL	LL	ATW	6185161076	200	160-380	246.53	309.3	0	sub-raise
2012	Mexico	MEX	LL	LL	ATW	50.617	2012	Mexico	MEX	LL	LL	ATW	6185161076	200	160-380	246.53	309.3	0	raise
2012	U.S.A.	USA-Com	HL	HAND	ATW	1313	2012	U.S.A.	USA-Com	HL	HAND	ATW	1293140083	6	194-249	223.5	215.5233471	1	*
2012	U.S.A.	USA-Com	HP	HARP	ATW	52.354	2012	U.S.A.	USA-Com	HP	HARP	ATW	58.07553477	373	155-279	2012533512	155.6984846	1	*
2012	U.S.A.	USA-Com	LL	LL	ATW	205.862	2012	U.S.A.	USA-Com	LL	LLD	ATW	207.2709316	1207.8125	135-283	203.2081443	1716085333	1	*
2012	U.S.A.	USA-Com	LL	LL	ATW	89.606	2012	U.S.A.	USA-Com	LL	LL	ATW	86.87257031	407	177-284	2211044226	213.446187	1	*
2012	U.S.A.	USA-Com	PS	PS	ATW	1678	2012	U.S.A.	USA-Com	PS	PS	ATW	1962437937	13	187-209	200.8846154	150.9567644	1	*
2012	U.S.A.	USA-Com	RR	RR	ATW	419.536	2012	U.S.A.	USA-Com	RR	RR	ATW	463.0282375	2472	152-344	207.8648867	187.3091576	1	*
2012	U.S.A.	USA-Rec	RR	RR	ATW	148.655	2012	U.S.A.	USA-Rec	RR	RR	ATW	150.2986813	4438.05	51-226	115.1423357	33.86592789	1	*
2013	Canada	CAN	HP	HP-E	ATW	25	2013	Canada	CAN	HP	HP-E	ATW	25.70200362	83	177-283	2415728797	309.7	1	re-raise
2013	Canada	CAN	LL	LL-surf	ATW	67	2013	Canada	CAN	LL	LL-surf	ATW	69.78905044	351	147-270	210.0340549	198.6	1	re-raise
2013	Canada	CAN	RR	RR	ATW	325	2013	Canada	CAN	RR	RR	ATW	337.3997226	1156	171-287	237.9469229	2917	1	re-raise
2013	Canada	CAN	TL	TL	ATW	52	2013	Canada	CAN	TL	TL	ATW	53.4894071	179	157-285	238.8807442	299.0	1	re-raise
2013	Canada	CAN	TP	TRAP	ATW	11	2013	Canada	CAN	TP	TRAP	ATW	1136659545	44	182-290	237.8185729	258.3	1	none
2013	Japan	JPN	LL	LLHB	ATW	317	2013	Japan	JPN	LL	LLHB	ATW	3312196523	1505	131-284	218.014973	220.1	1	re-raise
2013	Mexico	MEX	LL	LL	ATW	20	2013	Mexico	MEX	LL	LL	ATW	27.39707996	83	172-495	250.1506024	330.1	0	raise
2013	U.S.A.	USA-Com	HP	HARP	ATW	45	2013	U.S.A.	USA-Com	HP	HARP	ATW	45.1727451	326	159-290	190.791411	138.6	1	none
2013	U.S.A.	USA-Com	LL	LL	ATW	127	2013	U.S.A.	USA-Com	LL	LLD	ATW	127.9382268	709	130-281	205.8058208	180.4	1	none
2013	U.S.A.	USA-Com	LL	LL	ATW	63	2013	U.S.A.	USA-Com	LL	LL	ATW	63.86842163	299	175-286	222.3628763	213.6	1	re-raise
2013	U.S.A.	USA-Com	PS	PS	ATW	14	2013	U.S.A.	USA-Com	PS	PSD	ATW	14.29279371	127	161-219	1811535433	112.5	1	re-raise
2013	U.S.A.	USA-Com	PS	PS	ATW	29	2013	U.S.A.	USA-Com	PS	PS	ATW	29.08672698	192	174-250	199.3177083	1515	1	none
2013	U.S.A.	USA-Com	RR	RR	ATW	250	2013	U.S.A.	USA-Com	RR	RR	ATW	251070971	1593	152-287	197.1296296	157.6	1	none
2013	U.S.A.	USA-Rec	RR	RR	ATW	131	2013	U.S.A.	USA-Rec	RR	RR	ATW	133.1246424	3105	51-273	124.0917923	42.9	1	re-raise

* **Note**: US CAS and CAA were updated but national scientist, details of the updates are provided in SCRS/2014/172.

Table 4. Catch (Task I) for Mediterranean BFT (dark shade) and corresponding table of size/CAS information (light shade) to generate CAS and CAA for 2010-11. Highlighted lines shows SZ/CAS.

t1Yr	t1FlagN	tlFleetC	t1GearG	t1Gear	t1Stock	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2011	EU.Croatia	EU.HRV	HL	HAND	MED	5.564	2011	EU.Croatia	EU.HRV	HL	HAND	MED	5.49	133.0	112-197	124.6428571	41	0	raise
2011	EU.Croatia	EU.HRV	HL	SPHL	MED	3.039	2011	EU.Croatia	EU.HRV	HL	HAND	MED	5.491050425	133	112-197	124.6428571	41.3	0	sub-raise
2011	EU.Croatia	EU.HRV	PS	PS	MED	4.42	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.Croatia	EU.HRV	PS	PS	MED	361.585	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.Cyprus	EU.CYP	LL	LLBFT	MED	7.39	2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.367216642	33	115-249	160.6818182	102.0	1	sub-raise
2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	2.487	2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.367216642	33	115-249	160.6818182	102.0	1	re-raise
2011	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	31.0812	2011	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	35.36434213	1223	71-206	111.0674571	28.9	1	re-raise
2011	EU.España	EU.ESP-ES-MI	LL	LLJAP	MED	22.3147	2011	EU.España	EU.ESP-ES-MI	LL	LLJAP	MED	27.19361025	327	100-224	154.7629969	83.2	1	re-raise
2011	EU.España	EU.ESP-ES-MI	PS	PS	MED	877.049	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.España	EU.ESP-ES-MI	SP	SPOR	MED	7.4947	2011	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	35.36434213	1223	71-206	111.0674571	28.9	1	sub-raise
2011	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	4.4093	2011	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	5.457923092	145	75-199	119.2241379	37.6	1	re-raise
2011	EU.France	EU.FRA-MED	HL	SPHL	MED	14	2011	EU.France	EU.FRA-MED	HL	SPHL	MED	17.45921252	337	112-271	132.078635	51.8	0	raise
2011	EU.France	EU.FRA-MED	LL	LL	MED	20	2011	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	35.36434213	1223	71-206	111.0674571	28.9	1	sub-raise
2011	EU.France	EU.FRA-MED	PS	PS	MED	678	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	re-raise
2011	EU.France	EU.FRA-MED	TW	TRAW	MED	1	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.France	EU.FRA-MED	UN	UNCL	MED	93	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.Greece	EU.GRC	HL	HAND	MED	52.23885	2011	EU.Croatia	EU.HRV	HL	HAND	MED	5.491050425	133	112-197	124.6428571	41.3	0	sub-raise
2011	EU.Greece	EU.GRC	LL	LL-deri	MED	19.05858	2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.367216642	33	115-249	160.6818182	102.0	1	sub-raise
2011	EU.Greece	EU.GRC	PS	PS	MED	2.8	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.Greece	EU.GRC	PS	PSFB	MED	98.194	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	EU.Italy	EU.ITA	SP	SPOR	MED	66.0512	2011	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	35.36434213	1223	71-206	111.0674571	28.9	1	sub-raise
2011	EU.Italy	EU.ITA	UN	UNCL	MED	130.03891	2011	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	35.36434213	1223	71-206	111.0674571	28.9	1	sub-raise
2011	EU.Italy	EU.ITA-IT-ADF	LL	LLBFT	MED	3.3081	2011	EU.Italy	EU.ITA-IT-ADF	LL	LLBFT	MED	5.129195856	88	120-159	140.4166667	58.0	1	re-raise
2011	EU.Italy	EU.ITA-IT-IONI	LL	LLBFT	MED	4.748	2011	EU.Italy	EU.ITA-IT-IONI	LL	LLBFT	MED	6.985938776	111	130-169	144.8333333	63.2	1	re-raise
2011	EU.Italy	EU.ITA-IT-SAR	TP	TRAP	MED	164.7472	2011	EU.Italy	EU.ITA-IT-SAR	TP	TRAP	MED	197.977287	2658	110-279	148.0245347	74.5	1	re-raise
2011	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	582.3422	2011	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	721.0251726	5151	115-279	179.4241774	140.0	1	re-raise
2011	EU.Italy	EU.ITA-IT-TYR	LL	LLBFT	MED	79.11827	2011	EU.Italy	EU.ITA-IT-TYR	LL	LLBFT	MED	100.4671349	1216	115-249	152.9242424	82.6	1	re-raise
2011	EU.Italy	EU.ITA-IT-TYR	PS	PSFB	MED	752.15477	2011	EU.Italy	EU.ITA-IT-TYR	PS	PSFB	MED	737.0497817	7204	110-279	159.1666667	102.3	1	re-raise
2011	EU.Malta	EU.MLT	LL	LL-surf	MED	917.706	2011	EU.Malta	EU.MLT	LL	LL-surf	MED	114.8379138	706	94-321	187.0410765	162.7	0	raise
2011	EU.Malta	EU.MLT	PS	PS	MED	50.02000031	2011	EU.Italy	EU.ITA-IT-TYR	PS	PSFB	MED	737.0497817	7204	110-279	159.1666667	102.3	1	sub-raise
2011	Maroc	MAR	HL	HAND	MED	78	2011	Maroc	MAR	HL	HAND	ATE	86.54361659	525	155-279	210.7761905	164.8	1	re-raise
2011	Maroc	MAR	LL	LL	MED	1	2011	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	5.457923092	145	75-199	119.2241379	37.6	1	sub-raise
2011	Maroc	MAR	PS	PS	MED	103	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.2149279	4788	99-184	143.0025063	62.1	1	sub-raise
2011	Tunisie	TUN-TUN-MAI	PS	PS	MED	133.743	2012	EU.France	EU.FRA-MED	PS	PS	MED	251.9614056	2241	116-215	175.1688978	112.4	1	sub-raise
2011	Tunisie	TUN-TUN-SFA	PS	PS	MED	717.784	2012	EU.France	EU.FRA-MED	PS	PS	MED	251.9614056	2241	116-215	175.1688978	112.4	1	sub-raise
2011	Turkey	TUR	PS	PS	MED	8.175	2011	Turkey	TUR	PS	PS	MED	0.819642817	120	56-101	67.45833333	6.8	0	sub-raise
2011	Turkey	TUR	PS	PS	MED	519.357	2011	Turkey	TUR	PS	PS	MED	0.819642817	120	56-101	67.45833333	6.8	0	raise

t1Yr	t1FlagN	tIFleetC	t1GearG	t1Gear	t1Stock	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2012	Algerie	DZA	PS	PS	MED	69	2012	Algerie	DZA	PS	PS	MED	0.606193181	19	85-144	114.6052632	31.9	0	raise
2012	EU.Croatia	EU.HRV	HL	HAND	MED	5.125	2012	EU.Croatia	EU.HRV-ADR	HL	HAND	MED	5.20	124.0	114-196	124.5564516	42	0	raise
2012	EU.Croatia	EU.HRV	HL	SPHL	MED	1043	2012	EU.Croatia	EU.HRV-ADR	HL	SPHL	MED	1.05	17.0	126-179	142.6764706	62	0	none
2012	EU.Croatia	EU.HRV	LL	LL	MED	0.84	2012	EU.Croatia	EU.HRV-ADR	LL	LL	MED	0.85	15.0	115-166	137.7	56	0	none
2012	EU.Croatia	EU.HRV	PS	PS	MED	4.561	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.Croatia	EU.HRV	PS	PS	MED	362.218	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.Cyprus	EU.CYP	LL	LLBFT	MED	16.743	2012	EU.Cyprus	EU.CYP	LL	LLBFT	MED	1304121514	11	119-227	169.8636364	118.6	0	raise
2012	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	19.0243	2012	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	2167089051	679	50-193	114.5382916	31.9	1	re-raise
2012	EU.España	EU.ESP-ES-MI	LL	LLJAP	MED	15068	2012	EU.España	EU.ESP-ES-MI	LL	LLJAP	MED	1329460914	26	125-154	135.1923077	51.1	1	re-raise
2012	EU.España	EU.ESP-ES-MI	PS	PS	MED	1033.7457	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.España	EU.ESP-ES-MI	SP	SPOR	MED	3.8409	2012	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	2167089051	679	50-193	114.5382916	31.9	1	sub-raise
2012	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	5.7955	2012	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	6.716720617	161	60-164	124.6428571	41.7	1	re-raise
2012	EU.France	EU.FRA-MED	LL	LL	MED	112	2012	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	2167089051	679	50-193	114.5382916	31.9	1	sub-raise
2012	EU.France	EU.FRA-MED	PS	PS	MED	678	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	re-raise
2012	EU.France	EU.FRA-MED	TW	MWT	MED	1	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.Greece	EU.GRC	HL	HAND	MED	39.457	2011	EU.Croatia	EU.HRV	HL	HAND	MED	5.491050425	133	112-197	124.6428571	41.3	0	sub-raise
2012	EU.Greece	EU.GRC	LL	LL-deri	MED	35.444	2012	EU.Cyprus	EU.CYP	LL	LLBFT	MED	1304121514	11	119-227	169.8636364	118.6	0	sub-raise
2012	EU.Greece	EU.GRC	PS	PS	MED	6.704	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.Greece	EU.GRC	PS	PSFB	MED	94.763	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.Italy	EU.ITA	SP	SPOR	MED	7.565	2012	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	2167089051	679	50-193	114.5382916	31.9	1	sub-raise
2012	EU.Italy	EU.ITA	UN	UNCL	MED	24.6118	2012	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	2167089051	679	50-193	114.5382916	31.9	1	sub-raise
2012	EU.Italy	EU.ITA-IT-ADF	LL	LLBFT	MED	9.8591	2012	EU.Italy	EU.ITA-IT-ADF	LL	LLBFT	MED	10.73548358	210	115-189	133.622449	51.1	1	re-raise
2012	EU.Italy	EU.ITA-IT-SAR	TP	TRAP	MED	125.2239	2012	EU.Italy	EU.ITA-IT-SAR	TP	TRAP	MED	145.3064748	1014	115-249	186.8452381	143.3	1	re-raise
2012	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	240.6057	2012	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	288.1579259	1691	100-274	196.6624365	170.4	1	re-raise
2012	EU.Italy	EU.ITA-IT-SIC.:	PS	PSFB	MED	1373.8292	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	EU.Italy	EU.ITA-IT-TYR	LL	LLBFT	MED	5.8865	2012	EU.Italy	EU.ITA-IT-TYR	LL	LLBFT	MED	6.008492968	43	95-254	176.5	140.0	1	re-raise
2012	EU.Malta	EU.MLT	LL	LLBFT	MED	126.71063	2012	EU.Malta	EU.MLT	LL	LLBFT	MED	170.9073343	776	100-283	213.9213918	220.2	1	re-raise
2012	EU.Malta	EU.MLT	LL	LLSWO	MED	9.842752	2012	EU.Malta	EU.MLT	LL	LLBFT	MED	170.9073343	776	100-283	213.9213918	220.2	1	sub-raise
2012	Egypt	EGY	PS	PS	MED	63.7	2012	Egypt	EGY	PS	PS	MED	0.411959792	6	122-170	147.6666667	68.7	0	raise
2012	Libya	LBY	PS	PS	MED	6.76	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	Libya	LBY	PS	PS	MED	756.186	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	Maroc	MAR	HL	HAND	MED	120	2012	Maroc	MAR	HL	HAND	ATE	136.5928565	891	150-279	205.5527497	153.3	1	re-raise
2012	Maroc	MAR	PS	PS	MED	103	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	Tunisie	TUN-TUN-SFA	PS	PS	MED	1017.4	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise
2012	Turkey	TUR	PS	PS	MED	535.5506	2012	EU.France	EU.FRA-MED	PS	PS	MED	2519614056	2241	116-215	175.1688978	112.4	1	sub-raise

t1Yr	t1FlagN	tlFleetC	t1GearG	t1Gear	t1Stock	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2013	Albania	ALB	BB	BB	MED	9	2013	Albania	ALB	BB	BB	MED	0.079390777	4	98- 99	99	19.8	0	raise
2013	Algerie	DZA	PS	PS	MED	244	2013	Algerie	DZA	PS	PS	MED	0.442698299	6	113-212	145.5	73.8	0	raise
2013	EU.Croatia	EU.HRV	HL	HAND	MED	6	2013	EU.Croatia	EU.HRV	HL	HAND	MED	5.69	131.0	114-182	126.7748092	43	0	raise
2013	EU.Croatia	EU.HRV	HL	SPHL	MED	1	2013	EU.Croatia	EU.HRV	HL	SPHL	MED	1.37	24.0	117-169	139.5416667	57	0	none
2013	EU.Croatia	EU.HRV	LL	LL	MED	2	2013	EU.Croatia	EU.HRV	LL	LL	MED	1.48	27.0	115-195	135.4259259	55	0	raise
2013	EU.Croatia	EU.HRV	PS	PS	MED	5	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.Croatia	EU.HRV	PS	PS	MED	375	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.Cyprus	EU.CYP	LL	LLBFT	MED	15	2013	EU.Cyprus	EU.CYP	LL	LLBFT	MED	1.299692768	13	107-267	156.9615385	100.0	1	re-raise
2013	EU.Cyprus	EU.CYP	LL	LLSWO	MED	1	2013	EU.Cyprus	EU.CYP	LL	LLSWO	MED	0.942065411	6	119-249	182.8333333	157.0	1	re-raise
2013	EU.España	EU.ESP-ES-MI	HL	HAND	MED	1	2013	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	19.16092209	573	42-215	115.6082024	33.4	1	sub-raise
2013	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	17	2013	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	19.16092209	573	42-215	115.6082024	33.4	1	re-raise
2013	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	7	2013	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	8.266281297	122	60-229	138.6065574	67.8	1	re-raise
2013	EU.España	EU.ESP-ES-MI	PS	PS	MED	917	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.España	EU.ESP-ES-MI	SP	SPOR	MED	6	2013	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	19.16092209	573	42-215	115.6082024	33.4	1	sub-raise
2013	EU.France	EU.FRA-MED	LL	LL	MED	232	2013	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	8.266281297	122	60-229	138.6065574	67.8	1	sub-raise
2013	EU.France	EU.FRA-MED	PS	PS	MED	1940	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	re-raise
2013	EU.France	EU.FRA-MED	TR	TROL	MED	17	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.France	EU.FRA-MED	TW	MWT	MED	2	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.Greece	EU.GRC	HL	HAND	MED	35	2013	EU.Greece	EU.GRC	UN	UNCL	MED	54.12288841	754	95-299	143.9986737	71.7810191	0	sub-raise
2013	EU.Greece	EU.GRC	LL	LL-deri	MED	51	2013	EU.Greece	EU.GRC	UN	UNCL	MED	54.12288841	754	95-299	143.9986737	71.8	0	raise
2013	EU.Greece	EU.GRC	PS	PS	MED	2	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.Greece	EU.GRC	PS	PSFB	MED	90	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.Italy	EU.ITA	LL	LLBFT	MED	180	2013	EU.Italy	EU.ITA-IT-ADF	LL	LLBFT	MED	105.5896063	2648	110-164	124.1929134	39.9	1	join-raise
2013	EU.Italy	EU.ITA	LL	LLBFT	MED		2013	EU.Italy	EU.ITA-IT-IONI	LL	LLBFT	MED	13.97460613	250	110-209	135	55.9	1	join-raise
2013	EU.Italy	EU.ITA	LL	LLBFT	MED		2013	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	75.17067306	386	120-244	209.527027	194.9	1	join-raise
2013	EU.Italy	EU.ITA	LL	LLBFT	MED		2013	EU.Italy	EU.ITA-IT-TYR	LL	LLBFT	MED	19.21072901	271	110-234	143.4615385	70.9	1	join-raise
2013	EU.Italy	EU.ITA	PS	PSFB	MED	1474	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	EU.Italy	EU.ITA	SP	SPOR	MED	10	2013	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	19.16092209	573	42-215	115.6082024	33.4	1	sub-raise
2013	EU.Italy	EU.ITA	TP	TRAP-S	MED	222	2012	EU.Italy	EU.ITA-IT-SAR	TP	TRAP	MED	145.3064748	1014	115-249	186.8452381	143.3	1	sub-raise
2013	EU.Italy	EU.ITA	UN	UNCL	MED	51	2013	EU.España	EU.ESP-ES-MI	LL	LLALB	MED	19.16092209	573	42-215	115.6082024	33.4	1	sub-raise
2013	EU.Malta	EU.MLT	LL	LLBFT	MED	87	2013	EU.Malta	EU.MLT	LL	LLBFT	MED	101.2464168	431	0-295	221.0104408	234.9	1	re-raise
2013	EU.Malta	EU.MLT	LL	LLSWO	MED	2	2013	EU.Malta	EU.MLT	LL	LLSWO	MED	1.748215788	13	125-218	181.3461538	134.5	1	re-raise
2013	EU.Malta	EU.MLT	PS	PS	MED	66	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	Libya	LBY	PS	PS	MED	4	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	Libya	LBY	PS	PS	MED	929	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	Maroc	MAR	HL	HAND	MED	130	2013	Maroc	MAR	HL	HAND	ATE	146.7738807	835	145-289	215.1886228	175.8	1	re-raise
2013	Maroc	MAR	LL	LL	MED	9	2013	EU.España	EU.ESP-ES-MI	LL	LLHB	MED	8.266281297	122	60-229	138.6065574	67.8	1	sub-raise
2013	Maroc	MAR	PS	PS	MED	170	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	Tunisie	TUN-TUN-MAI	PS	PS	MED	70	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	Tunisie	TUN-TUN-MOI	PS	PS	MED	96	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise
2013	Tunisie	TUN-TUN-SFA	PS	PS	MED	987	2013	Tunisie	TUN-TUN-SFA	PS	PS	MED	0.88850115	9	130-219	163.6111111	98.7	0	raise
2013	Turkey	TUR	PS	PS	MED	551	2013	EU.France	EU.FRA-MED	PS	PS	MED	810.7691454	7100	146-204	175.746338	114.2	1	sub-raise

Table 5. Estimated size, weight and weight at size conversion factors for Atlantic bluefin tuna stocks. Highlighted weight - size functions correspond to the annual equations representing overall mean for the population. Size measures are straight fork length (SFL), curved fork length (CFL), length 1st dorsal spine (LD1), head length straight line from snout to operculum (HeadL), pre-opercular length straight line from the snout to pre-operculum (PreOP). Weight measures are round weight: weihgt of the whole fish (RWT), gutted weight: weight without guts and gonads (GWT); gutted and gilled: weight without guts, gonads and gills (GGWT); gutted gilled and tailed: weight without guts, gonads, gills and tail (GGTWT); and dressed weight: weight of fish gutted, head and tail off (DWT). All size units are centimeters (cm) and weight in kilograms (kg).

Weight-length relationships / stock unit	**X**	**Y**	**X range**	**Y range**	**n**	**alpha**	**beta**	**r^2**	**Residual standard error**	**Method**
West - BFT										
Size conversion factors										
SFL = alpha + beta*CFL	CFL cm	SFL cm	55 - 275	53 - 265	1035	1.85746	0.9606	0.991004	2.564565	Fit Robust Estimate
CFL = alpha + beta*SFL	SFL cm	CFL cm	53 -265	55 -274	1035	-0.8319	1.03141	0.991004	2.670115	Fit Robust Estimate
Weight conversion factors										
RWT = alpha + beta*DWT	DWT kg	RWT kg	93 - 637	70 - 514	1960	6.19709	1.23034	0.976003	12.58053	Fit Robust Estimate
DWT = alpha + beta*RWT	RWT kg	DWT kg	70 - 514	93 - 637	1960	0.29114	0.79671	0.976003	10.13543	Fit Robust Estimate
Weight size relations										
RWT_std = alpha*SFL_std^beta	SFL cm	RWT kg	53 -353	4 -637	51204	1.59137E-05	3.020584	na	29.777988	nonlinear fit weight CV RWT
RWT = alpha*CFL^beta	CFL cm	RWT kg	4 - 637	56 -338	2977	4.94442E-05	2.80941	na	32.624945	nonlinear fit Gauss-Newton
RWT = alpha*SFL^beta	SFL cm	RWT kg	53 - 278	4 - 402	1826	1.14771E-05	3.090373	na	9.2913829	nonlinear fit Gauss-Newton
DWT = alpha*CFL^beta	CFL cm	DWT kg	25 - 514	127 - 366	49344	8.31E-06	3.078037	na	24.749856	nonlinear fit Gauss-Newton
GGTWT = alpha*SFL^beta	SFL cm	GGTWT kg	11 - 403	92 -289	2324	1.27354E-05	3.049098	na	18.241847	nonlinear fit Gauss-Newton

Weight-length relationships / stock unit	**X**	**Y**	**X range**	**Y range**	**n**	**alpha**	**beta**	**r^2**	**Residual standard error**	**Method**
East - BFT										
Size conversion factors										
LD1 = alpha + beta*SFL	SFL cm	LD1 cm	56 -300	17 - 71	636	5.68911	0.25426	0.97762	2.051968	Fit Robust Estimate
CFL = alpha + beta*SFL	SFL cm	CFL cm	78 - 242	84 - 252	222	-1.887	1.05065	0.989565	4.121014	Fit Robust Estimate
SFL = alpha + beta*LD1	LD1 cm	SFL cm	17 - 71	56 - 300	636	-19.733	3.86483	0.97762	8.063375	Fit Robust Estimate
CFL = alpha + beta*LD1	LD1 cm	CFL cm	24 - 71	84 - 283	312	-27.832	4.12726	0.963645	8.838777	Fit Robust Estimate

LD1 = alpha + beta*CFL	CFL cm	LD1 cm	84 - 283	24 - 71	312	7.9182	0.23547	0.963645	2.116302	Fit Robust Estimate
SFL = alpha + beta*CFL	CFL cm	SFL cm	84 - 252	78 - 242	222	2.94574	0.94419	0.989565	3.885642	Fit Robust Estimate
HeadL = alpha + beta*CFL	CFL cm	HeadL cm	84 - 284	22 - 74	306	4.40413	0.22418	0.865423	3.048081	Fit Robust Estimate
PreOP = alpha + beta*CFL	CFL cm	PreOP cm	153 - 284	33 - 74	294	1.09339	0.18922	0.646239	3.099589	Fit Robust Estimate
PreOP = alpha + beta*HeadL	HeadL cm	PreOP cm	38 - 74	33 - 74	294	-2.2179	0.83582	0.782967	2.427795	Fit Robust Estimate
Weight conversion factors										
GWT = alpha + beta*RWT	RWT kg	GWT kg	0.3 - 370	0.3 - 358	236	-0.2169	0.95401	0.999741	1.090203	Fit Robust Estimate
GGWT = alpha + beta*RWT	RWT kg	GGWT kg	3 - 300	2.8 - 239	187	1.29846	0.74208	0.991269	5.918475	Fit Robust Estimate
RWT = alpha + beta*GGWT	GGWT kg	RWT kg	2.8 - 239	3 - 300	187	-1.6151	1.33725	0.991269	7.811807	Fit Robust Estimate
RWT = alpha + beta*GWT	GWT kg	RWT kg	0.3 - 358	0.3 - 370	236	0.23115	1.04789	0.999741	1.140367	Fit Robust Estimate
Wgt size relations										
RWT_std = alpha*SFL_std^beta	SFL cm	RWT kg	27 - 300	0.25 - 513	74096	3.15551E-05	2.898454	na	51.449903	nonlinear fit weight CV RWT
RWT = alpha*SFL^beta	SFL cm	RWT kg	27 - 300	0.25 - 470	65046	4.16892E-05	2.838279	na	9.0252449	nonlinear fit Gauss-Newton
GGTWT = alpha*SFL^beta	SFL cm	GGTWT kg	75 - 281	8 - 362	8034	4.58875E-05	2.807655	na	13.407286	nonlinear fit Gauss-Newton
GGWT = alpha*SFL^beta	SFL cm	GGWT kg	55 - 289	2.8 - 385	3469	0.00010655	2.630105	na	14.248998	nonlinear fit Gauss-Newton
GGWT = alpha*CFL^beta	CFL cm	GGWT kg	94 -289	10 - 338	4962	2.54806E-05	2.893777	na	15.35662	nonlinear fit Gauss-Newton
GGWT = alpha*LD1^beta	LD1 cm	GGWT kg	29 - 76	20 -350	2044	0.003845665	2.621073	na	21.819718	nonlinear fit Gauss-Newton
RWT = alpha*LD1^beta	LD1 cm	RWT kg	17 - 79	3 - 425	2796	0.001120971	2.917953	na	20.019236	nonlinear fit Gauss-Newton

Table 6. Estimated coefficients alpha and beta for the monthly weight-size relationship for Atlantic Bluefin tuna. All functions correspond to straight fork length (SFL) cm and round weight (RWT) kg.

West - BFT			**East - BFT**		
Wgt size relations by month					
	alpha	**Beta*lsMonth**		**alpha**	**Beta*lsMonth**
Jan	1.59137E-05	3.017605144	Jan	3.15551E-05	2.898286574
Feb	1.59137E-05	3.01636155	Feb	3.15551E-05	2.896381959
Mar	1.59137E-05	3.026902737	Mar	3.15551E-05	2.89620393
Apr	1.59137E-05	3.052966822	Apr	3.15551E-05	2.899521914
May	1.59137E-05	3.019216646	May	3.15551E-05	2.906703518
Jun	1.59137E-05	3.006766766	Jun	3.15551E-05	2.903141844
Jul	1.59137E-05	3.01146935	Jul	3.15551E-05	2.891982942
Aug	1.59137E-05	3.017746764	Aug	3.15551E-05	2.892878325
Sep	1.59137E-05	3.022284806	Sep	3.15551E-05	2.896368538
Oct	1.59137E-05	3.029588559	Oct	3.15551E-05	2.897158519
Nov	1.59137E-05	3.024966899	Nov	3.15551E-05	2.897887564
Dec	1.59137E-05	3.015181387	Dec	3.15551E-05	2.8958942

Table 7. Specifications for Indices of Abundance for Western Bluefin Tuna.

CONTINUITY MODEL INDEX SPECIFICATIONS			
Index	Ages	Time period	Partial Catch-at-Age Filter Criteria
Canadian Gulf of St. Lawrence	13-16	1981-2009, 2011-2013	FlagName="Canada" GearGrpCode="RR" or "TL" Monthc="Aug","Sep", or "Oct"
Canadian Southwest Nova Scotia	8-14	1988-2013	FlagName="Canada", GearGrpCode="RR","TL", or "HP" Monthc="Aug","Sep", or "Oct"
U.S.A. Rod and Reel <145 cm	1-5	1980-83, 1985-1992	FlagName="U.S.A." GearGrpCode="RR" Size<145 Monthc="Jun", "Jul", Aug", or "Sep"
U.S.A. Rod and Reel 66-114 cm	2-3	1993-2013	FlagName="U.S.A." GearGrpCode="RR" Size>66 and Size<115 Monthc="Jun", "Jul", Aug" or ,"Sep"
U.S.A. Rod and Reel 115-144 cm	4-5	1993-2013	FlagName="U.S.A." GearGrpCode="RR" Size>114 and Size<145 Monthc="Jun", "Jul", Aug" or ,"Sep"
U.S.A. Rod and Reel >195 cm	10-16	1983-1992	FlagName="U.S.A." GearGrpCode="RR" Size>195 Monthc="Jul", Aug","Sep", or "Oct"
U.S.A. Rod and Reel >177 cm	8-16	1993-2013	FlagName="U.S.A." GearGrpCode="RR" Size>177 Monthc="Jul", Aug" ,"Sep", or "Oct"
Japan Longline Area 2	2-16	1976-2013	FlagName="Japan"
Gulf of Mexico Larval Survey	9-16	1977-78, 1981-84, 1986-2013	Equal to Japan GOM LL 1974-1981 and U.S.A. GOM LL 2004-2013
U.S.A. Gulf of Mexico Longline	9-16	1987-2013	FlagName="U.S.A." GearGrpCode="LL" Monthc="Jan", "Feb", "Mar", "Apr", or "May" SampAreaCode="BF60"
Japan Gulf of Mexico Longline	9-16	1974-1981	FlagName="Japan"
Tagging	1-3	1970-1981	Fixed selectivity: ages 1-3 fully selected, ages 4+ not selected
MODIFICATIONS TO INDEX SPECIFICATIONS FOR BASE MODEL			
Canadian Gulf of St. Lawrence	8-16	No change	FlagName="Canada" GearCode="RR", "RRFB", or "TL" Monthc="Aug","Sep", or "Oct" Lat=45 (1991 and later) Lon=60 (1991 and later)
Canadian Southwest Nova Scotia	5-16	No change	FlagName="Canada" Monthc="Aug","Sep", or "Oct" GearCode="HARP" or "HP-E" (Lat=40, Lon=60) for 1991 and later plus GearCode="RR", "RRFP", "TL", "HARP" or "HP-E" (Lat=45, Lon=60) for 1991 and later
U.S.A. Gulf of Mexico Longline	No Change	1992-2013	No Change

Table 8. CPUE series used in the eastern and Mediterranean bluefin stock assessment.

Series	JP LL		JP LL		MO-SP TRAP		MO TRAP		SP BB1		SP BB2		SP BB3		Norway PS from Task II		
Age	4-10		6-10		6-10+		10+		5-Jun		2-Mar		3-Jun		10+		
Indexing	Number		Number		Number		Number		Weight		Weight		Weight		Weight		
Area	NEAtl		East Atl and Med		East Atl and Med		East Atl and Med		East Atl and Med		East Atl and Med		East Atl and Med		East Atl		
Method	delta log-normal		delta log-normal		Neg. Binom. (log) no.		Neg. Binom. (log) no.		delta log-normal		delta log-normal		delta log-normal		Nominal		
Time of year	Begin-year		Begin-year		Mid-year		Mid-year		Mid-year		Mid-year		Mid-year		Unknown		
Source	SCRS/2014/045		SCRS/2012/131		SCRS/2014/060		SCRS/2014/168		SCRS/2014/054		SCRS/2014/054		SCRS/2014/054				
Year	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Std. CPUE	CV	Task I	Effort	CPUE
1952									179.22	0.425							
1953									184.74	0.53							
1954									226.46	0.414							
1955									187.01	0.423					13394	370	36
1956									470.53	0.431					5313	250	21
1957									315.05	0.411					6437	225	29
1958									252.25	0.409					3860	160	24
1959									506.79	0.412					3241	100	32
1960									485.16	0.425					4215	90	47
1961									327.29	0.413					8553	165	52
1962									180.12	0.462					8730	135	65
1963											312.09	0.493			167	100	2
1964											457.4	0.415			1461	43	34
1965											228.91	0.41			2506	36	70
1966											349.1	0.421			1000	28	36
1967											345.89	0.414			2015	33	61
1968											447	0.422			753	32	24
1969											610.62	0.401			842	30	28
1970											594.66	0.431			470	11	43
1971											744.71	0.403			653	15	44
1972											525.63	0.413			430	10	43
1973											535.63	0.396			421	10	42
1974											245.39	0.439			869	19	46
1975			1.9	0.15							484.22	0.41			988	26	38
1976			2.15	0.12							483.96	0.414			529	25	21
1977			3.53	0.14							547.56	0.407			764	18	42
1978			1.5	0.15							705.26	0.412			221	18	12
1979			2.7	0.14							623.01	0.409			60	16	4
1980			1.69	0.16							634.81	0.446			282	14	20
1981			1.63	0.17	768.36	0.5719					510.66	0.422					
1982			3.32	0.13	1038.12	0.3463					503.78	0.418					
1983			2.12	0.13	1092.05	0.3463					625.14	0.432					
1984			1.62	0.12	1200.27	0.3463					331.71	0.449					
1985			1.75	0.15	814.46	0.3464					1125.74	0.407					
1986			1.32	0.14	394.33	0.2805	1962.8	0.084			751.21	0.419					
1987			2.16	0.13	433.53	0.2805	1489.6	0.088			1008.43	0.415					
1988			1.35	0.14	1014.56	0.2803	3725.74	0.077			1394.68	0.419					
1989			1.05	0.16	531.45	0.2609	1113.18	0.065			1285.6	0.4					
1990	0.401	0.318	1.41	0.14	614.37	0.226	421.08	0.054			986.51	0.407					
1991	0.504	0.271	1.21	0.13	727.86	0.2259	1800.92	0.043			901.2	0.422					
1992	0.857	0.164	1.03	0.14	313.95	0.2263	255.43	0.059			695.16	0.427					
1993	0.843	0.136	1.04	0.14	325.36	0.2262	353.8	0.055			2093.55	0.403					
1994	1.008	0.159	1.12	0.16	341.9	0.2262	435.29	0.053			1007.03	0.419					
1995	1.030	0.134	1.42	0.15	223.43	0.2265	261.37	0.059			1235.91	0.405					
1996	2.582	0.130	0.5	0.22	375.22	0.2462	426.57	0.061			1739.29	0.398					
1997	1.611	0.128	0.53	0.21	992.41	0.2459	1073.92	0.052			2246.41	0.404					
1998	0.848	0.160	0.71	0.17	925.14	0.2459	1780.47	0.049			879.51	0.409					
1999	1.202	0.147	0.64	0.22	1137.45	0.2459	1116.41	0.052			339.77	0.436					
2000	1.209	0.116	0.74	0.2	739.23	0.2259	1298.08	0.045			960.44	0.402					
2001	1.441	0.122	0.96	0.17	1284.62	0.2258	3632.88	0.039			704.49	0.447					
2002	1.104	0.126	2.05	0.15	1130.42	0.2258	2890.3	0.040			687.42	0.423					
2003	1.134	0.142	1.7	0.13	662.66	0.2368	1834.58	0.043			444.91	0.482					
2004	1.015	0.118	0.82	0.18	332.36	0.2262	579.33	0.051			1210.46	0.417					
2005	0.733	0.115	0.88	0.15	677.39	0.2259	1765.14	0.043			2383.57	0.4					
2006	0.866	0.115	1.91	0.15	633.94	0.226	1249.32	0.045			850.09	0.48					
2007	0.887	0.116	0.94	0.19	1000.6	0.2259	2422.15	0.041					2176.44	0.315			
2008	1.035	0.115	1.22	0.17	634.18	0.226	1166.68	0.045					2144.54	0.304			
2009	1.529	0.114	1.04	0.24	876.71	0.2259	1351.18	0.044					955.29	0.305			
2010	2.486	0.129			1042.24	0.2366	1205.37	0.051					2109.08	0.309			
2011	4.204	0.168			674.97	0.2259	1054.29	0.046					2762.62	0.306			
2012	9.253	0.214			1187.75	0.2366	2065.48	0.048					2216.18	0.39			
2013	7.751	0.177			4285.56	0.3312	6978.12	0.041					1571.64	0.445			

Table 9. Description of available indices of abundance for the 2014 western bluefin tuna assessment.

	CAN GLS		CAN SWNS		US RR<145		US RR66-114	
Age Min	8		5		1		2	
Age Max	16+		16+		5		3	
Catch Unit	Numbers		Numbers		Numbers		Numbers	
Effort Unit	Hour		Hour		Offset = log(Hours Fished)		Offset = log(Hours Fished)	
Method	Delta-Lognormal		Delta-Lognormal		Delta-Poisson		Negative Binomial	
Months Covered	Aug 1 - Oct 31		Aug 1 - Oct 31		June-Sept		June-Sept	
Area Covered	Canada - Gulf of St. Lawrence		Canada - SW Nova Scotia		NE UNITED STATES		NE UNITED STATES	
Updated Since Last Assessment	YES		YES		NO		YES	
USED FOR IN LAST ASSESSMENT	BASE		BASE		BASE		BASE	
	CAN GLS		CAN SWNS		US RR<145		US RR66-114	
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1960	-	-	-	-	-	-	-	-
1961	-	-	-	-	-	-	-	-
1962	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	-	-
1965	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-	-
1967	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-
1975	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-
1977	-	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	-
1980	-	-	-	-	0.799	0.430	-	-
1981	1.320	0.160	-	-	0.399	0.520	-	-
1982	0.600	0.380	-	-	2.102	0.330	-	-
1983	1.540	0.100	-	-	1.114	0.260	-	-
1984	0.850	0.090	-	-	-	-	-	-
1985	0.210	0.230	-	-	0.630	0.640	-	-
1986	0.240	0.220	-	-	0.778	0.430	-	-
1987	0.320	0.320	-	-	1.219	0.400	-	-
1988	0.530	0.250	13.860	0.190	0.988	0.380	-	-
1989	0.650	0.280	13.030	0.180	0.988	0.430	-	-
1990	0.190	0.270	12.320	0.180	0.904	0.340	-	-
1991	0.650	0.220	9.510	0.190	1.261	0.350	-	-
1992	1.450	0.200	9.410	0.180	0.820	0.420	-	-
1993	0.900	0.130	6.090	0.190	-	-	1.105	0.364
1994	0.250	0.130	7.280	0.180	-	-	0.258	0.446
1995	0.720	0.090	7.040	0.190	-	-	1.108	0.345
1996	0.080	0.200	5.560	0.180	-	-	1.631	0.376
1997	0.130	0.170	4.480	0.170	-	-	2.368	0.330
1998	0.240	0.150	7.950	0.170	-	-	1.389	0.373
1999	0.420	0.120	10.820	0.180	-	-	1.334	0.432
2000	0.320	0.130	4.660	0.180	-	-	0.951	0.501
2001	0.290	0.160	9.370	0.190	-	-	0.465	0.352
2002	0.450	0.130	11.490	0.180	-	-	1.485	0.399
2003	0.830	0.090	15.900	0.180	-	-	0.406	0.346
2004	1.080	0.100	9.150	0.190	-	-	2.233	0.318
2005	1.040	0.080	10.550	0.170	-	-	2.179	0.316
2006	1.140	0.090	11.660	0.180	-	-	0.578	0.345
2007	2.280	0.150	9.480	0.180	-	-	0.445	0.314
2008	1.740	0.110	13.650	0.200	-	-	0.352	0.327
2009	2.560	0.160	10.570	0.180	-	-	0.351	0.326
2010	9.310	0.190	9.180	0.210	-	-	0.611	0.327
2011	3.700	0.110	10.430	0.210	-	-	0.796	0.355
2012	5.620	0.110	9.660	0.200	-	-	0.399	0.408
2013	4.810	0.090	5.340	0.190	-	-	0.554	0.363

Table 9. cont.

	US RR115-144		US RR>195		LARVAL ZERO INFLATED		US RR>177	
Age Min	4		8		9		8	
Age Max	5		10		16+		16+	
Catch Unit	Numbers		Numbers		Index of Spawning Biomass		Numbers	
Effort Unit	Offset = log(Hours Fished)		Offset = log(Hours Fished)		CPUE = Larvae/100m^2		Offset = log(Hours Fished)	
Method	Negative Binomial		Delta-Poisson		Delta-lognormal Zero inflated		Negative Binomial	
Months Covered	June-Sept		June-Sept		Apr 20 - May 31		June-Sept	
Area Covered	NE UNITED STATES		NE UNITED STATES		Gulf of Mexico		NE UNITED STATES	
Updated Since Last Assessment	YES		NO		YES		YES	
	BASE		BASE		BASE		BASE	
	US RR115-144		US RR>195		LARVAL ZERO INFLATED		US RR>177	
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1960	-	-	-	-	-	-	-	-
1961	-	-	-	-	-	-	-	-
1962	-	-	-	-	-	-	-	-
1963	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	-	-
1965	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	-	-
1967	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	-	-
1970	-	-	-	-	-	-	-	-
1971	-	-	-	-	-	-	-	-
1972	-	-	-	-	-	-	-	-
1973	-	-	-	-	-	-	-	-
1974	-	-	-	-	-	-	-	-
1975	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	-	-
1977	-	-	-	-	2.249	0.510	-	-
1978	-	-	-	-	4.388	0.245	-	-
1979	-	-	-	-	-	-	-	-
1980	-	-	-	-	-	-	-	-
1981	-	-	-	-	0.812	0.491	-	-
1982	-	-	-	-	1.184	0.300	-	-
1983	-	-	2.805	0.100	0.838	0.347	-	-
1984	-	-	1.246	0.188	0.313	0.566	-	-
1985	-	-	0.857	0.300	-	-	-	-
1986	-	-	0.503	1.097	0.346	0.434	-	-
1987	-	-	0.529	0.476	0.311	0.470	-	-
1988	-	-	0.941	0.364	1.113	0.347	-	-
1989	-	-	0.763	0.364	0.617	0.376	-	-
1990	-	-	0.626	0.335	0.326	0.359	-	-
1991	-	-	0.820	0.284	0.301	0.613	-	-
1992	-	-	0.910	0.276	0.422	0.359	-	-
1993	0.985	0.407	-	-	0.439	0.693	0.685	0.306
1994	0.263	0.546	-	-	0.536	0.351	0.937	0.287
1995	0.633	0.405	-	-	0.220	0.538	1.129	0.269
1996	0.728	0.481	-	-	0.792	0.518	3.329	0.255
1997	0.243	0.477	-	-	0.327	0.393	1.498	0.375
1998	0.899	0.382	-	-	0.114	0.551	1.622	0.256
1999	0.770	0.506	-	-	0.462	0.529	1.881	0.289
2000	1.266	0.556	-	-	0.252	0.538	0.629	0.280
2001	1.358	0.392	-	-	0.461	0.327	1.376	0.301
2002	2.599	0.454	-	-	0.239	0.649	1.937	0.241
2003	0.590	0.387	-	-	0.790	0.396	0.449	0.286
2004	0.674	0.376	-	-	0.554	0.706	0.745	0.284
2005	0.630	0.377	-	-	0.181	0.304	0.655	0.272
2006	1.457	0.384	-	-	0.467	0.352	0.426	0.376
2007	1.476	0.348	-	-	0.387	0.450	0.328	0.373
2008	1.384	0.358	-	-	0.312	0.392	0.399	0.356
2009	0.387	0.397	-	-	0.582	0.335	0.288	0.403
2010	1.240	0.372	-	-	0.392	0.520	0.945	0.270
2011	1.273	0.408	-	-	1.018	0.400	0.590	0.295
2012	1.106	0.459	-	-	0.300	0.491	0.651	0.269
2013	1.038	0.429	-	-	0.978	0.360	0.503	0.293

Table 9. cont.

	JLL AREA 2 (WEST)		JLL GOM		TAGGING		US PLL GOM		US PLL GOM Early	
Age Min	2		9		1		9		9	
Age Max	16+		16+		3		16+		16+	
Catch Unit	Numbers		Numbers		Numbers		Numbers		Numbers	
Effort Unit					-		1000 Hooks		1000 Hooks	
Method	Delta-lognormal		Delta-lognormal		-		Delta-Lgn with Repeated Measures		Delta-Lgn with Repeated Measures	
Months Covered					-		Jan 1 - May 31		Jan 1 - May 31	
Area Covered							Gulf of Mexico and US Florida East Coast		Gulf of Mexico and US Florida East Coast	
Updated Since Last Assessment	YES		NO		NO		YES		YES	
	BASE		BASE		BASE		BASE		BASE	
	JLL AREA 2 (WEST)		JLL GOM		TAGGING		US PLL GOM 1 - 6		US PLL GOM 1 - 6	
YEAR	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV	INDEX	CV
1960	-	-	.	.	-	-	-	-	-	-
1961	-	-	.	.	-	-	-	-	-	-
1962	-	-	.	.	-	-	-	-	-	-
1963	-	-	.	.	-	-	-	-	-	-
1964	-	-	.	.	-	-	-	-	-	-
1965	-	-	.	.	-	-	-	-	-	-
1966	-	-	.	.	-	-	-	-	-	-
1967	-	-	.	.	-	-	-	-	-	-
1968	-	-	.	.	-	-	-	-	-	-
1969	-	-	.	.	-	-	-	-	-	-
1970	-	-	.	.	1065132	0.200	-	-	-	-
1971	-	-	.	.	1001624	0.200	-	-	-	-
1972	-	-	.	.	431955	0.200	-	-	-	-
1973	-	-	.	.	183616	0.200	-	-	-	-
1974	-	-	0.968	0.266	341589	0.200	-	-	-	-
1975	-	-	0.534	0.205	554596	0.200	-	-	-	-
1976	0.609	0.432	0.666	0.207	253265	0.200	-	-	-	-
1977	2.362	0.215	0.913	0.216	257385	0.200	-	-	-	-
1978	1.140	0.289	0.876	0.225	121110	0.200	-	-	-	-
1979	0.782	0.254	1.287	0.283	98815	0.200	-	-	-	-
1980	1.487	0.209	1.158	0.265	192541	0.200	-	-	-	-
1981	1.932	0.155	0.553	0.239	337995	0.242	-	-	-	-
1982	0.708	0.248	-	-	-	-	-	-	-	-
1983	0.434	0.315	-	-	-	-	-	-	-	-
1984	1.017	0.216	-	-	-	-	-	-	-	-
1985	1.184	0.208	-	-	-	-	-	-	-	-
1986	0.088	0.598	-	-	-	-	-	-	-	-
1987	0.782	0.264	-	-	-	-	-	-	3.390	0.297
1988	1.179	0.205	-	-	-	-	-	-	1.634	0.324
1989	0.991	0.214	-	-	-	-	-	-	2.532	0.310
1990	0.818	0.243	-	-	-	-	-	-	1.979	0.324
1991	0.818	0.259	-	-	-	-	-	-	3.307	0.302
1992	1.252	0.212	-	-	-	-	0.803	0.350	-	-
1993	1.229	0.227	-	-	-	-	0.452	0.368	-	-
1994	1.136	0.220	-	-	-	-	0.332	0.394	-	-
1995	0.842	0.288	-	-	-	-	0.313	0.397	-	-
1996	2.105	0.204	-	-	-	-	0.182	0.404	-	-
1997	1.304	0.252	-	-	-	-	0.334	0.368	-	-
1998	0.614	0.290	-	-	-	-	0.357	0.375	-	-
1999	0.657	0.308	-	-	-	-	0.609	0.330	-	-
2000	0.820	0.272	-	-	-	-	0.893	0.330	-	-
2001	0.519	0.401	-	-	-	-	0.507	0.381	-	-
2002	0.606	0.307	-	-	-	-	0.475	0.392	-	-
2003	0.597	0.395	-	-	-	-	0.862	0.325	-	-

2004	0.529	0.385	-	-	-	-	0.779	0.327	-	-
2005	0.640	0.228	-	-	-	-	0.589	0.343	-	-
2006	1.100	0.229	-	-	-	-	0.414	0.393	-	-
2007	1.690	0.229	-	-	-	-	0.550	0.382	-	-
2008	0.726	0.349	-	-	-	-	1.262	0.336	-	-
2009	1.675	0.334	-	-	-	-	1.054	0.358	-	-
2010	0.607	0.366	-	-	-	-	0.887	0.342	-	-
2011	2.588	0.24	-	-	-	-	0.729	0.488	-	-
2012	3.61	0.295	-	-	-	-	1.339	0.339	-	-
2013	2.618	0.263	-	-	-	-	0.433	0.406	-	-

Table 10. Technical specifications of the ADAPT-VPA runs investigated for the East Atlantic and Mediterranean bluefin tuna stock (for acronyms of CPUE series, see **Table 8**).

Run	Period	CPUE series	CAA and PCAA	F-ratios	Plus group	Name of the run in SCRS/2014/113
2012 Base case	1950-2011	Norwegian purse seine, Spain-Moroccan trap, Japanese longline North East Atlantic, Japanese longline East Atlantic & Mediterranean, and the Spanish bait boat indices	As in 2012	As in 2012	10+	Run_0
2012 Base case updated	1950-2011	Same CPUEs as 2012, but updated	Updated	As in 2012	10+	Run_1
Update1	1950-2013	As 2012 Base case updated but update all indices	Updated	As in 2012	10+	Run_2
Update1_Split_JP	1950-2013	As Update1 but split Japanese longline North East Atlantic (1990-2009, 2010-2013)	Updated	As in 2012	10+	Run_3
Update1_2yrBB	1950-2013	As Update1 but remove last 2 years in Spanish bait boat index	Updated	As in 2012	10+	Run_4
Update1_aerial	1950-2013	As Update1 with aerial survey index	Updated	As in 2012	10+	Run_6
Continuity run (CR)	**1950-2013**	**As Update1 but remove last 1 years in Spanish-Moroccan trap**	**Updated**	**As in 2012**	**10+**	**Run_5**
CR_Split_JP	1950-2013	As CR but split Japanese longline North East Atlantic (1990-2009, 2010-2013)	Updated	As in 2012	10+	Run_7
CR_Mo_TP	1950-2013	As CR but use Moroccan trap CPUE instead of Spanish-Moroccan trap	Updated	As in 2012	10+	Run_17
CR_est_Fratio_v1	1950-2013	As CR	Updated	Estimated, but using the same period as run 5	10+	Run_14
CR_est_Fratio_v2	1950-2013	As CR	Updated	Estimated, but with periods defined by the Catch curve	10+	Run_15

				analysis (SCRS/2014/115)		
CR_+Group_16	1950-2013	As CR	Updated	All=1	16+	Run_16
CR_New_CAA	1950-2013	As CR	New CAA-PCAA coming from GBYP	As Run_5	10+	Run_5new

Table 11. Parameter specifications of the VPA continuity, base, and sensitivity runs for western Bluefin tuna.

Run number	*0-18,22-23, 25-26*	*19*	*20*	*21*	*24*
First Age	1	1	1	1	1
Plus Group Age	16+	16+	16+	16+	16+
First Year	1970	1970	1970	1970	1970
Last Year	2013	2013	2013	2013	2013
Natural Mortality	0.14 all ages	Age1: 0.49, Ages2-5: 0.24, Age6: 0.20, Age7: 0.18, Age8: 0.15, Age9: 0.13, Age10+: 0.10	0.14 all ages	0.14 all ages	0.14 all ages
Maturity	Same as 2012: Knife-Edged; 0.0 for ages 0-8; 1.0 at 9+		Age1-3:0, Ages4: 0.5, Age6+:1	Age1-8: 0, Ages9: 0.01, Age10: 0.02, Age11: 0.05 Age12: 0.1, Age13: 0.3, Age14: 0.6, Age15: 0.9, Age16: 1	Same as 2012: Knife-Edged; 0.0 for ages 0-8; 1.0 at 9+
Constraint on Vulnerability (Applied to Last N Years; Std Dev; First Age - Last Age)	3; 0.5; 1-15				
F in last year	Estimated for ages 1-15				
F-ratio	Fixed at 1.0 for all years				Fixed at 1.0 for first year, estimated using a random walk for all years following
Index Weighting	Indices equally weighted (estimating a single variance parameter common to all indices)				
Bootstrap Specifications	If bootstapped, used Stine correction to inflate residuals				

Table 12. Eastern Atlantic and Mediterranean bluefin tuna. Summary of the values of the current fishing mortality and spawning stock biomass for the different scenarios for recruitment and historical catch levels

Ref. point	Recr. scen.	Catch level	Quantile10%	Median	Quantile90%	Quantile10% 2012	Median 2012	Quantile90% 2012
F0.1	low	Reported	0.07	0.07	0.07	0.09	0.1	0.13
F0.1	low	Inflated	0.07	0.07	0.07	0.08	0.08	0.09
F0.1	med	Reported	0.07	0.07	0.07	0.09	0.1	0.13
F0.1	med	Inflated	0.07	0.07	0.07	0.08	0.08	0.09
F0.1	high	Reported	0.07	0.07	0.08	0.09	0.1	0.13
F0.1	high	Inflated	0.07	0.07	0.08	0.08	0.08	0.09
SSB0.1	low	Reported	349300	351200	352800	303800	318500	331200
SSB0.1	low	Inflated	352200	354000	355800	337100	342300	346500
SSB0.1	med	Reported	505900	508400	510600	431100	452400	470000
SSB0.1	med	Inflated	553400	556000	558600	515600	523800	530000
SSB0.1	high	Reported	839900	843600	847400	739000	774400	805900
SSB0.1	high	Inflated	1116000	1121000	1126000	1069000	1087000	1100000

Table 13. Eastern Atlantic and Mediterranean bluefin tuna. Summary of the values of the reference points for the different scenarios for recruitment and historical catch levels.

Catch Scen.	Recr. scen.	$SSB/SSB_{F0.1}$	F/F0.1	$SSB/SSB_{F0.1}$	F/F0.1 2012
Reported	low	1.53	0.89	0.45	0.7
Reported	med	1.09	0.63	0.41	0.7
Reported	high	0.69	0.37	0.4	0.69
Inflated	low	1.66	1.17	0.43	0.36
Inflated	med	1.1	0.77	0.38	0.36
Inflated	high	0.59	0.37	0.36	0.36

Table 14. Spawning stock biomass and recruitment estimates from the base VPA of Western BFT.

Year	SSB	Recruitment
1970	51113	363640
1971	50857	322392
1972	51266	278521
1973	51539	150973
1974	46241	465746
1975	41025	164391
1976	36159	135241
1977	31021	112512
1978	27718	95145
1979	24534	99656
1980	22252	81299
1981	19138	80599
1982	18020	82285
1983	17279	104287
1984	16438	93252
1985	14850	98867
1986	15239	102505
1987	14630	91424
1988	14523	138821
1989	14103	121629
1990	13546	114105
1991	13283	94800
1992	12927	83580
1993	13133	77333
1994	13055	88548
1995	13721	114612
1996	14996	92054
1997	16121	75317
1998	16494	101446
1999	16136	104719
2000	16445	90853
2001	16249	91803
2002	16103	105420
2003	16178	173337
2004	16797	149469
2005	17324	63186
2006	18047	86729
2007	20301	96287
2008	21323	74561
2009	21706	65547
2010	22700	80317
2011	26607	-
2012	28318	-
2013	27966	-

Table 15. Preliminary average age-length key applied to the catch-at-size of western bluefin tuna for a sensitivity comparison with the age-slicing method used in the base
VPA.

Size_bin	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16+
51	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
79	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
83	0.000	0.667	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
91	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
99	0.000	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
103	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
107	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
111	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
115	0.000	0.000	0.000	0.500	0.000	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
119	0.000	0.000	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
123	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
127	0.000	0.000	0.250	0.250	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
131	0.000	0.000	0.000	0.333	0.667	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
135	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
139	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
143	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
147	0.000	0.000	0.000	0.000	0.250	0.500	0.000	0.000	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000
151	0.000	0.000	0.000	0.000	0.000	0.500	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
155	0.000	0.000	0.000	0.000	0.000	0.125	0.625	0.250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
159	0.000	0.000	0.000	0.000	0.000	0.077	0.231	0.615	0.000	0.000	0.077	0.000	0.000	0.000	0.000	0.000
163	0.000	0.000	0.000	0.143	0.000	0.571	0.143	0.000	0.143	0.000	0.000	0.000	0.000	0.000	0.000	0.000
167	0.000	0.000	0.000	0.000	0.000	0.167	0.833	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
171	0.000	0.000	0.000	0.000	0.333	0.000	0.333	0.000	0.333	0.000	0.000	0.000	0.000	0.000	0.000	0.000
175	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.667	0.000	0.333	0.000	0.000	0.000	0.000	0.000	0.000
179	0.000	0.000	0.000	0.000	0.000	0.000	0.333	0.000	0.000	0.000	0.333	0.000	0.000	0.000	0.333	0.000
183	0.000	0.000	0.000	0.000	0.022	0.000	0.217	0.239	0.239	0.217	0.065	0.000	0.000	0.000	0.000	0.000
187	0.000	0.000	0.000	0.000	0.000	0.016	0.098	0.393	0.262	0.148	0.033	0.033	0.000	0.016	0.000	0.000
191	0.000	0.000	0.000	0.000	0.000	0.000	0.111	0.444	0.333	0.056	0.056	0.000	0.000	0.000	0.000	0.000
195	0.000	0.000	0.000	0.000	0.000	0.000	0.174	0.174	0.391	0.174	0.087	0.000	0.000	0.000	0.000	0.000
199	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.200	0.450	0.150	0.100	0.000	0.000	0.000	0.050	0.000
203	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.107	0.393	0.357	0.143	0.000	0.000	0.000	0.000	0.000
207	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.162	0.405	0.216	0.081	0.027	0.027	0.027	0.000	0.027
211	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.105	0.158	0.526	0.158	0.000	0.000	0.000	0.000	0.000
215	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.027	0.351	0.297	0.189	0.081	0.027	0.000	0.000	0.027
219	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.211	0.000	0.526	0.211	0.000	0.053	0.000	0.000	0.000
223	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.053	0.211	0.316	0.316	0.105	0.000	0.000	0.000	0.000
227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.238	0.381	0.190	0.048	0.048	0.000	0.000	0.048
231	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.583	0.083	0.042	0.208	0.000	0.000	0.000
235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.154	0.308	0.077	0.115	0.115	0.038	0.192
239	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.083	0.167	0.250	0.083	0.083	0.083	0.000	0.250
243	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.154	0.000	0.231	0.077	0.077	0.077	0.077	0.308
247	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.067	0.000	0.067	0.067	0.133	0.067	0.200	0.067	0.333
251	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.054	0.081	0.243	0.027	0.054	0.135	0.054	0.351
255	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.111	0.000	0.111	0.074	0.111	0.222	0.370
259	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025	0.025	0.150	0.150	0.025	0.200	0.425
263	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.097	0.000	0.032	0.097	0.161	0.581
267	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.176	0.059	0.118	0.118	0.529
271	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.038	0.038	0.154	0.077	0.115	0.577
275	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.267	0.733
279	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.063	0.000	0.063	0.125	0.750
283	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.071	0.000	0.000	0.929
287	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
291	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.900
295	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000
299	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
303	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000
307	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.000	0.000	0.000	0.500

Table 16. WBFT: Estimated benchmarks and reference points with 80% confidence intervals.

Low Recruitment						
MEASURE	LOWER CL	MEDIAN	UPPER CL	AVERAGE	RUN 0	STD. DEV.
F at MSY	0.17	0.20	0.24	0.21	0.19	0.03
MSY	2807	3050	3307	3056	3086	200
Y/R at MSY	30.3	31.6	32.7	31.5	32.0	1.0
S/R at MSY	130	137	144	137	138	5
SPR AT MSY	0.19	0.20	0.21	0.20	0.21	0.01
SSB AT MSY	12969	13226	13645	13268	13343	263
F at max. Y/R	0.20	0.23	0.26	0.23	0.23	0.02
Y/R maximum	30.4	31.7	32.8	31.6	32.1	1.0
S/R at Fmax	113	122	129	122	113	6
SPR at Fmax	0.17	0.18	0.19	0.18	0.17	0.01
SSB at Fmax	0	0	0	514	0	2588
F 0.1	0.11	0.12	0.13	0.12	0.12	0.01
Y/R at F0.1	28.0	29.0	29.8	29.0	29.5	0.7
S/R at F0.1	226	239	250	239	229	10
SPR at F0.1	0.34	0.36	0.37	0.36	0.34	0.01
SSB at F0.1	21330	23042	24966	23140	22101	1432

High Recruitment						
MEASURE	LOWER CL	MEDIAN	UPPER CL	AVERAGE	RUN 0	STD. DEV.
F at MSY	0.07	0.08	0.10	0.08	0.08	0.01
MSY	4442	5316	5863	5233	5343	554
Y/R at MSY	24.4	25.9	27.2	25.9	25.6	1.0
S/R at MSY	288	307	323	307	312	14
SPR AT MSY	0.43	0.46	0.48	0.46	0.46	0.02
SSB AT MSY	50096	63102	72921	62443	64998	9166
F at max. Y/R	0.20	0.23	0.26	0.23	0.23	0.02
Y/R maximum	30.5	31.7	32.8	31.7	32.2	1.0
S/R at Fmax	113	121	129	121	113	6
SPR at Fmax	0.17	0.18	0.19	0.18	0.17	0.01
SSB at Fmax	0	1244	6317	2192	0	2624
F 0.1	0.11	0.12	0.13	0.12	0.12	0.01
Y/R at F0.1	28.1	29.1	29.8	29.0	29.5	0.7
S/R at F0.1	226	238	250	239	229	10
SPR at F0.1	0.34	0.35	0.37	0.36	0.34	0.01
SSB at F0.1	32329	40179	45458	39559	36554	5095

Table 17. Comparison of benchmark estimates between the 2014 base VPA and 2012 base VPA assessments of western bluefin tuna.

Low Recruitment						
	2014 Base VPA			2012 Base VPA		
MEASURE	LOWER CL	MEDIAN	UPPER CL	LOWER CL	MEDIAN	UPPER CL
F at MSY	0.17	0.20	0.24	0.14	0.17	0.19
MSY	2807	3050	3307	2452	2634	2834
SSB AT MSY	12969	13226	13645	12717	12944	13268
F 0.1	0.11	0.12	0.13	0.10	0.11	0.12
SPR at F0.1	0.34	0.36	0.37	0.33	0.35	0.36
SSB at F0.1	21330	23042	24966	18476	19986	21708

High Recruitment						
	2014 Base VPA			2012 Base VPA		
MEASURE	LOWER CL	MEDIAN	UPPER CL	LOWER CL	MEDIAN	UPPER CL
F at MSY	0.07	0.08	0.10	0.06	0.06	0.07
MSY	4442	5316	5863	5736	6472	7500
SSB AT MSY	50096	63102	72921	77289	93621	116679
F 0.1	0.11	0.12	0.13	0.10	0.11	0.12
SPR at F0.1	0.34	0.35	0.37	0.33	0.35	0.36
SSB at F0.1	32329	40179	45458	33170	41028	46115

Table 18. WBFT: The annual probability that $F_{current} < F_{MSY}$ at various levels of total allowable catch. The current TAC of 1,750 mt is highlighted in bold.

A) Low Recruitment

Probability that F < Fmsy (No Overfishing)							
TAC	2013	2014	2015	2016	2017	2018	2019
0-1600 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1700 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1750 mt	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***
1800 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1900 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2000 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2100 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2200 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2300 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2400 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2500 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2600 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2700 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2800 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2900 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%
3000 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.6%
3100 mt	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%	99.4%
3200 mt	100.0%	100.0%	100.0%	100.0%	99.8%	99.4%	98.6%
3300 mt	100.0%	100.0%	100.0%	99.8%	99.4%	99.2%	98.0%
3400 mt	100.0%	100.0%	100.0%	99.4%	98.8%	98.4%	97.2%
3500 mt	100.0%	100.0%	99.6%	99.4%	98.6%	97.6%	96.4%

B) High Recruitment

Probability that F < Fmsy (No Overfishing)							
TAC	2013	2014	2015	2016	2017	2018	2019
0-400 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
500 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
600 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
700 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
800 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
900 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
1000 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
1100 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
1200 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
1300 mt	78.6%	97.4%	100.0%	100.0%	100.0%	100.0%	100.0%
1400 mt	78.6%	97.4%	99.8%	100.0%	100.0%	100.0%	100.0%
1500 mt	78.6%	97.4%	99.8%	99.8%	100.0%	100.0%	100.0%
1600 mt	78.6%	97.4%	98.6%	98.8%	99.2%	99.6%	99.8%
1700 mt	78.6%	97.4%	98.0%	98.2%	98.6%	98.8%	99.2%
1750 mt	***78.6%***	***97.4%***	***97.2%***	***97.8%***	***98.2%***	***98.8%***	***99.0%***
1800 mt	78.6%	97.4%	96.6%	97.4%	97.8%	98.2%	98.6%
1900 mt	78.6%	97.4%	92.8%	94.6%	96.4%	97.2%	97.2%
2000 mt	78.6%	97.4%	89.2%	91.6%	93.2%	94.8%	96.0%
2100 mt	78.6%	97.4%	84.2%	87.6%	90.2%	91.8%	93.4%
2200 mt	78.6%	97.4%	79.2%	82.2%	85.6%	88.0%	89.6%
2300 mt	78.6%	97.4%	69.2%	75.4%	79.6%	83.8%	85.8%

Table 19. WBFT: The annual probability that SSB > SSB_{MSY} at various levels of total allowable catch. The current TAC of 1,750 mt is highlighted in bold.

A) Low Recruitment

Probability that SSB > SSBmsy (Not Overfished)							
TAC	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
0-1600 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1700 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1750 mt	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***
1800 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1900 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2000 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2100 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2200 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2300 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2400 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2500 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2600 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2700 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2800 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2900 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3000 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3100 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3200 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3300 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3400 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%
3500 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%

B) High Recruitment

Probability that SSB > SSBmsy (Not Overfished)							
TAC	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
0-400 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	4.2%
500 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	3.8%
600 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	3.4%
700 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	3.0%
800 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.4%
900 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.4%
1000 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.4%
1100 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.2%
1200 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.2%
1300 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1400 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1500 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1600 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1700 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1750 mt	***0.8%***	***1.0%***	***1.2%***	***1.2%***	***1.0%***	***1.2%***	***1.6%***
1800 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.2%	1.6%
1900 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.2%	1.4%
2000 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.2%	1.4%
2100 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.0%	1.4%
2200 mt	0.8%	1.0%	1.2%	1.2%	0.8%	0.4%	1.2%
2300 mt	0.8%	1.0%	1.2%	1.2%	0.8%	0.4%	1.2%

Table 20. WBFT: The annual joint probability that $F<F_{MSY}$ and $SSB > SSB_{MSY}$ at various levels of total allowable catch. The current TAC of 1,750 mt is highlighted in bold.

A) Low Recruitment

Probability that F < Fmsy and SSB > SSBmsy (No Overfishing and Not Overfished)							
TAC	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
0-1600 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1700 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1750 mt	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***
1800 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1900 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2000 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2100 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2200 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2300 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2400 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2500 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2600 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2700 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2800 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
2900 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%
3000 mt	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.6%
3100 mt	100.0%	100.0%	100.0%	100.0%	100.0%	99.8%	99.4%
3200 mt	100.0%	100.0%	100.0%	100.0%	99.8%	99.4%	98.6%
3300 mt	100.0%	100.0%	100.0%	99.8%	99.4%	99.2%	98.0%
3400 mt	100.0%	100.0%	100.0%	99.4%	98.8%	98.4%	97.2%
3500 mt	100.0%	100.0%	99.6%	99.4%	98.6%	97.6%	96.4%

B) High Recruitment

Probability that F < Fmsy and SSB > SSBmsy (No Overfishing and Not Overfished)							
TAC	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
0-400 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	4.2%
500 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	3.8%
600 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	3.4%
700 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	3.0%
800 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.4%
900 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.4%
1000 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.4%
1100 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.2%
1200 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	2.2%
1300 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1400 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1500 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1600 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1700 mt	0.8%	1.0%	1.2%	1.2%	1.2%	1.2%	1.6%
1750 mt	***0.8%***	***1.0%***	***1.2%***	***1.2%***	***1.0%***	***1.2%***	***1.6%***
1800 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.2%	1.6%
1900 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.2%	1.4%
2000 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.2%	1.4%
2100 mt	0.8%	1.0%	1.2%	1.2%	1.0%	1.0%	1.4%
2200 mt	0.8%	1.0%	1.2%	1.2%	0.8%	0.4%	1.2%
2300 mt	0.8%	1.0%	1.2%	1.2%	0.8%	0.4%	1.2%

Table 21. The probabilities of $F<F_{MSY}$ for quotas from 0 to 30,000t for 2014 through 2022. Shading corresponds to the probabilities of being in the ranges of 50-59%, 60- 69%, 70-79%, 80-89% and greater or equal to 90%.

TAC	2014	2015	2016	2017	2018	2019	2020	2021	2022
0	100	100	100	100	100	100	100	100	100
2000	100	100	100	100	100	100	100	100	100
4000	100	100	100	100	100	100	100	100	100
6000	100	100	100	100	100	100	100	100	100
8000	100	100	100	100	100	100	100	100	100
10000	100	100	100	100	100	100	100	100	100
12000	100	100	100	100	100	100	100	100	100
13500	100	100	100	100	100	100	100	100	100
14000	100	100	100	100	100	100	100	100	100
15000	100	100	100	100	100	100	100	100	100
16000	100	100	100	100	100	100	100	100	100
18000	100	100	100	100	100	100	100	100	100
20000	100	100	100	100	100	100	100	100	100
22000	100	100	100	100	100	100	100	100	100
24000	100	100	100	100	100	100	100	100	100
26000	100	100	100	100	100	100	100	100	100
28000	100	100	100	100	100	100	100	100	100
30000	100	100	100	100	100	100	100	100	100

Table 22. The probabilities of SSB >SSB_{MSY} for quotas from 0 to 30000 t for 2014 through 2022. Shading corresponds to the probabilities of being in the ranges of 50-59%, 60- 69%, 70-79%, 80-89% and greater or equal to 90%.

TAC	2014	2015	2016	2017	2018	2019	2020	2021	2022
0	63	67	73	80	89	94	98	99	100
2000	63	67	73	80	88	94	97	99	100
4000	63	67	72	79	87	93	97	99	100
6000	63	67	72	79	87	93	97	99	100
8000	63	67	72	79	86	92	96	98	99
10000	63	67	72	78	86	92	96	98	99
12000	63	67	72	78	85	91	95	98	99
13500	63	67	71	77	84	91	94	97	99
14000	63	67	71	77	84	90	94	97	99
15000	63	67	71	77	84	90	94	97	99
16000	63	67	71	77	83	90	94	97	99
18000	63	67	71	76	83	89	93	96	98
20000	63	67	71	76	82	88	93	96	98
22000	63	67	70	76	82	88	92	95	97
24000	63	67	70	75	81	87	91	94	97
26000	63	67	70	75	80	86	90	94	96
28000	63	67	70	75	80	85	89	93	95
30000	63	67	70	74	79	85	89	92	95

Table 23. The probabilities of $F<F_{MSY}$ and $SSB>SSB_{MSY}$ for quotas from 0 to 30000 t for 2014 through 2022. Shading corresponds to the probabilities of being in the ranges of 50-59 %, 60- 69 %, 70-79 %, 80-89 % and greater or equal to 90 %.

TAC	2014	2015	2016	2017	2018	2019	2020	2021	2022
0	63	67	73	80	89	94	98	99	100
2000	63	67	73	80	88	94	97	99	100
4000	63	67	72	79	87	93	97	99	100
6000	63	67	72	79	87	93	97	99	100
8000	63	67	72	79	86	92	96	98	99
10000	63	67	72	78	86	92	96	98	99
12000	63	67	72	78	85	91	95	98	99
13500	63	67	71	77	84	91	94	97	99
14000	63	67	71	77	84	90	94	97	99
15000	63	67	71	77	84	90	94	97	99
16000	63	67	71	77	83	90	94	97	99
18000	63	67	71	76	83	89	93	96	98
20000	63	67	71	76	82	88	93	96	98
22000	63	67	70	76	82	88	92	95	97
24000	63	67	70	75	81	87	91	94	97
26000	63	67	70	75	80	86	90	94	96
28000	63	67	70	75	80	85	89	93	95
30000	63	66	69	74	79	84	89	92	95

Table 24 General evaluation matrix for each proposal formulated by the proponent CPC.

	Proposal	CPC	Type of index	Source of data New or old?	Timeframe Solution	Feasibility/ Scientific Merit	Contribute to Biology/Ecology	Limitations/ Uncertainties	Method track Record	Time Commitment	Spatial Coverage	Collaboration/ Technology Transfer	Incidental Mortalities	Budget Available	Funding Identified
1	Acoustic-trolling BFT survey for the development of a new fishery independent index of abundance	Canada	Fishery Independent Index	New	Long-Term	Yes	Yes	Yes	New	Ongoing/continuing	Expandable	Yes	Yes	Yes	No
2	A Mark and Recapture Experiment to Determine the Abundance of Atlantic Bluefin Tuna in the Gulf of St. Lawrence, Canada	Canada	Intermediate	New	Short-Term	To be determined	Yes	Yes	Proven	Multi-year	In some cases	Yes	Yes	Yes	No
3	Longline CPUE survey in the intermediate area of three nations' fishing grounds	Japan	Fishery Dependent Index	New and old	Long-Term	Yes	Yes	Yes	Proven	Multi-year	Expandable	Yes	Yes	No	No
4	Improvements to the Current Larval Index - expand existing sampling on annual surveys	USA	Fishery Independent Index	New and old	Long-Term	Yes	Yes	Yes	Proven	Ongoing/continuing	Restricted	Yes	No	Yes	No
5	Improvements to the Current Larval Index - dynamic age/growth mode and predictive recruitment model	USA	Fishery Independent Index	New and old	Long-Term	Yes	Yes	Yes	New	Ongoing/continuing	Restricted	Yes	No	Yes	No
6	Larval prey, feeding success and growth index	USA	Fishery Dependent Index	New	Long-Term	Yes	Yes	Yes	New	Ongoing/continuing	Restricted	Yes	No	Yes	No
7	Develop and index of daily egg production with continuous eggs sampling and genetic analysis of eggs	USA	Fishery Independent Index	New	Long-Term	To be determined	Yes	Yes	New	Ongoing/continuing	Restricted	Yes	No	No	No
8	Extension of sampling efforts in the Caribbean and western North Atlantic	USA	Fishery Independent Index	New	Short-Term	Yes	Yes	Yes	Proven	Ongoing/continuing	Restricted	Yes	No	Yes	No

9	Improve existing and/or develop new indices for stock assessments	USA	Fishery Dependent Index	New and old	Short-Term	Yes	Yes	Yes		Ongoing/continuing	Restricted	Yes	No	No	No
10	Improve the collection and processing of biological material (otoliths, spines, tissue samples) from the fishery	USA	Fishery Dependent Index	New and old	Short-Term	Yes	Yes	Yes	Proven	Ongoing/continuing	Restricted	Yes	No	No	No
11	Develop a genomic-based approach to assessment of BFT similar to the close-kin estimates of spawning biomass of southern bluefin tuna	USA	Intermediate	New	Long-Term	To be determined	Yes	Yes	New	Ongoing/continuing	Expandable	Yes	No	No	No
12	Young-of-the-year index	USA	Fishery Independent Index	New	Long-Term	To be determined	Yes	Yes	New	Ongoing/continuing	Restricted	No	Yes	No	No

Table 25 Suggestions for Proposal Evaluation Criteria.

1. Type of index of abundance:
   a. Fishery Independent Index of abundance
   b. Fishery Dependent Index of abundance
   c. Intermediate – relies to some extent on the fishery
2. Source of data: (Is this a new index of abundance?)
   a. Yes
   b. No – improvements to existing index
3. Timeframe for solution: (Does the proposal address a long or short term solution?)
   a. Short-term
   b. Long-term
4. Feasibility: (Is the proposal/method feasible and have scientific merit?)
   a. Yes
   b. No
   c. To be determined
5. Biology/ecology: (Will the proposal contribute to our understanding of the biology/ecology of BFT
   a. Yes
   b. No
6. Limitations: (Are there assumptions/uncertainties that could seriously impact the index?)
   a. Yes
   b. No
   c. Potentially
7. Track record: (Does the methodology/technology have a proven track record?)
   a. Yes
   b. No
8. Time commitment
   a. Ongoing/continuing
   b. One year
   c. Multi-year
9. Coverage: (Can the proposal be expanded to other areas – increased coverage?)
   a. Yes
   b. No
   c. In some cases
10. Collaboration: (Is there potential for collaboration/technology transfer?)
    a. Yes
    b. No
11. Incidental mortalities: (Will there be a requirement for incidental mortalities?)
    a. Yes
    b. No
12. Budget: (Has a budget been provided with the proposal?)
    a. Yes
    b. No
13. Funding: (Has a source of funding been identified?)
    a. Yes
    b. No

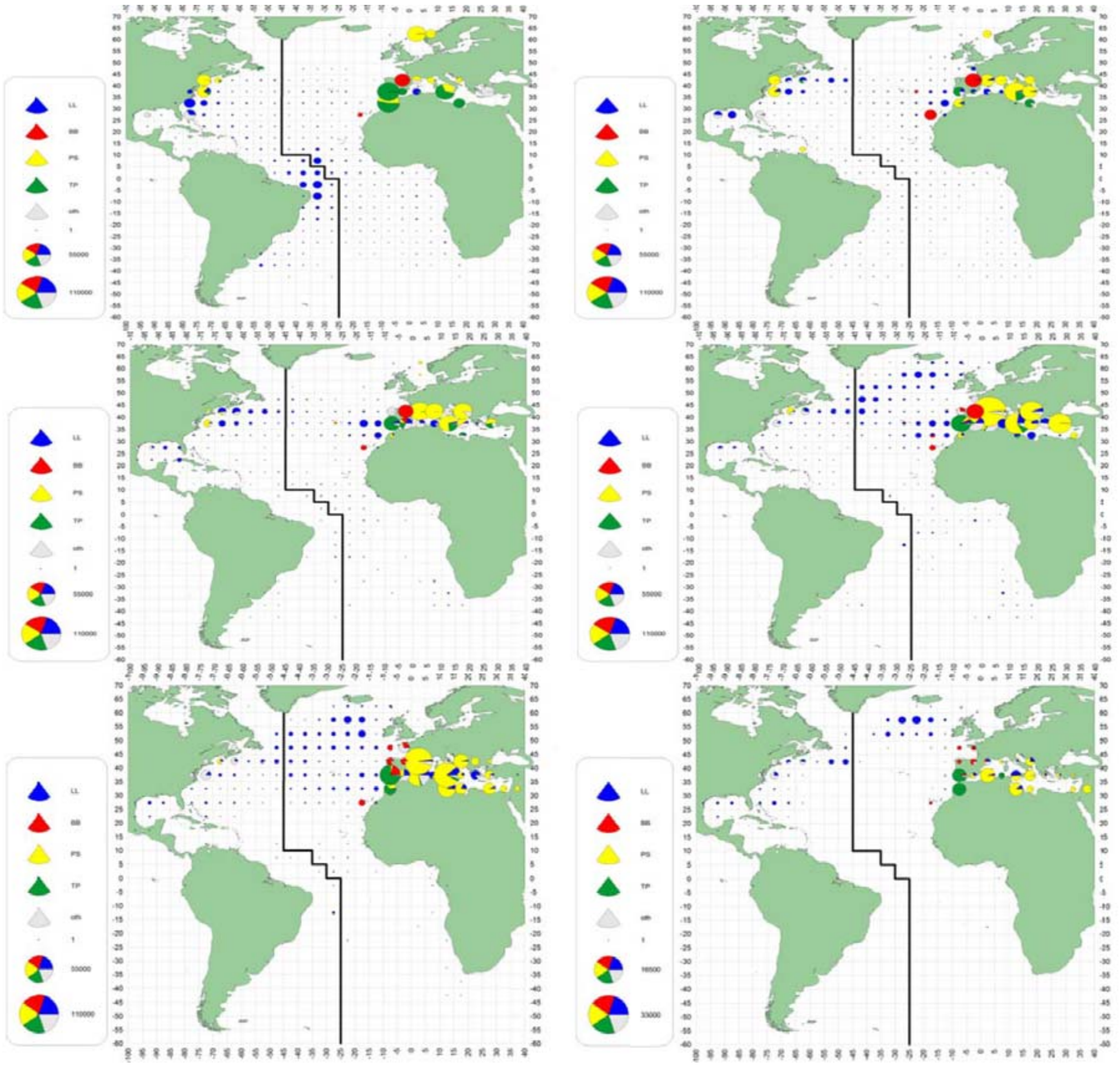


Figure 1. Estimated task I catch distribution (5x5 lat long) of bluefin tuna, by decade (1950-2012) and by major gear.

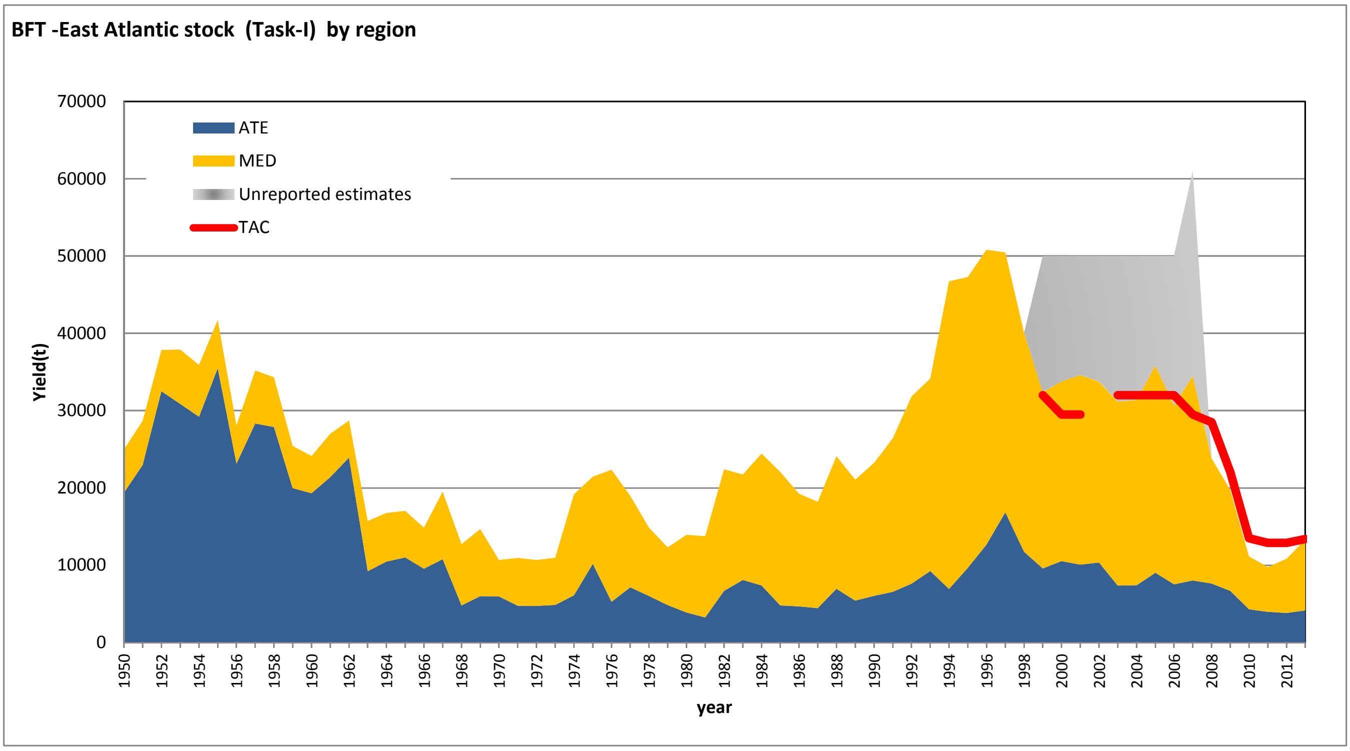


Figure 2. Eastern Atlantic and Mediterranean bluefin reported and estimated catches by area. The estimated catches are indicated by the gray area, and the TAC is indicated by the red line.

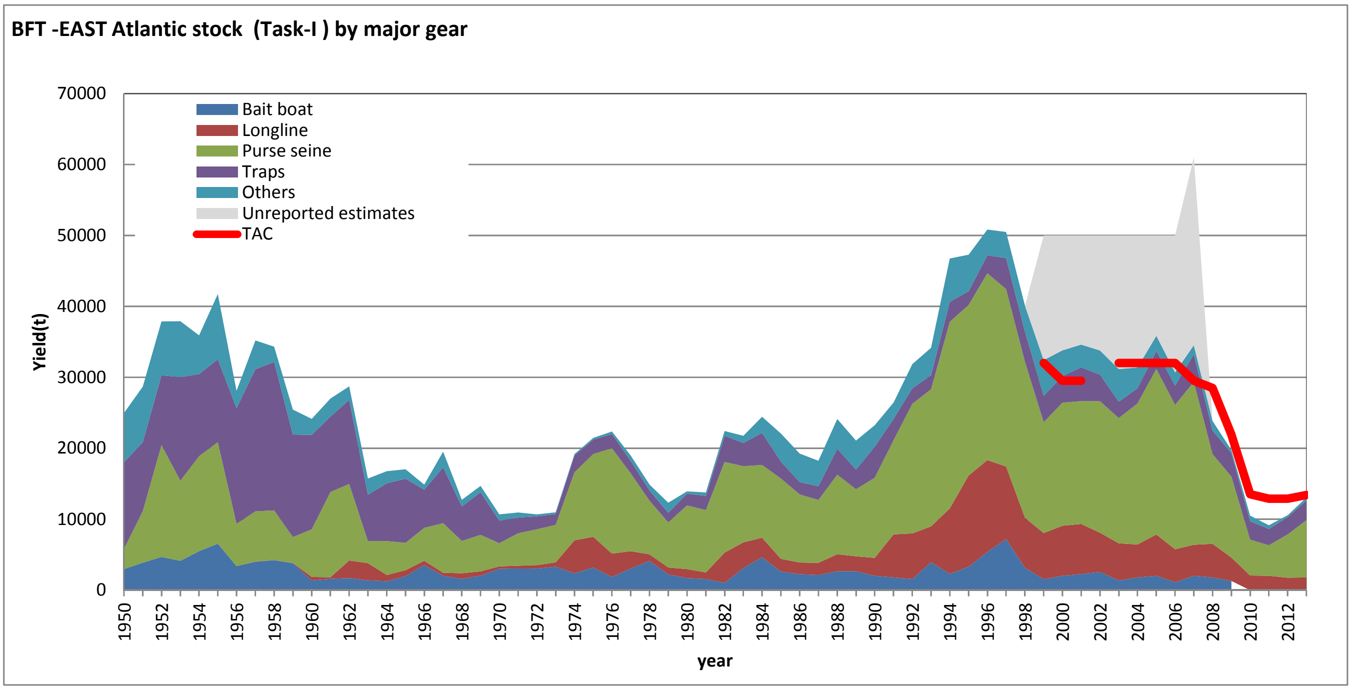


Figure 3. Eastern Atlantic and Mediterranean bluefin reported and estimated catches by main gears. The estimated catches are indicated by the gray area, and the TAC is indicated by the red line.

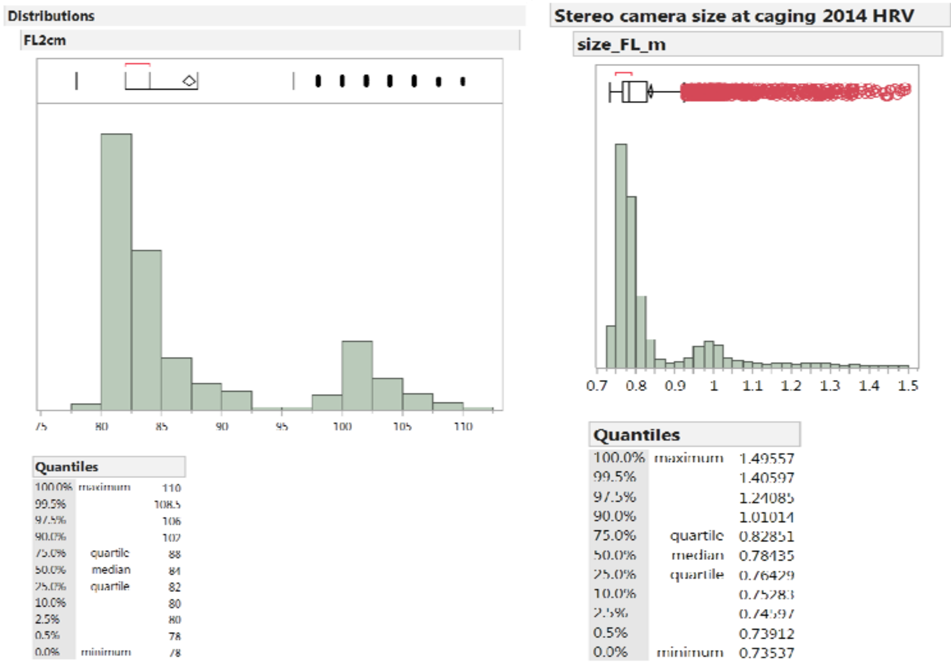


Figure 4. Size frequency distributions for purse seine EU_Croatia from tagging GBYP experiments 2013 (left) and stereo camera measures at caging 2014.

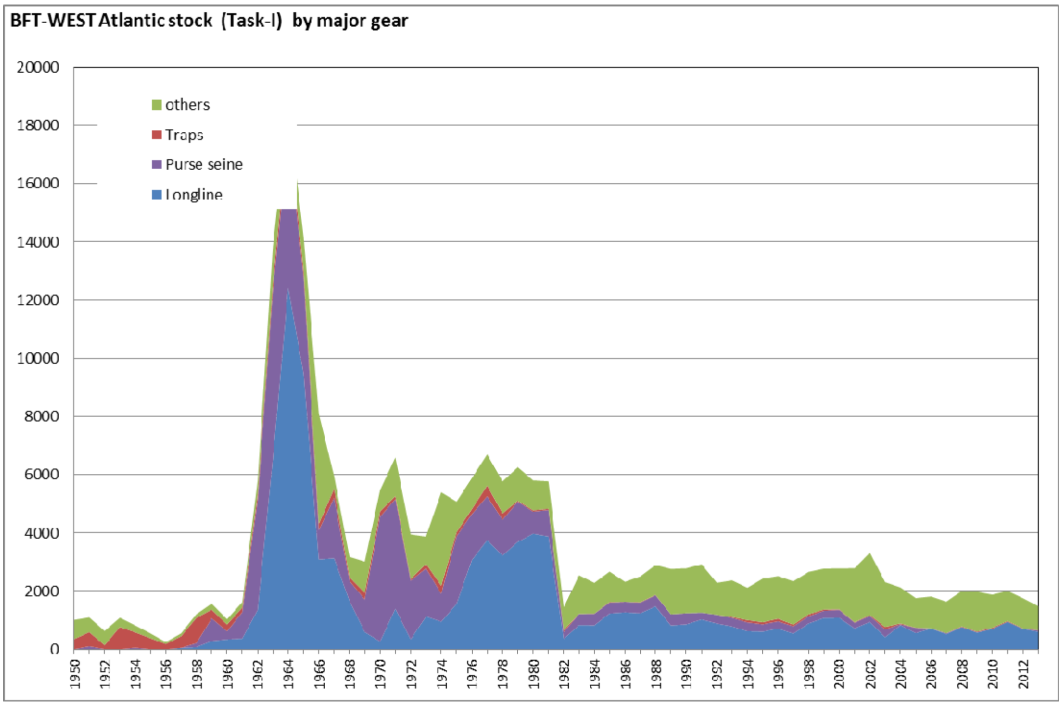


Figure 5. Western Atlantic bluefin tuna reported catch by year and main gears

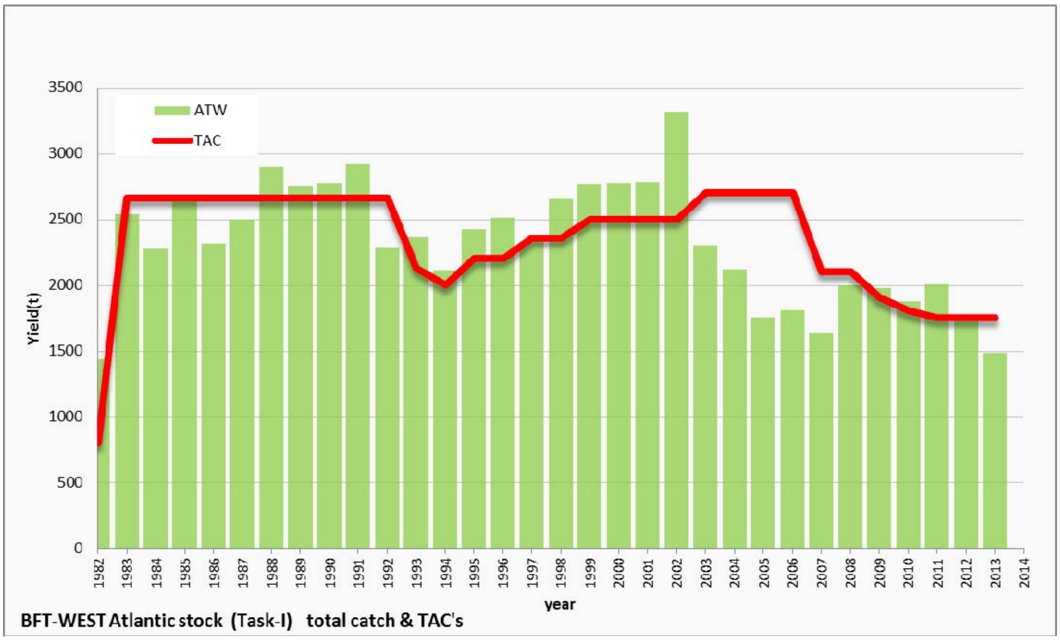


Figure 6. Western Atlantic bluefin tuna reported catch (bars) and the corresponding annual TAC (red line)

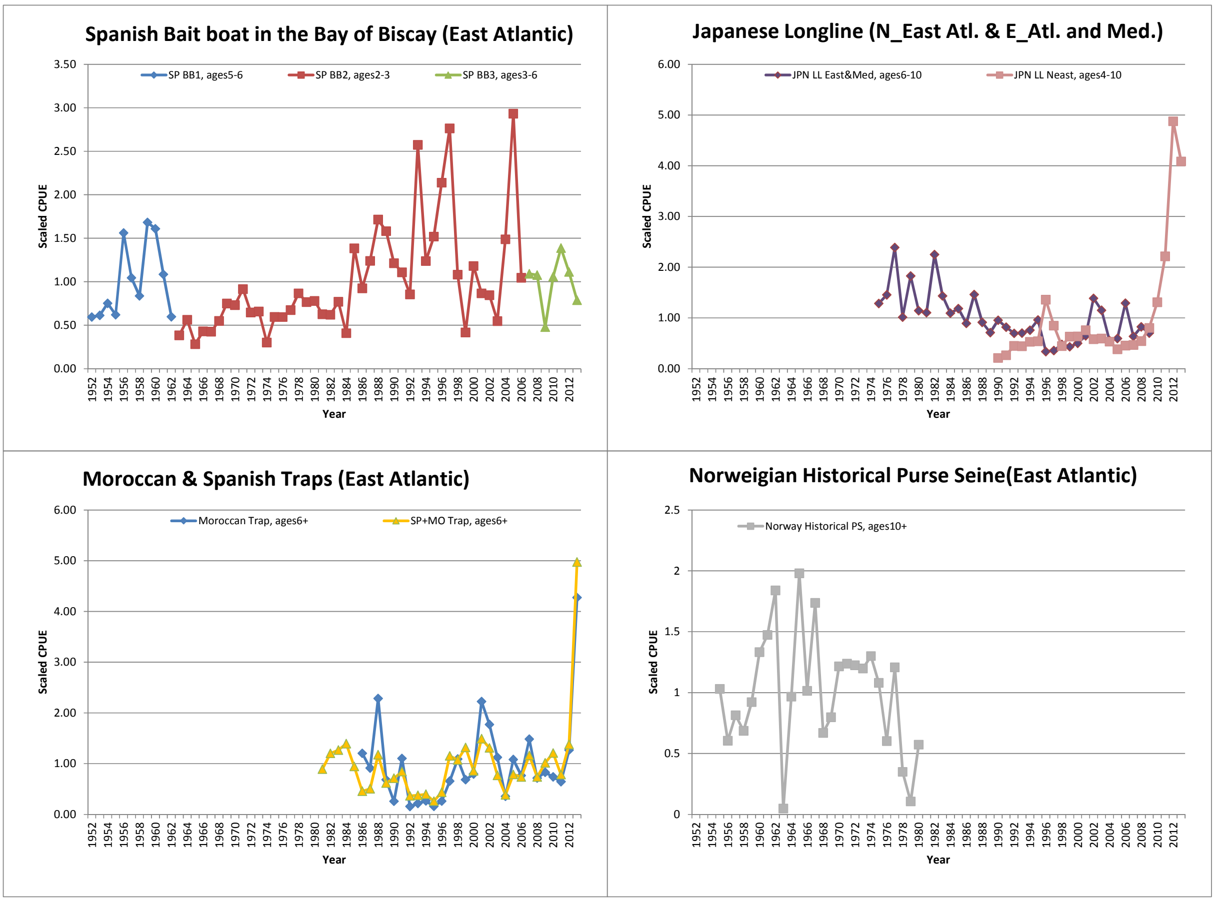


Figure 7. Plots of the CPUE time series fishery indicators for the East Atlantic and Mediterranean bluefin tuna stock used in the 2014 stock assessment. All CPUE series are standardized series except the nominal Norway PS index. The Spanish BB series (top left panel) was split in three series to account for changes in selectivity patterns, and the latest series was updated until 2013 using both French and Spanish BB data due to the sale of the quota by the Spanish fleet. The Moroccan-Spanish traps CPUE and the Japanese Longlines CPUE for the Northeast Atlantic have been updated until 2013. The Moroccan CPUE was used only for the sensitivity analysis.

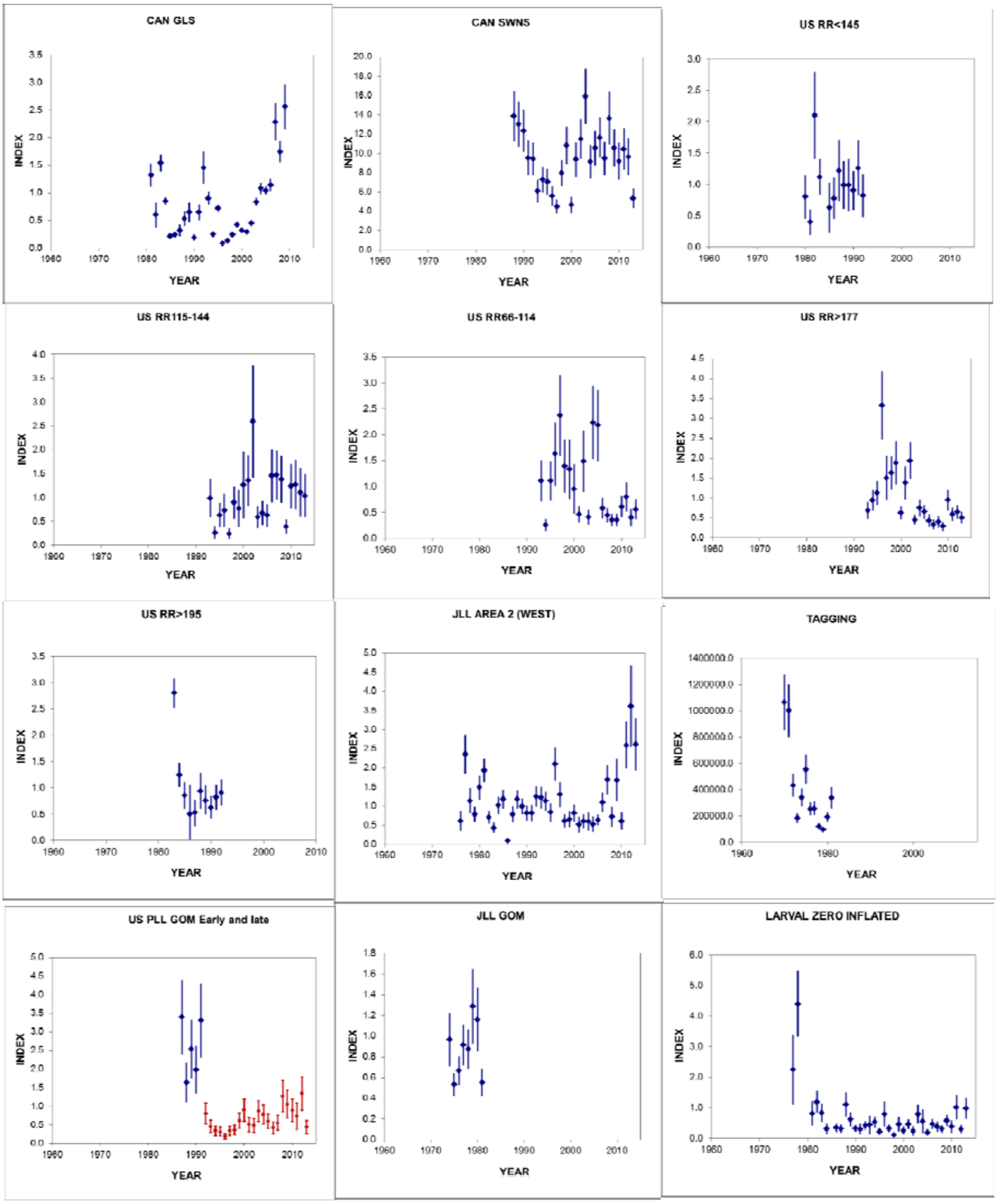


Figure 8. Indices of abundance used in the base VPA model of western bluefin tuna (+/- 1 standard error).

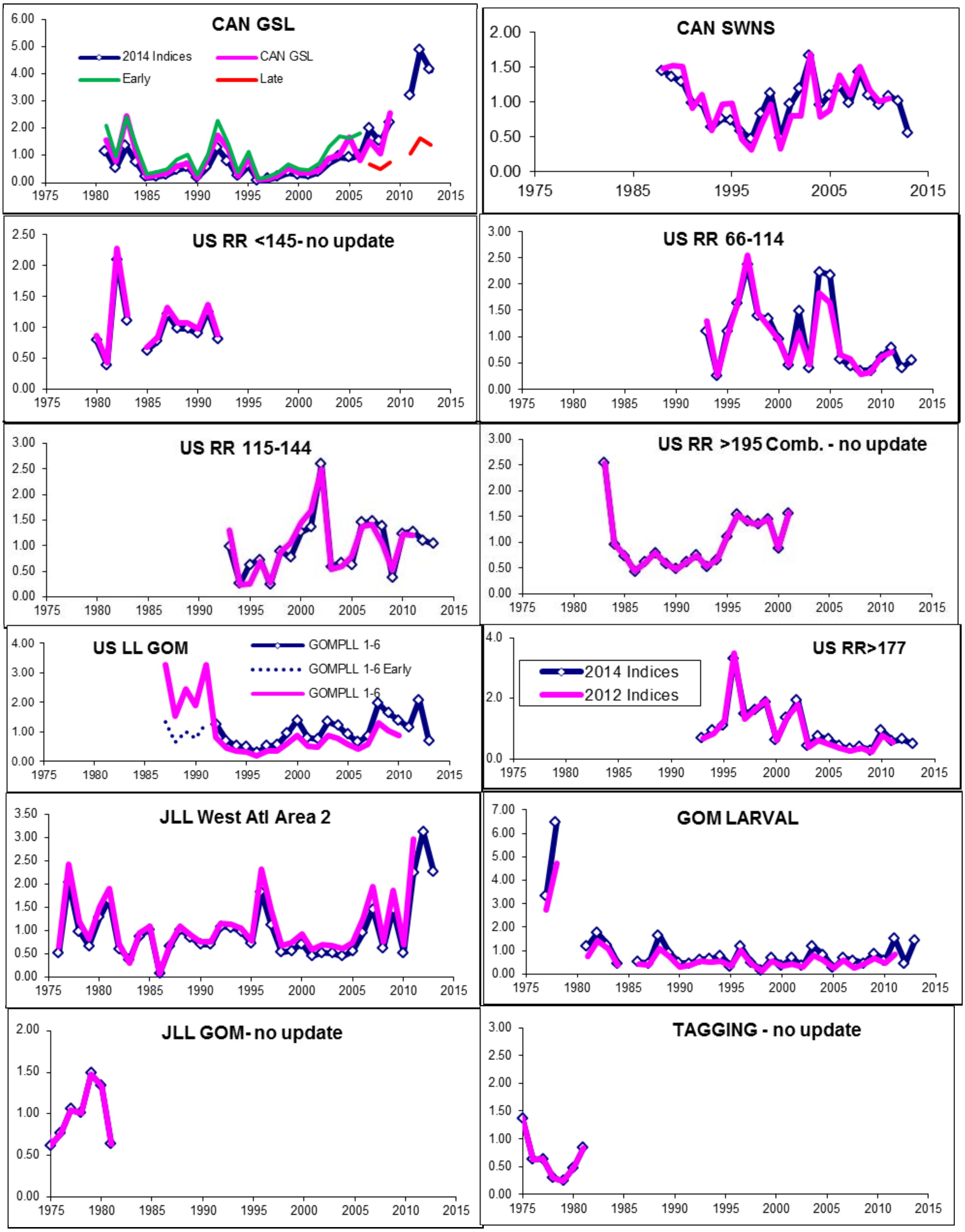


Figure 9. Comparison of indices used in the 2014 update stock assessment with the 2012 western BFT VPA. The split GSL index used for sensitivity run is shown.

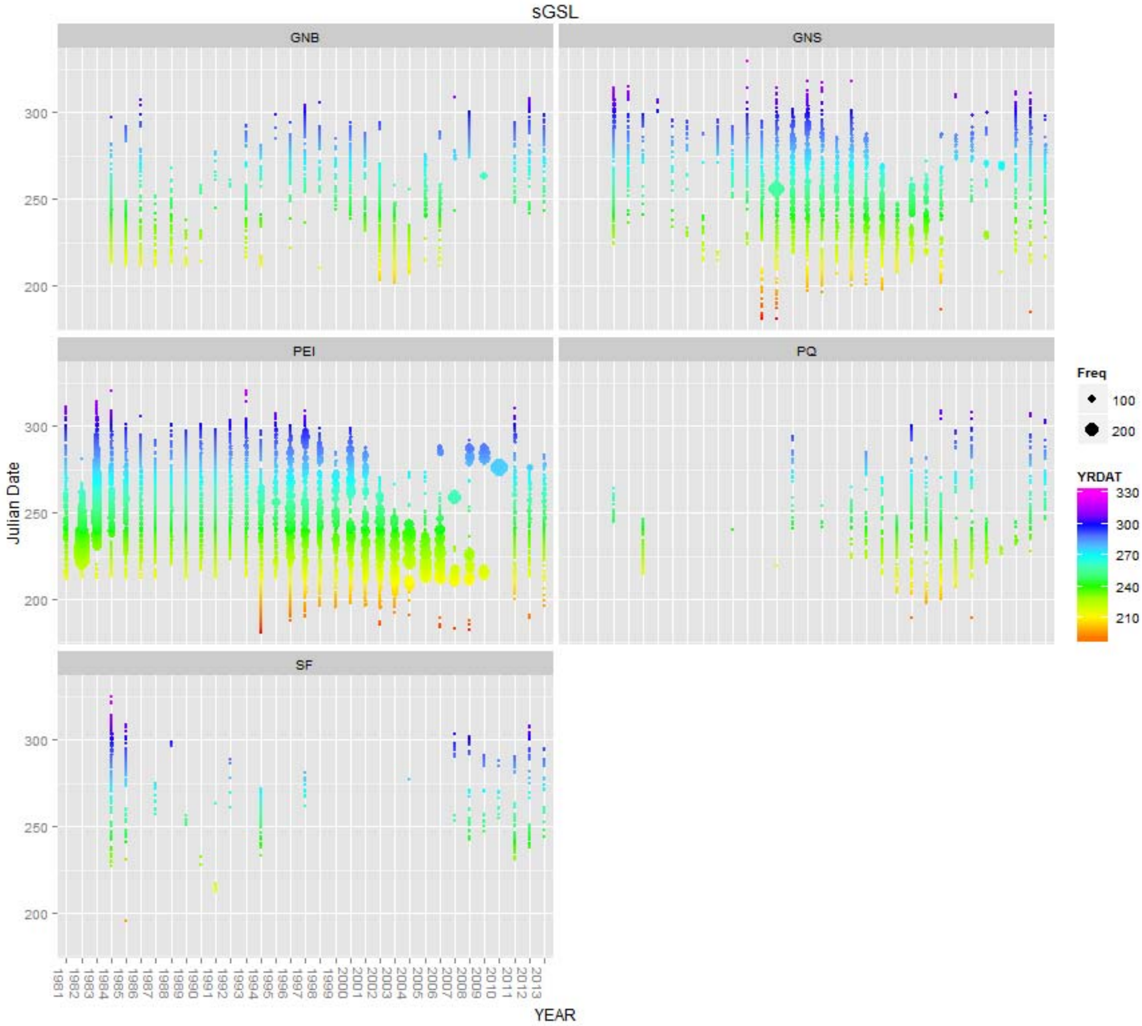


Figure 10. Frequency of trips by bluefin tuna fleets fishing in the Gulf of St. Lawrence (1981-2013). Colors correspond to the day of the year and bubble sizes reflect the relative number of trips.

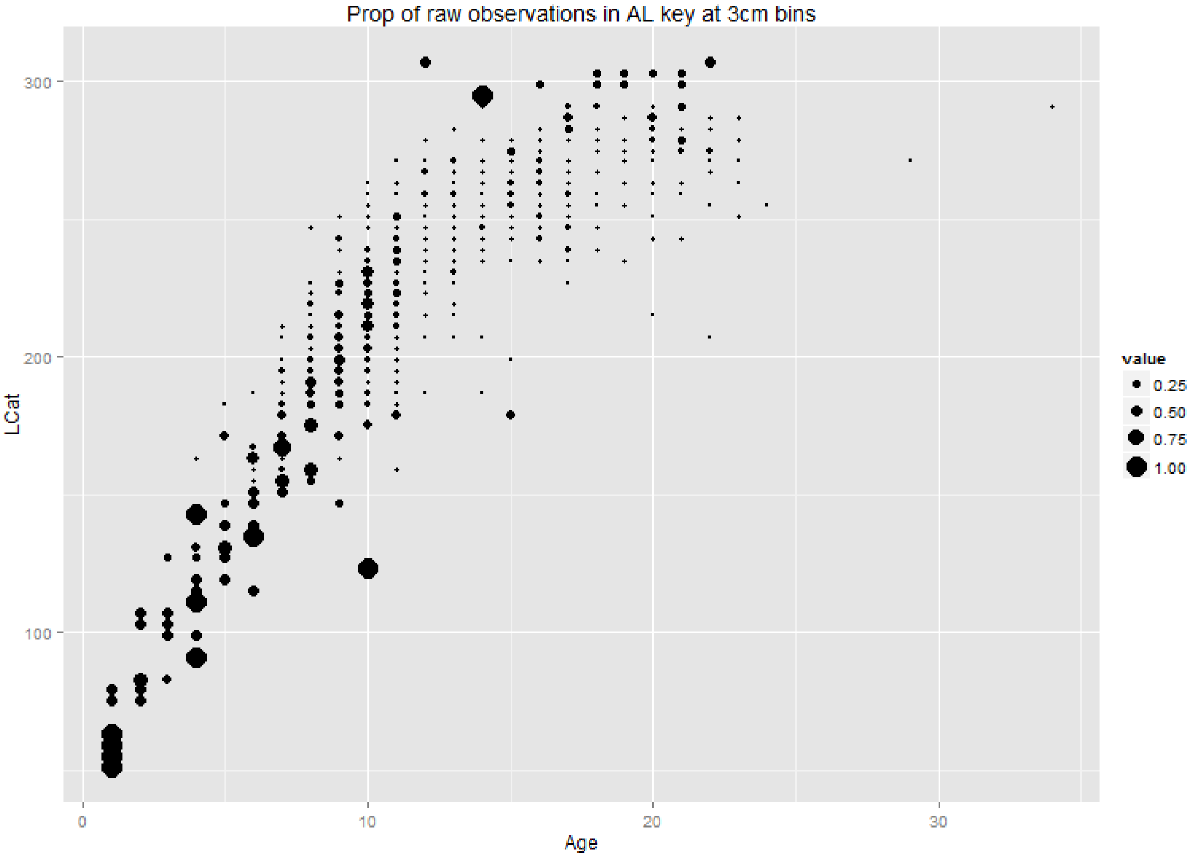


Figure 11. Age-at-length data used to construct and age-length key for assigning ages to catch-at-size data in the pilot western bluefin VPA.

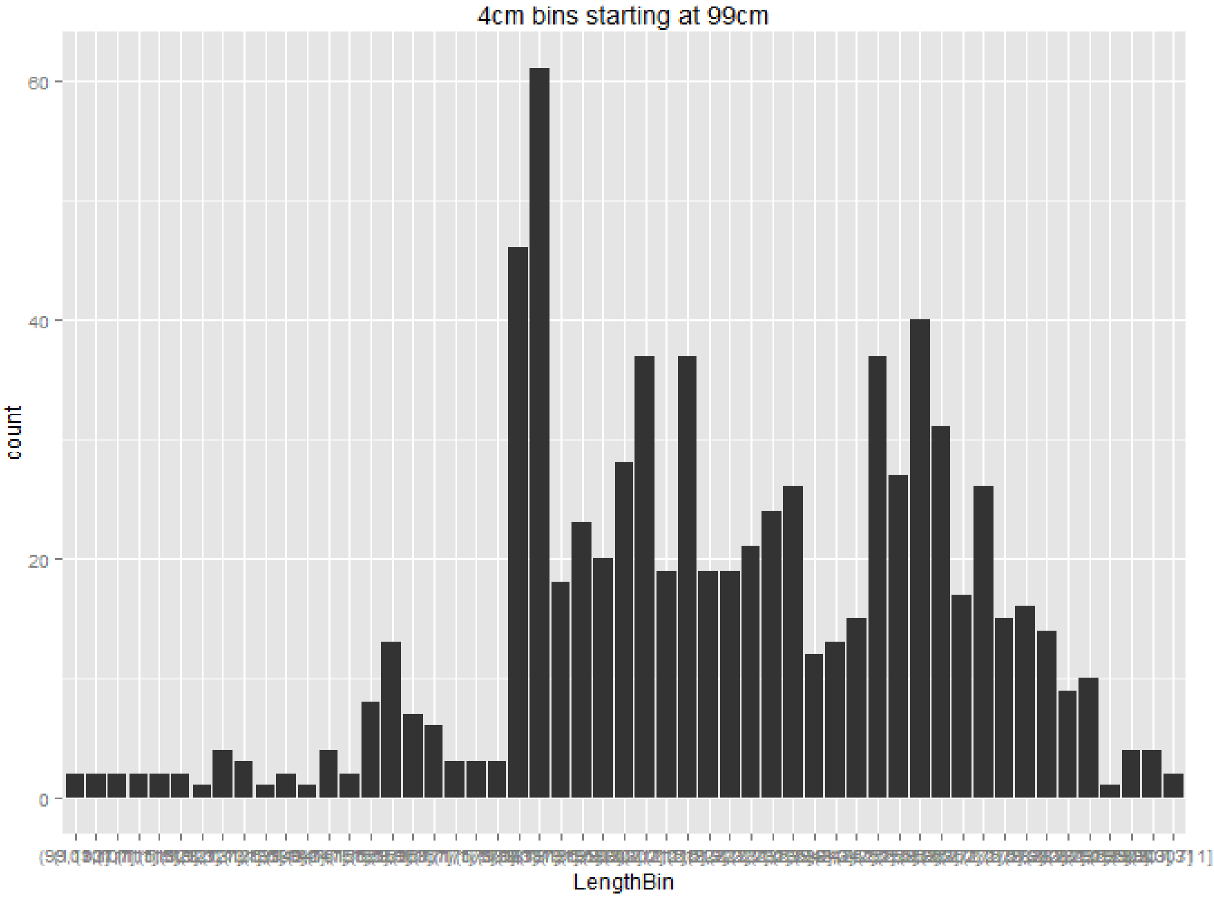


Figure 12. Size distribution of samples used in the construction of the age-length key for western bluefin.

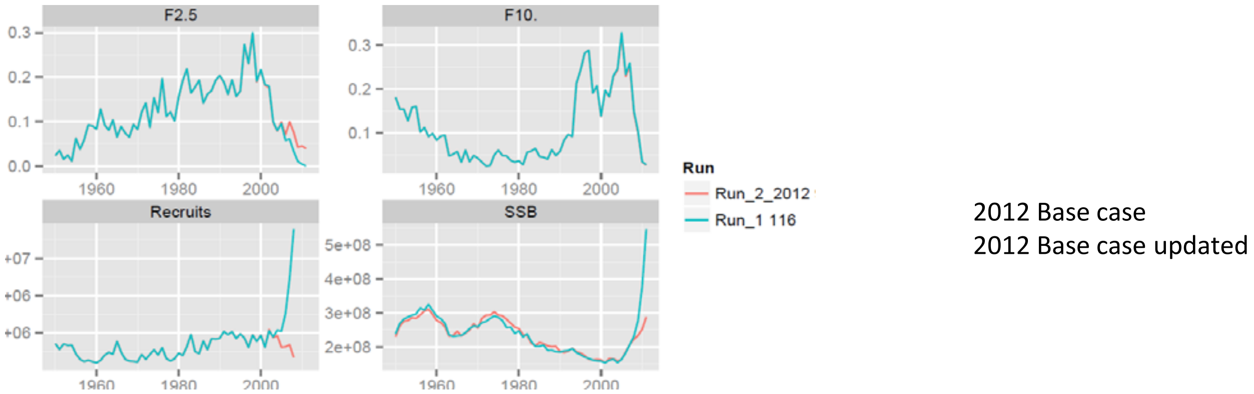


Figure 13. Eastern bluefin tuna. Runs for the 2012 base assessment and its update using updated data up until 2011, *(reported and inflated)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last years removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis VPA issue (bottom left), and SSB (bottom right).

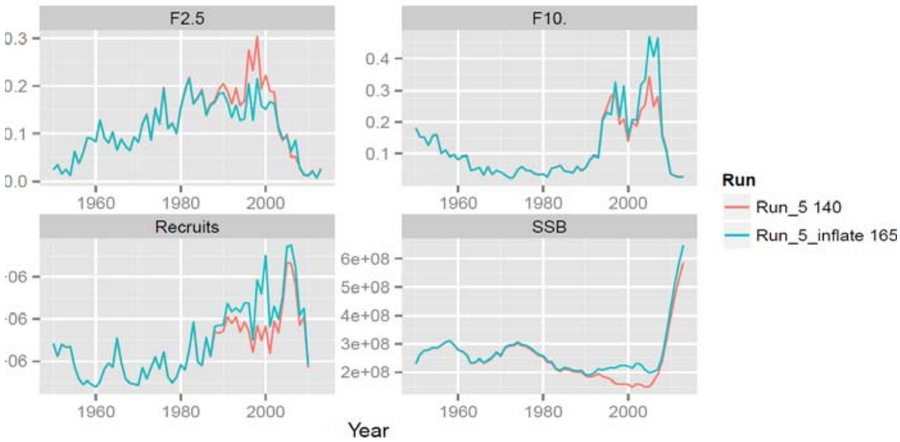


Figure 14. Eastern bluefin tuna. Results for the continuity run *(reported and inflated)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last years removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis VPA issue (bottom left), and SSB (bottom right).

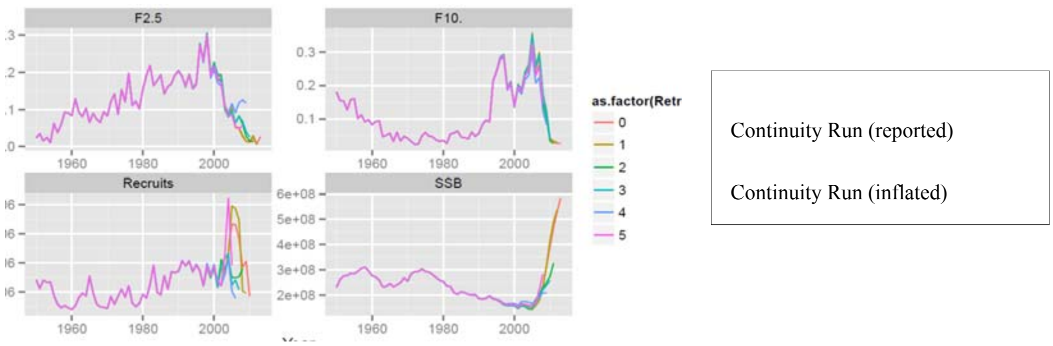


Figure 15. Eastern bluefin tuna. Retrospective runs for the continuity run *(reported catch)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis (bottom left), and SSB (bottom right).

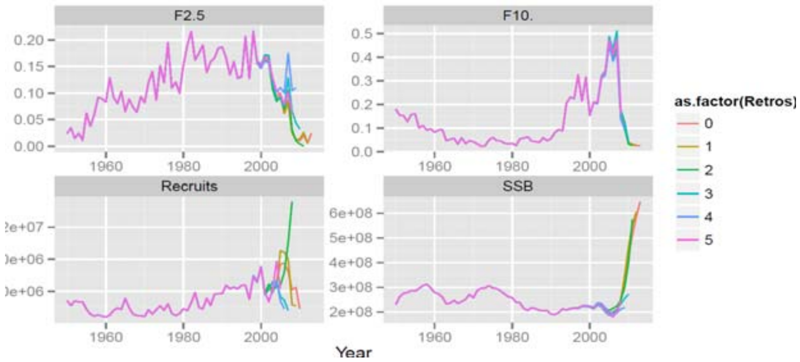


Figure 16. Eastern bluefin tuna. Retrospective runs for the continuity run *(inflated catch, i.e., catch raised to 50,000 tonnes from 1998 to 2006 and to 61,000 tonnes in 2007, but no inflation of the reported catch since 2008)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis (bottom left), and SSB (bottom right).

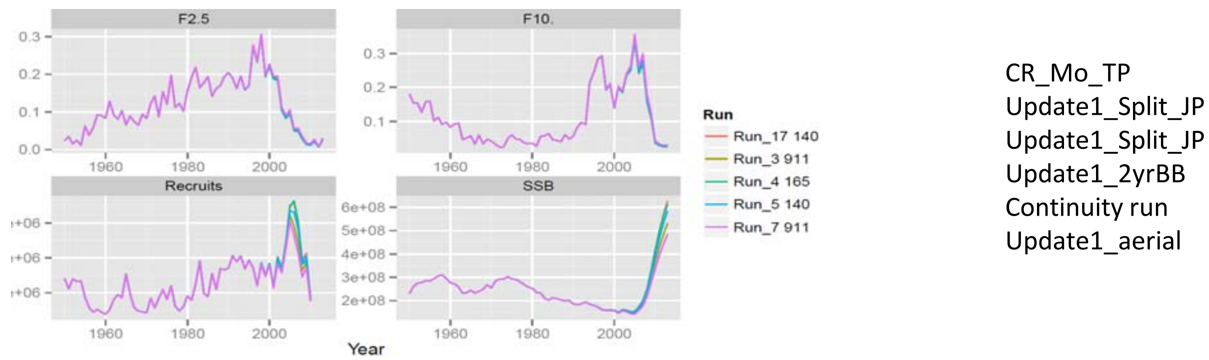


Figure 17. Eastern bluefin tuna. Runs for the five sensitivity runs for the assumptions about the choice of the CPUE series using the reported catch showing time series of fishing mortality at ages 2-5 (top left), f ishing mortality at ages 10+ (top right), recruits with the three last removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis (bottom left), and SSB (bottom right). The runs were compared to the continuity run.

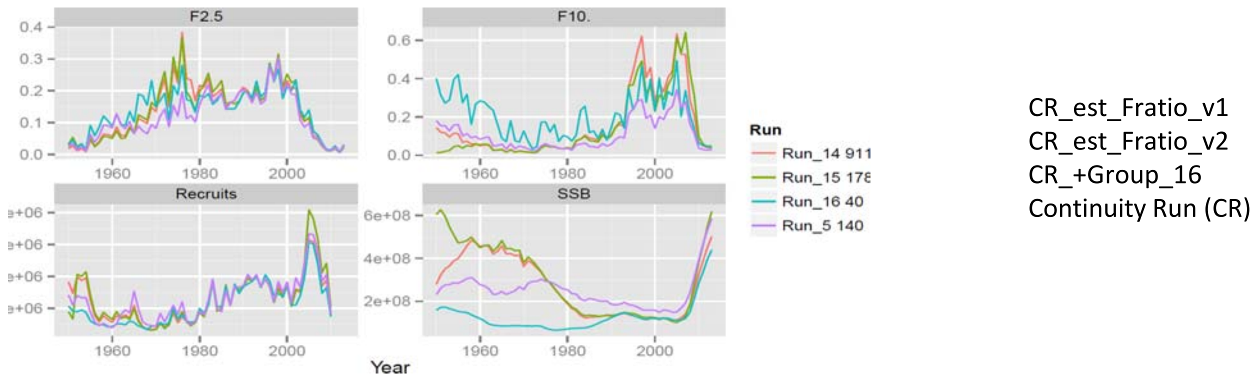


Figure 18. Eastern bluefin tuna. Runs for the 3 sensitivity runs for the assumptions about the F- ratios and terminal ages using the reported catch showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last removed because o f it is not possible to estimate recent recruitment reliably from the catch-at-age analysis (bottom left), and SSB (bottom right). The runs were compared to the continuity run.

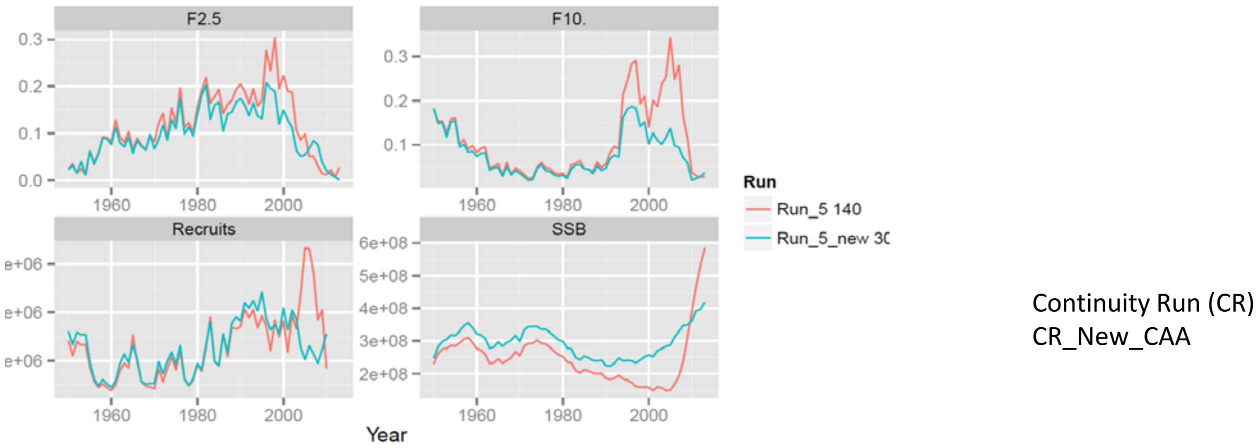


Figure 19. Eastern bluefin tuna. The preliminary benchmark run (pilot study) with the same settings as the continuity run was explored using the reported catch, however the Group could not fully review these results due to the lack of time available for the update stock assessment during the meeting. showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis (bottom left), and SSB (bottom right). The runs were compared to the continuity run.

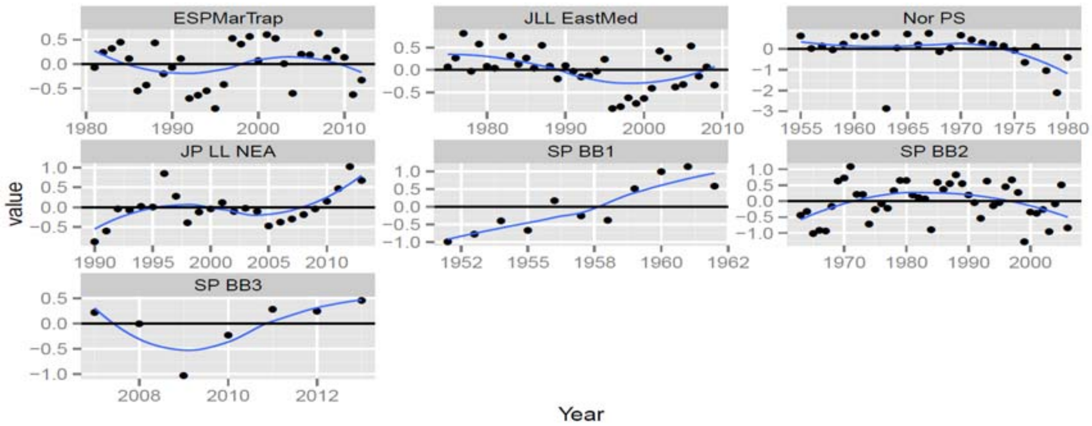


Figure 20. Eastern bluefin tuna. CPUE series (points) and fitted values (lines) resulting from the VPA of continuity run (reported catch) using reported catch.

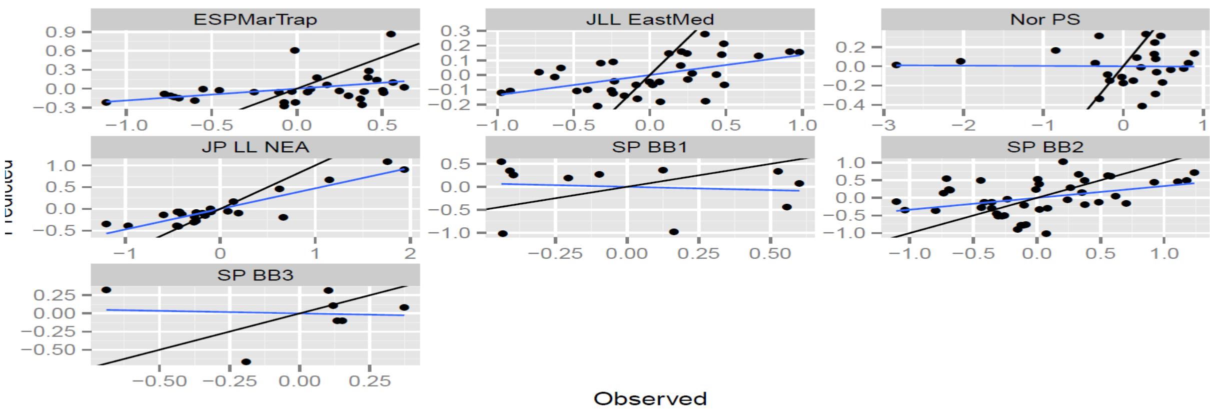


Figure 21. Eastern bluefin tuna. Observed and expected values of CPUE values are plotted against each other (continuity run using reported catch). This allows a quick check of which indices are correlated with the population estimates, the black line is the Y=X line and the blue a linear regression fitted to the data. If an index agrees closely with the VPA results then the blue and black lines will near coincide.

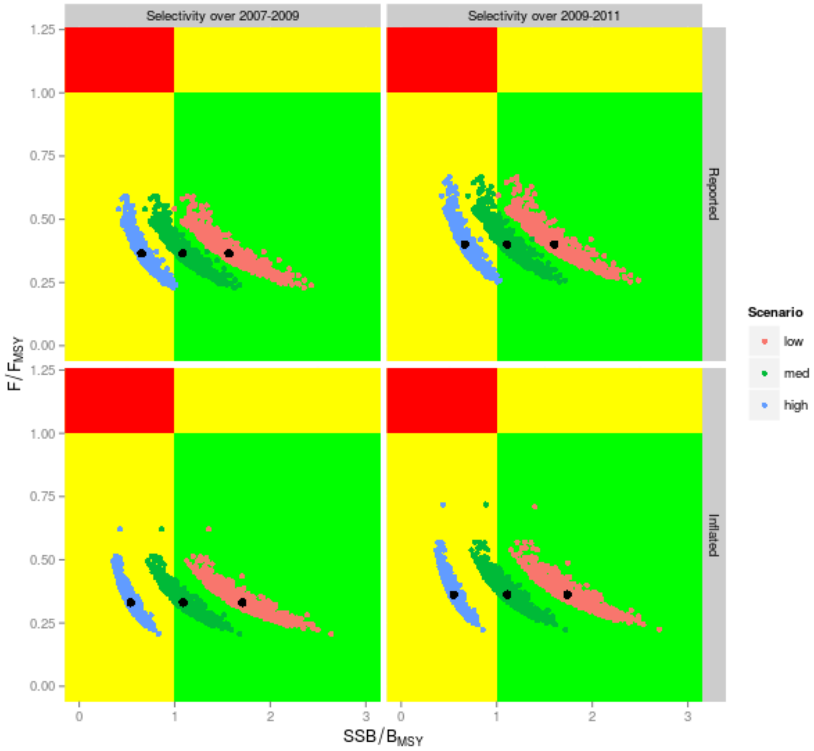


Figure 22. Eastern bluefin tuna. Stock status from 2011 to the terminal year (2013) estimated from VPA continuity run with reported and inflated catch (upper and lower panels) and considering low, medium and high recruitment levels (blue, green and red lines). Blue, green and red dots represent the distribution of the terminal year obtained through bootstrapping for the corresponding three recruitment levels. Left Panel (selectivity over 2007-2009): 2013 SSB and F relative to reference points calculated with the selectivity pattern over 2007-2009 which was same period as the 2010 stock assessment. Right Panel (selectivity over 2009-2011): 2013 SSB and F relative to the reference points with the selectivity pattern over 2009-2011 which was same period as the 2012 stock assessment.

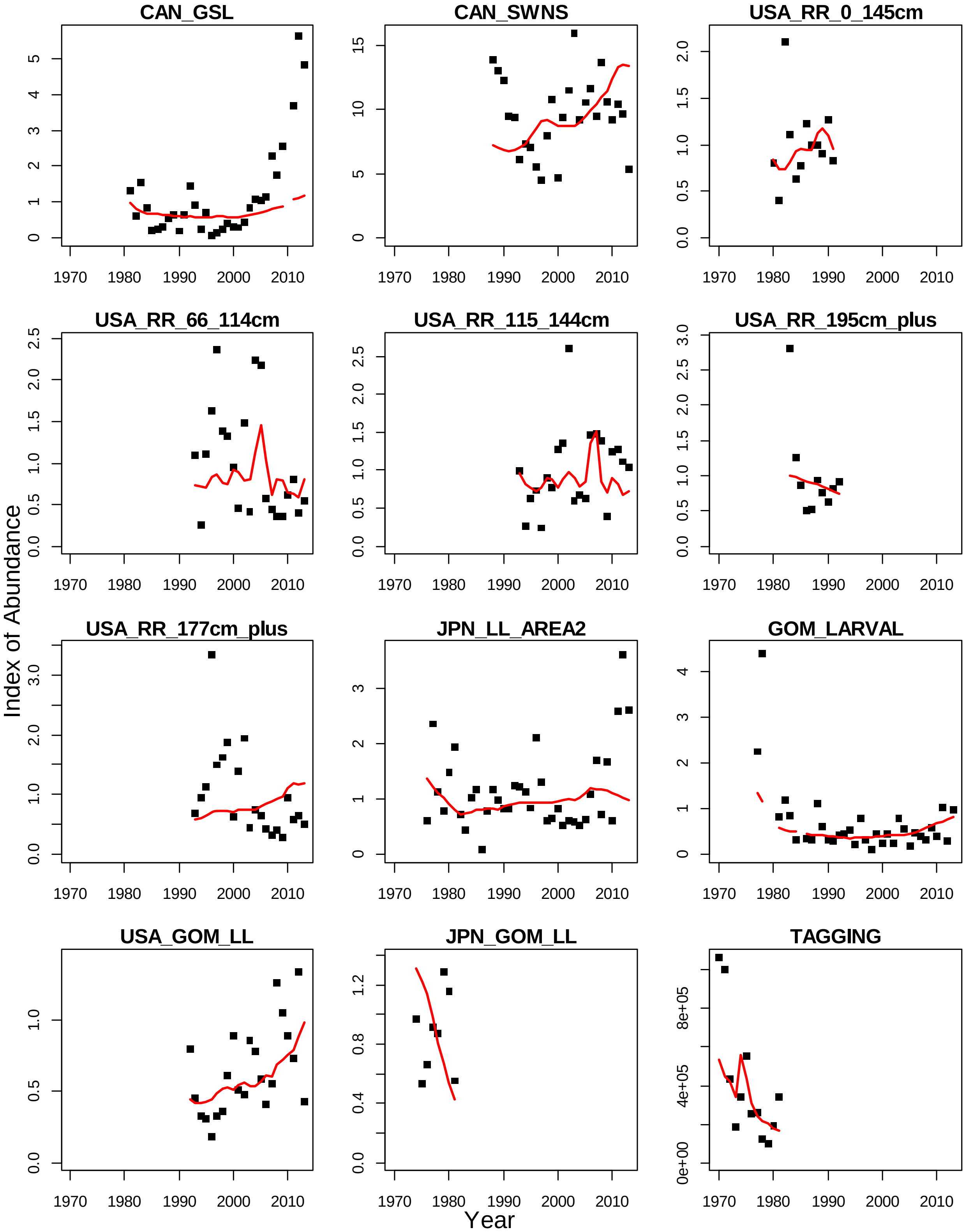


Figure 23. Fits to CPUE indices for 2014 western Atlantic BFT base VPA (observed shown as black points, model predicted shown as red lines).

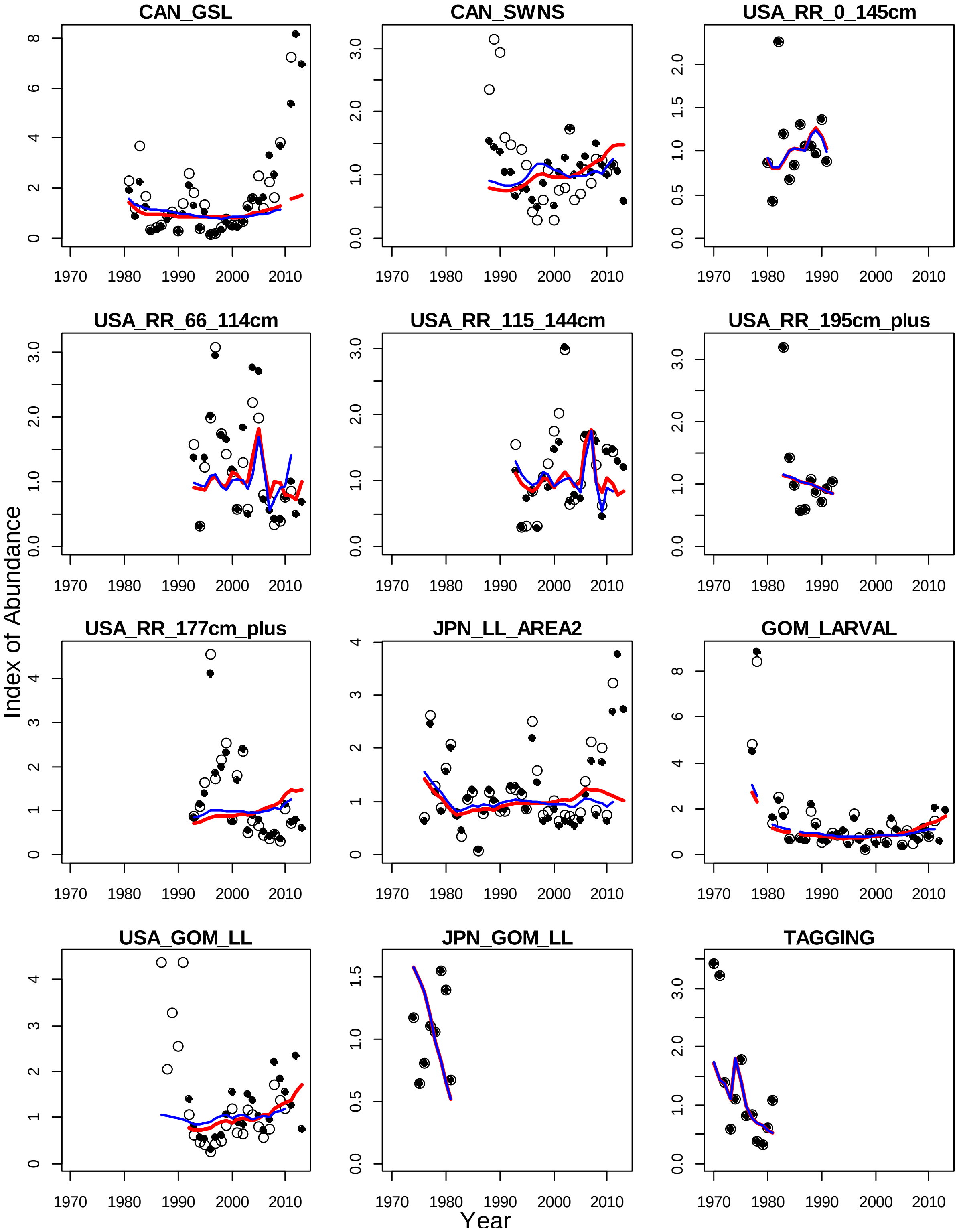


Figure 24. Fits to the CPUE indices for 2014 western Atlantic BFT base VPA (observed shown as solid points, predicted shown as red lines) compared to the 2012 base model (observed shown as open circles, predicted shown as blue lines).

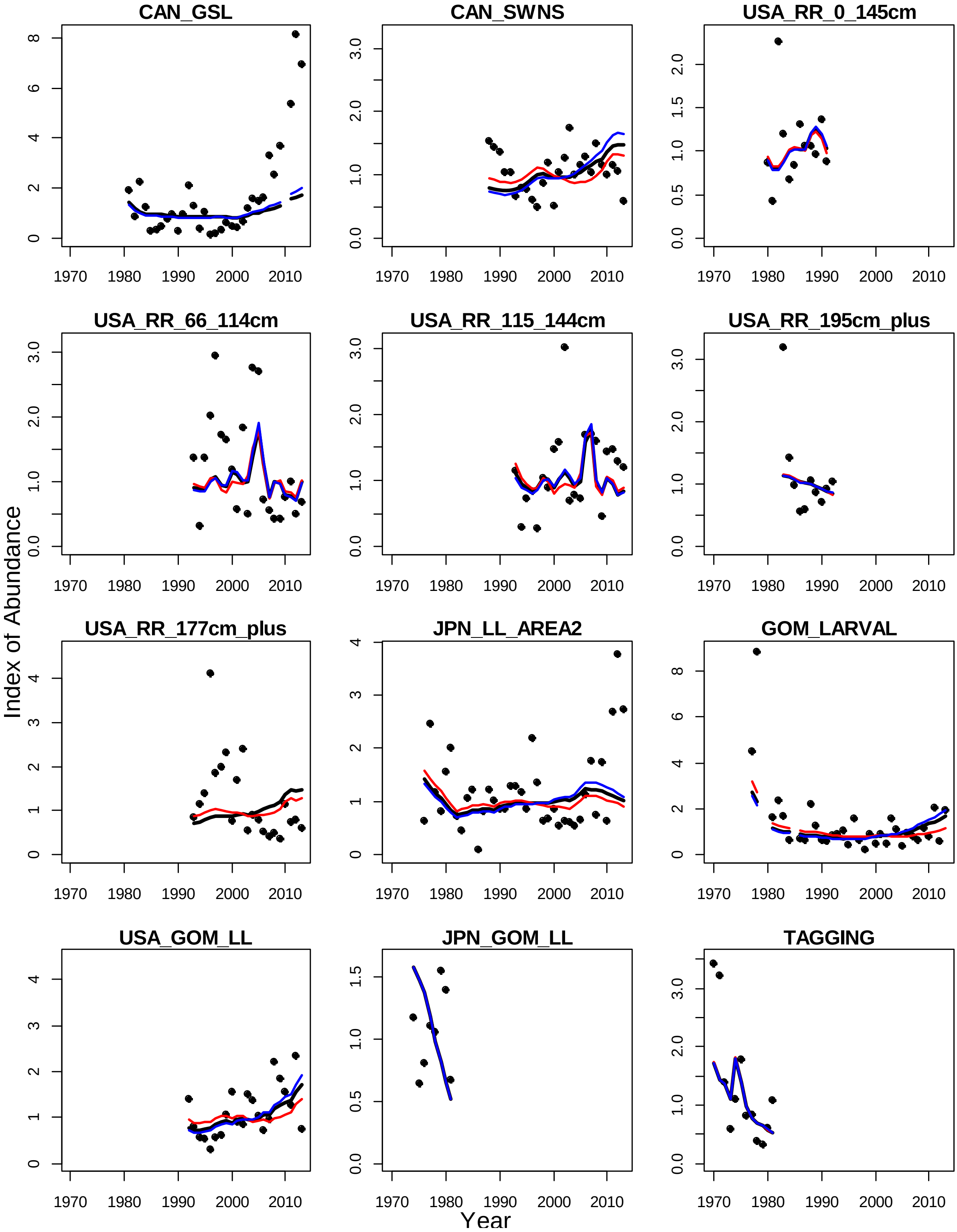


Figure 25. Fits to CPUE indices for western Atlantic BFT base VPA run (black lines) compared to jackknife sensitivity runs without Canadian GSL index (red lines) and USA RR>177 cm index (blue lines).

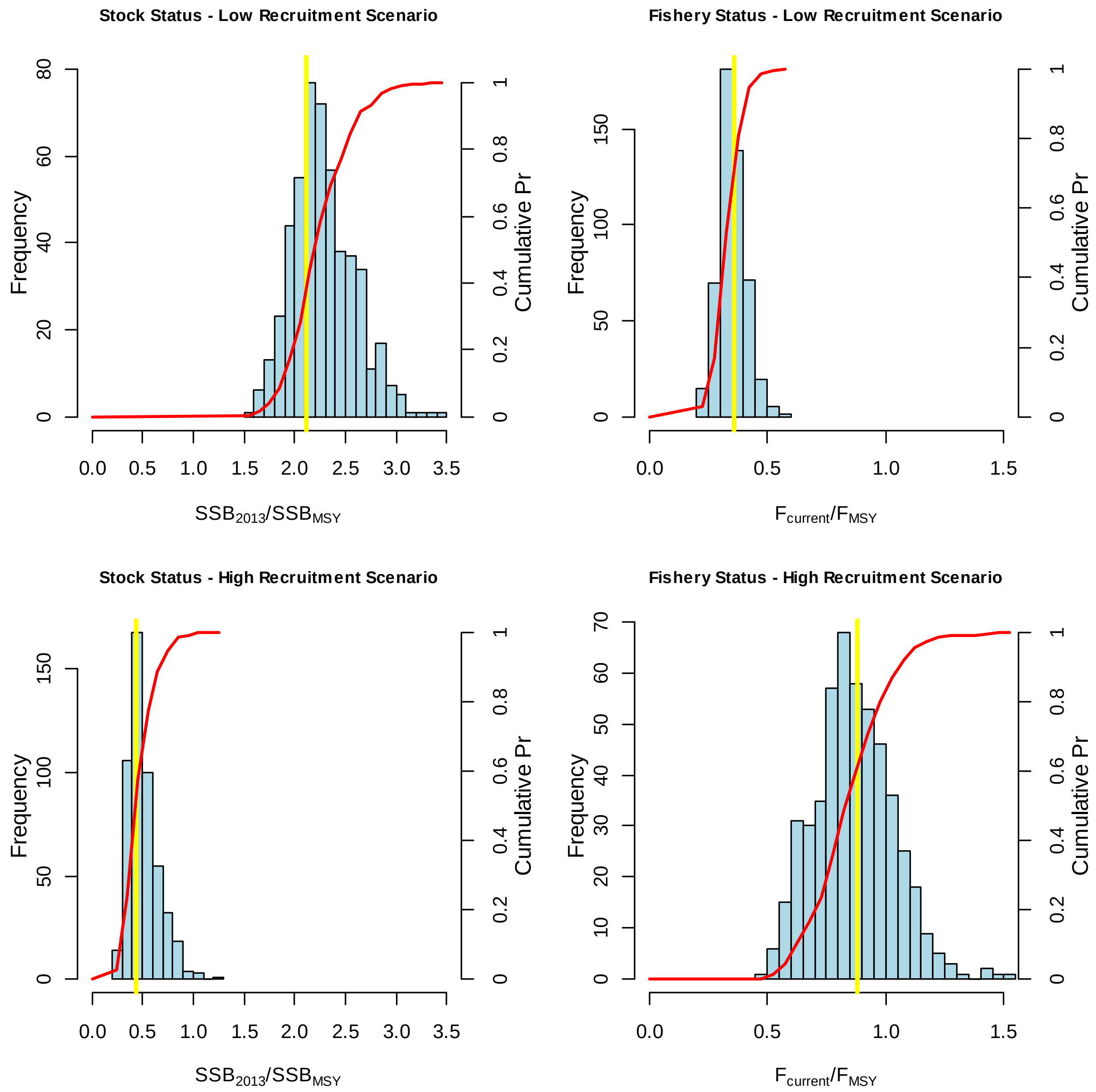


Figure 26. Western BFT: Histograms of bootstrap estimates of 2013 stock and fishery status. The yellow bar represents the value corresponding to the base-case deterministic point estimate. The cumulative probability is shown as a solid red line.

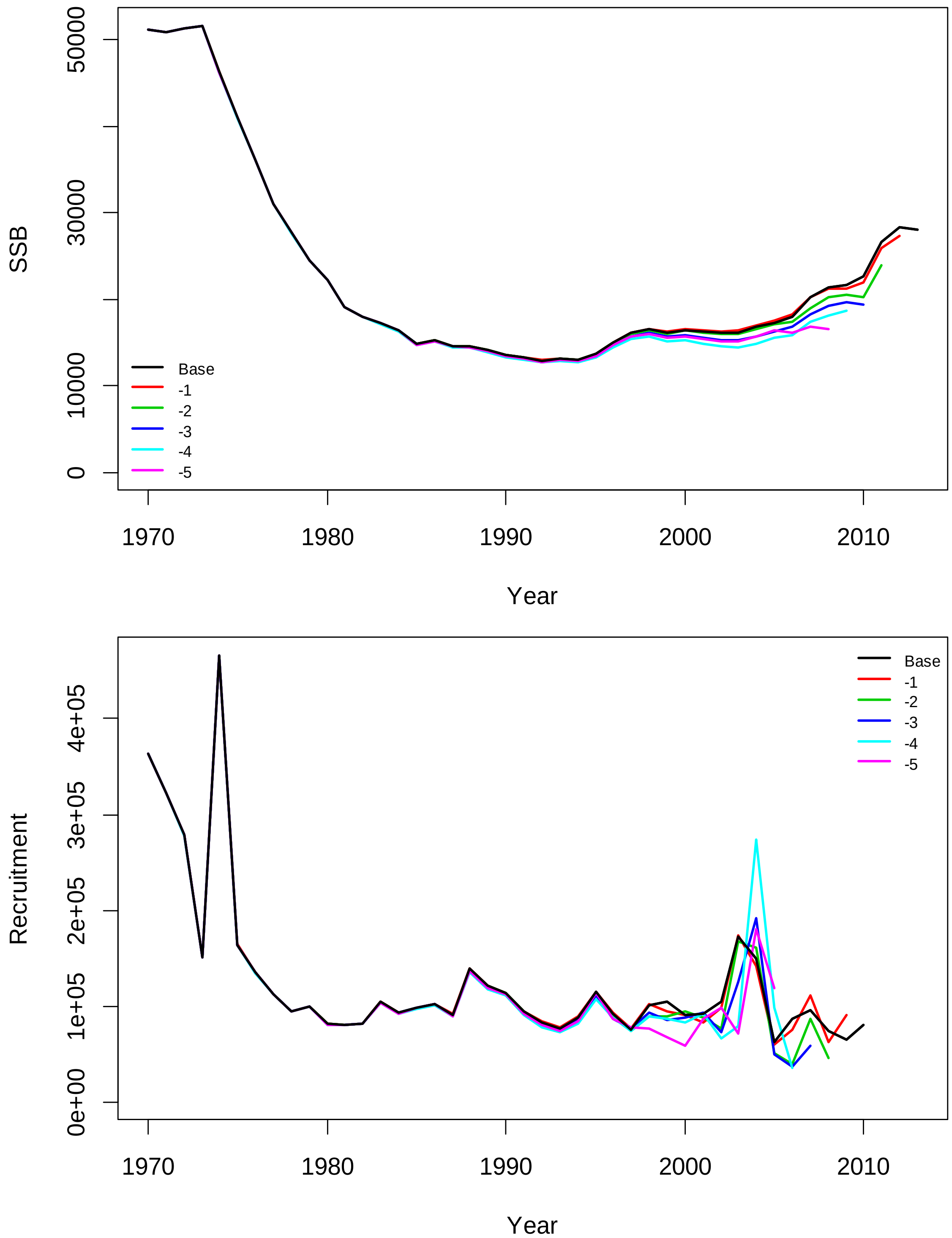


Figure 27. Retrospective trends of spawning biomass (ages 9 and older) and recruitment (age 1) from the western BFT base case. The legend indicates the number of years of data removed from the 2014 base VPA.

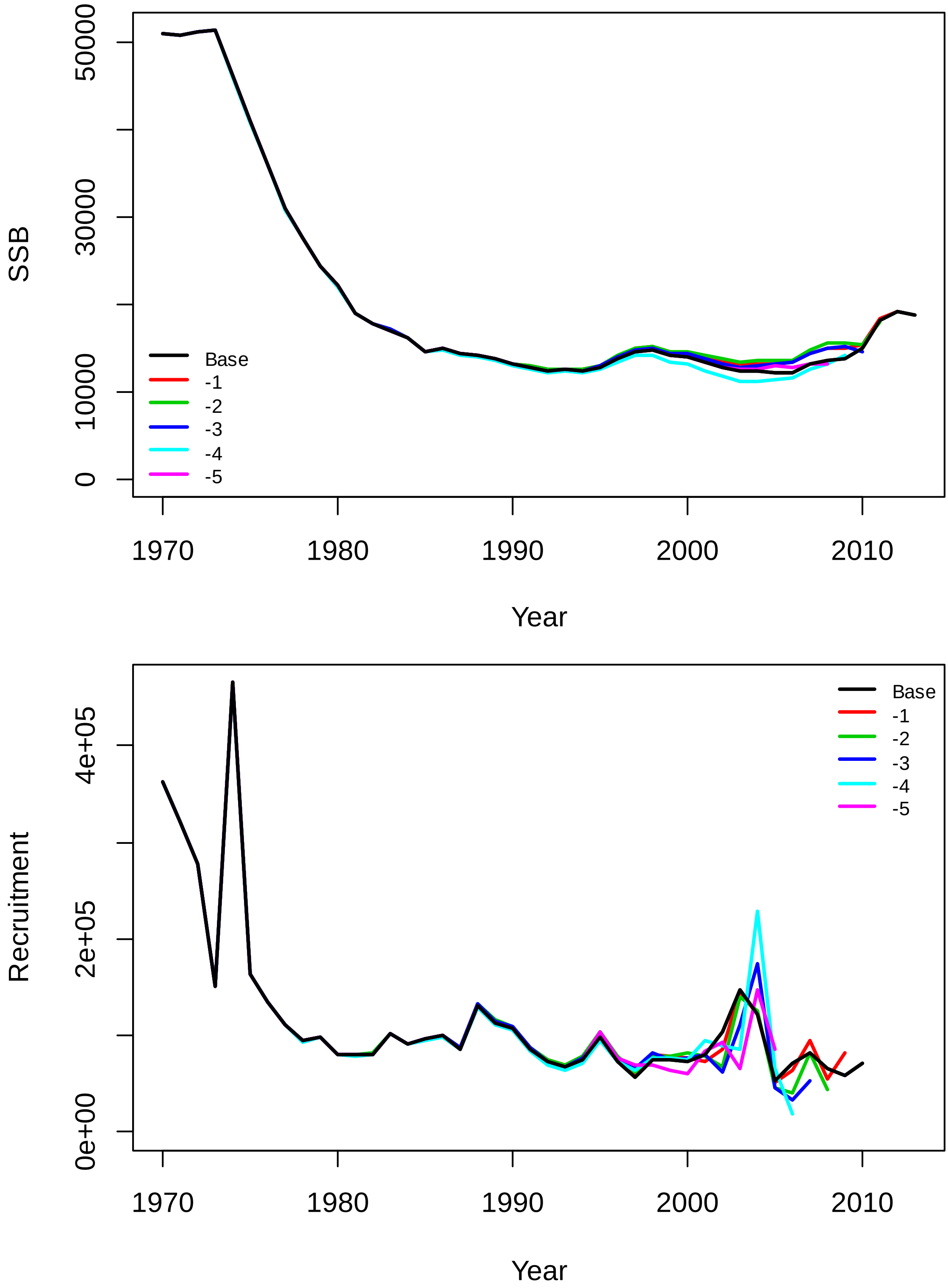


Figure 28. Western BFT: Retrospective trends of spawning biomass (ages 9 and older) and recruitment (age 1) from the jack-knife sensitivity run with Canadian GSL index removed. The legend indicates the number of years of data removed from the 2014 base VPA.

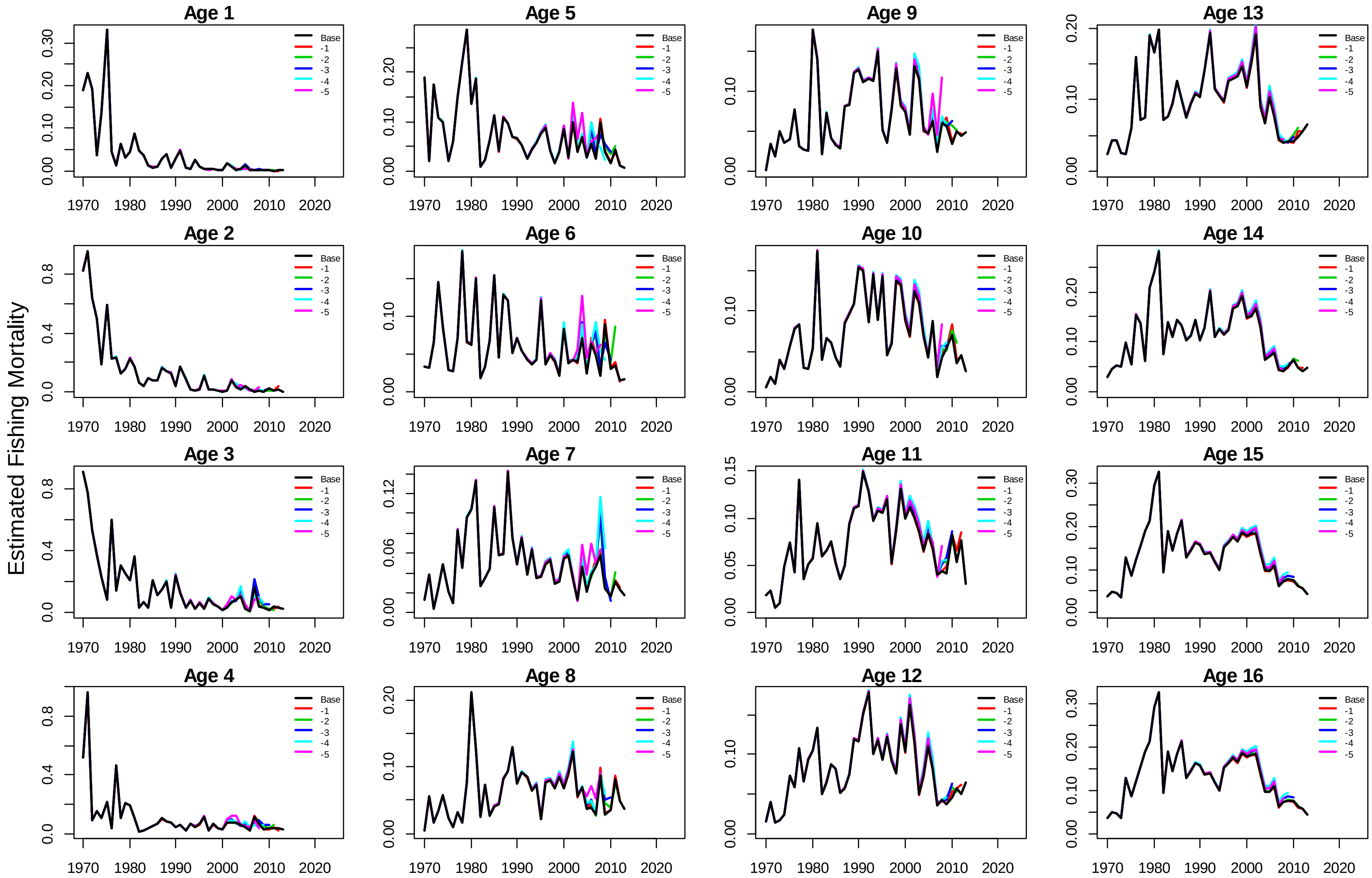


Figure 29. Retrospective patterns of fishing mortality by age from the western BFT base case model. The legend indicates the number of years removed from the 2014 base VPA.

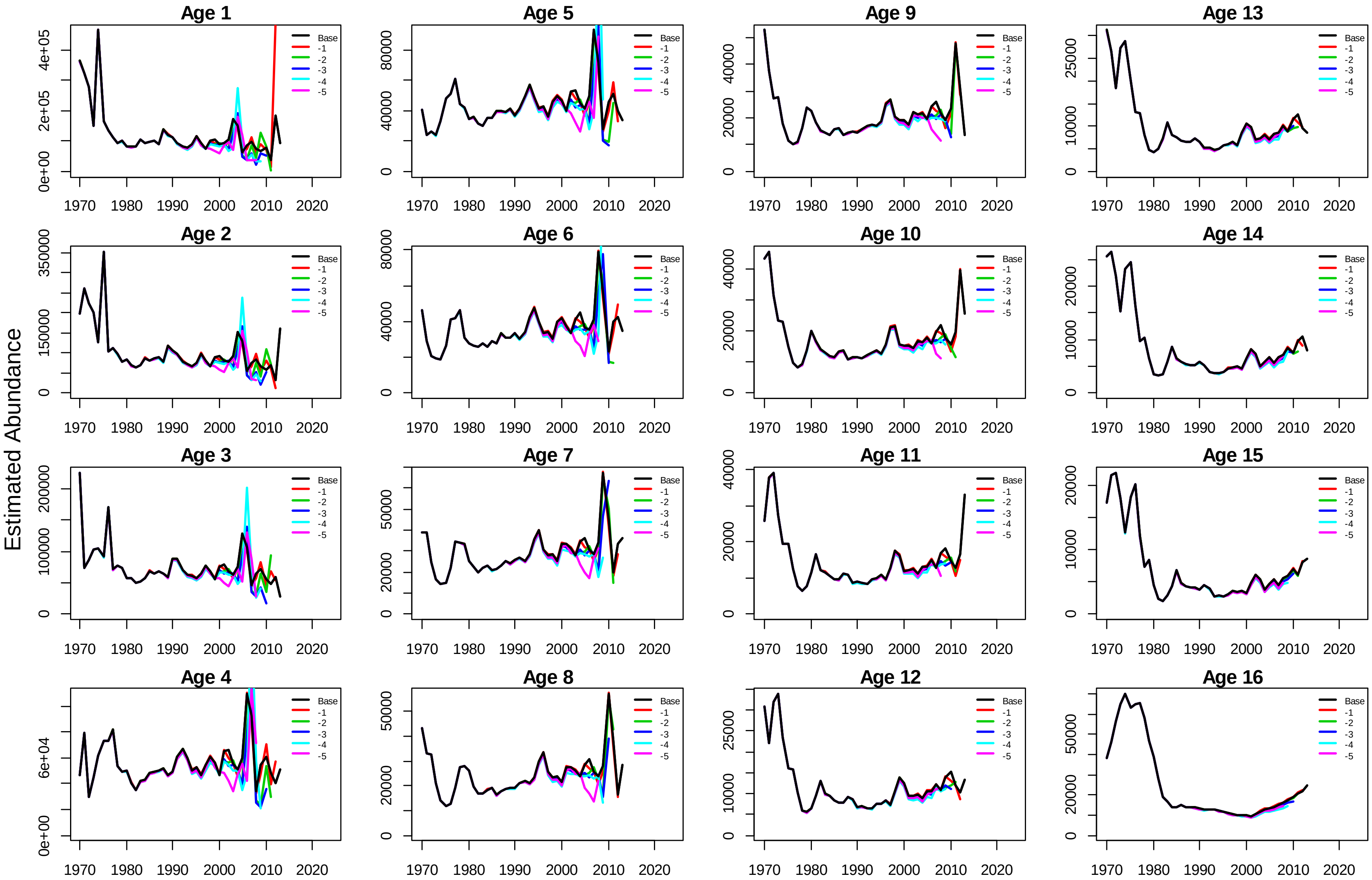


Figure 30. Retrospective patterns of numbers-at-age from the western BFT base case model. The legend indicates the number of years removed from the 2014 base VPA.

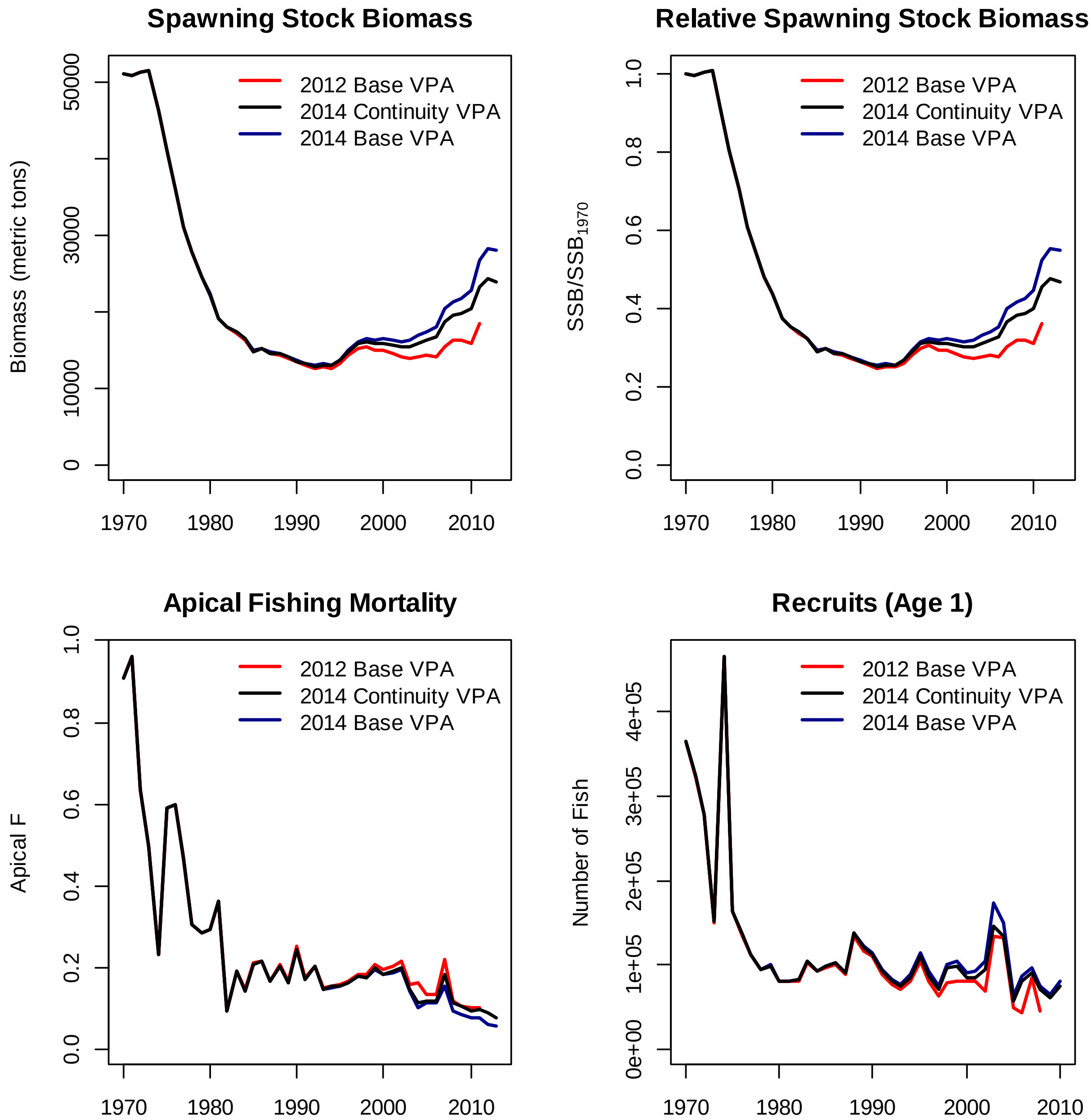


Figure 31. Western BFT: Annual estimates of spawning stock biomass, depletion relative to 1970, recruitment, and fishing mortality for the 2012 base (red lines), 2014 continuity (black lines) and 2014 (dark blue lines) base runs.

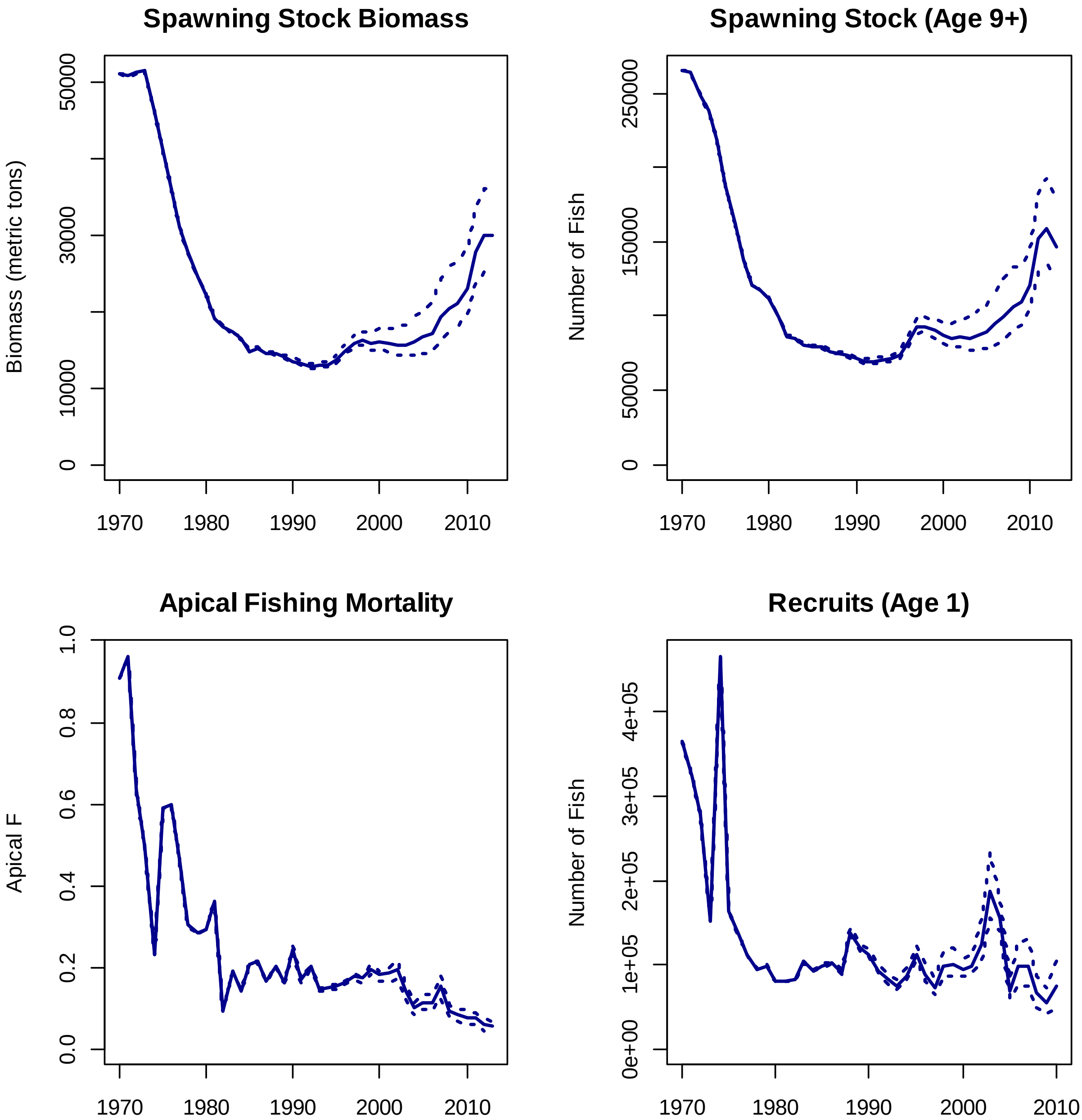


Figure 32. Western BFT: Median (solid line) estimates of spawning stock biomass, abundance of spawners (Age 9+), apical fishing mortality, and recruitment for the base model. Dashed lines indicate the 80% confidence interval.

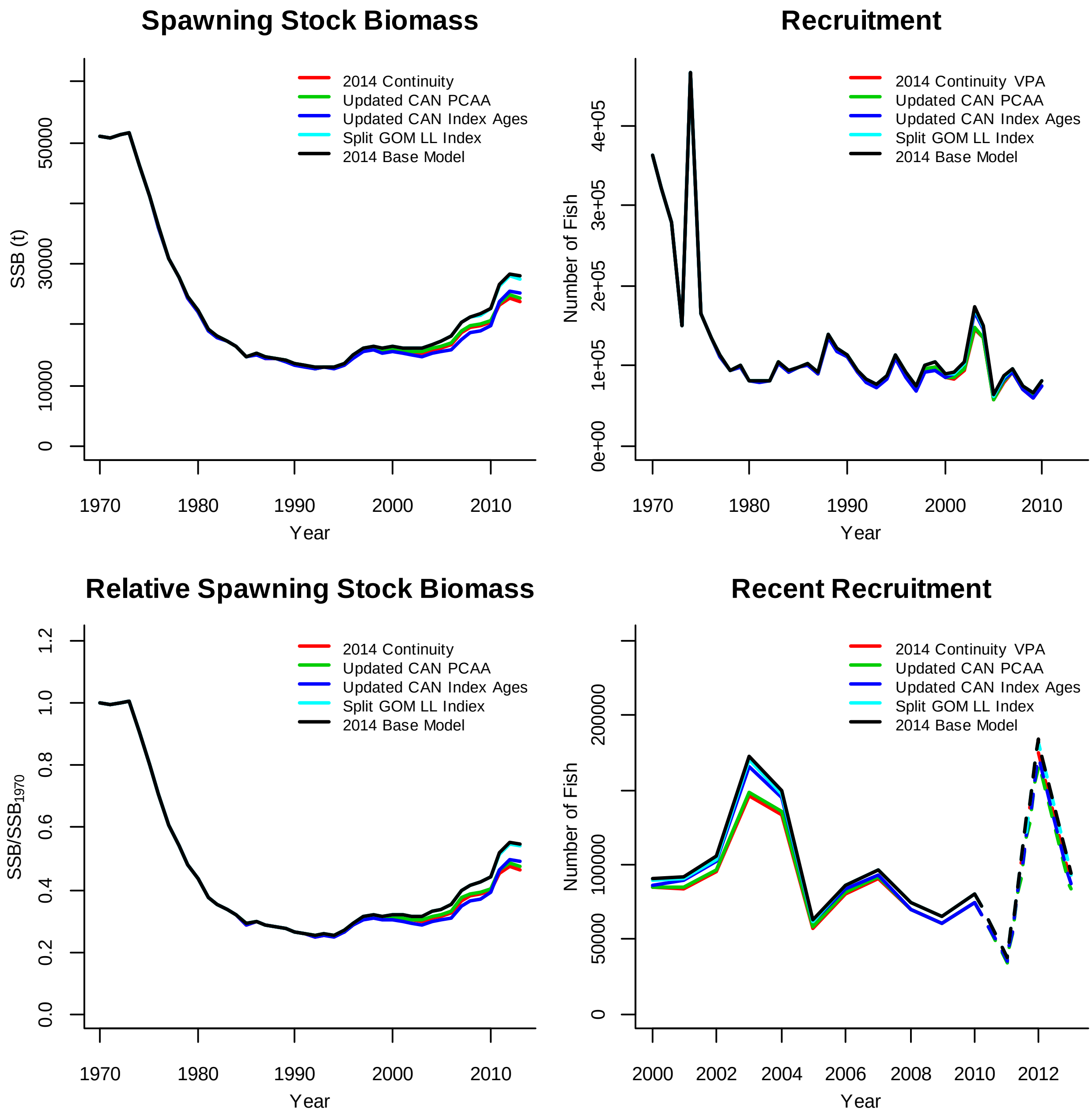


Figure 33. Western BFT: Annual estimates of spawning stock biomass, depletion relative to 1970, and recruitment for the 2014 continuity VPA, iterative modifications to the continuity, and 2014 base VPA.

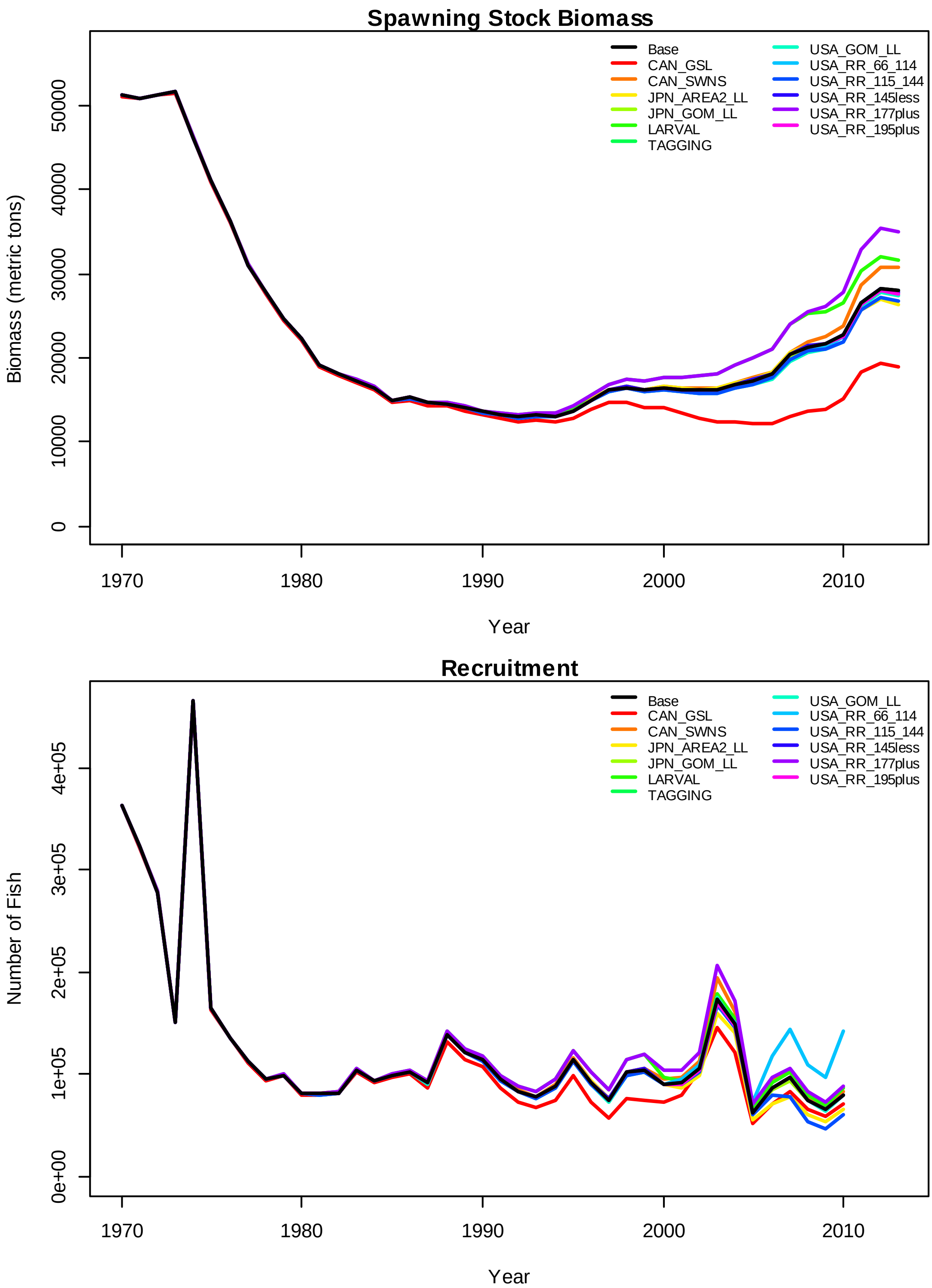


Figure 34. Jackknife analysis demonstrating the effects of iteratively removing individual relative abundance indices and associated partial catch-at-age matrices from the western BFT VPA.

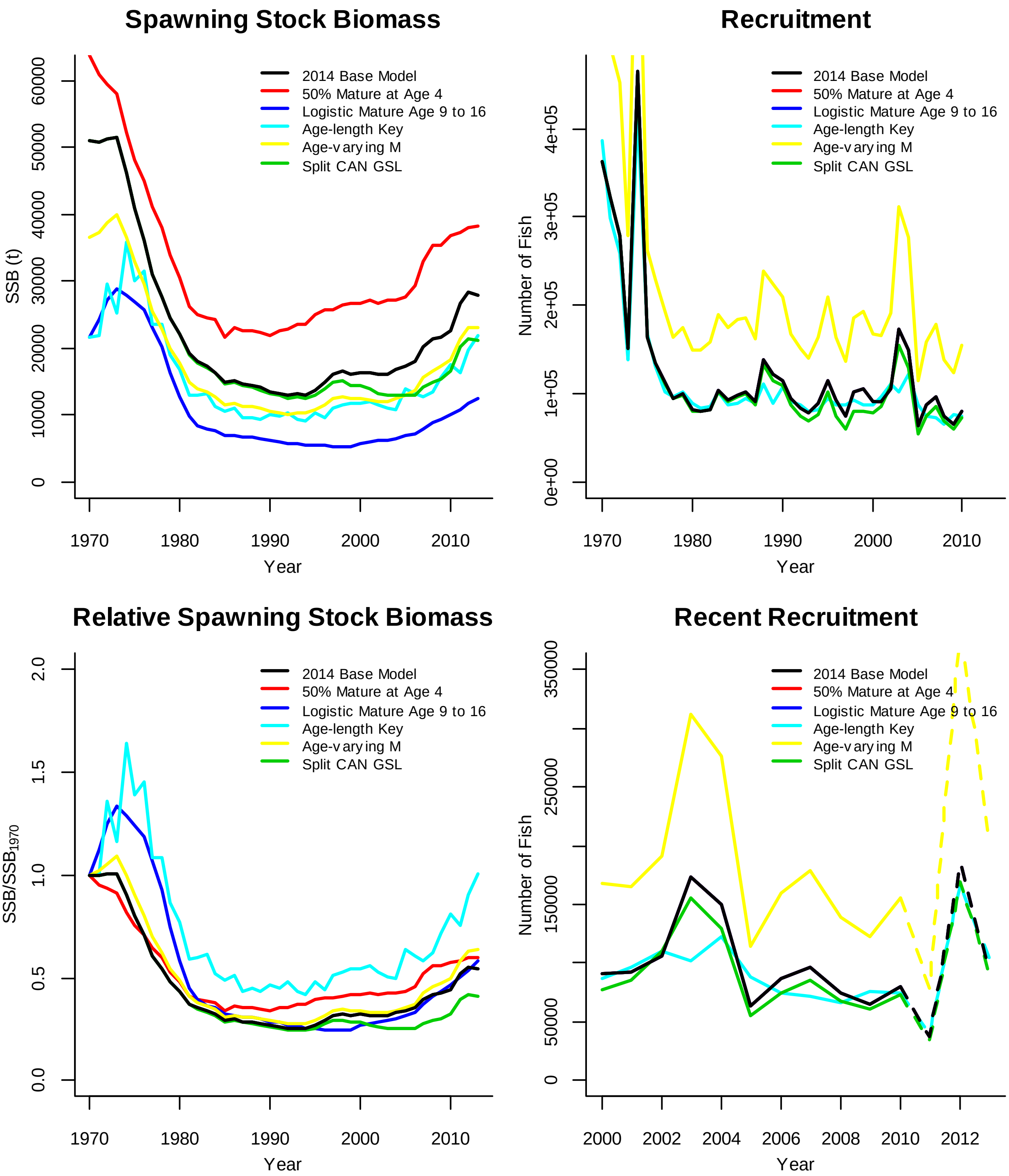


Figure 35. Western BFT: Annual estimates of spawning stock biomass, depletion relative to 1970, and recruitment for the select sensitivity runs that demonstrated deviation in trends from the 2014 base VPA.

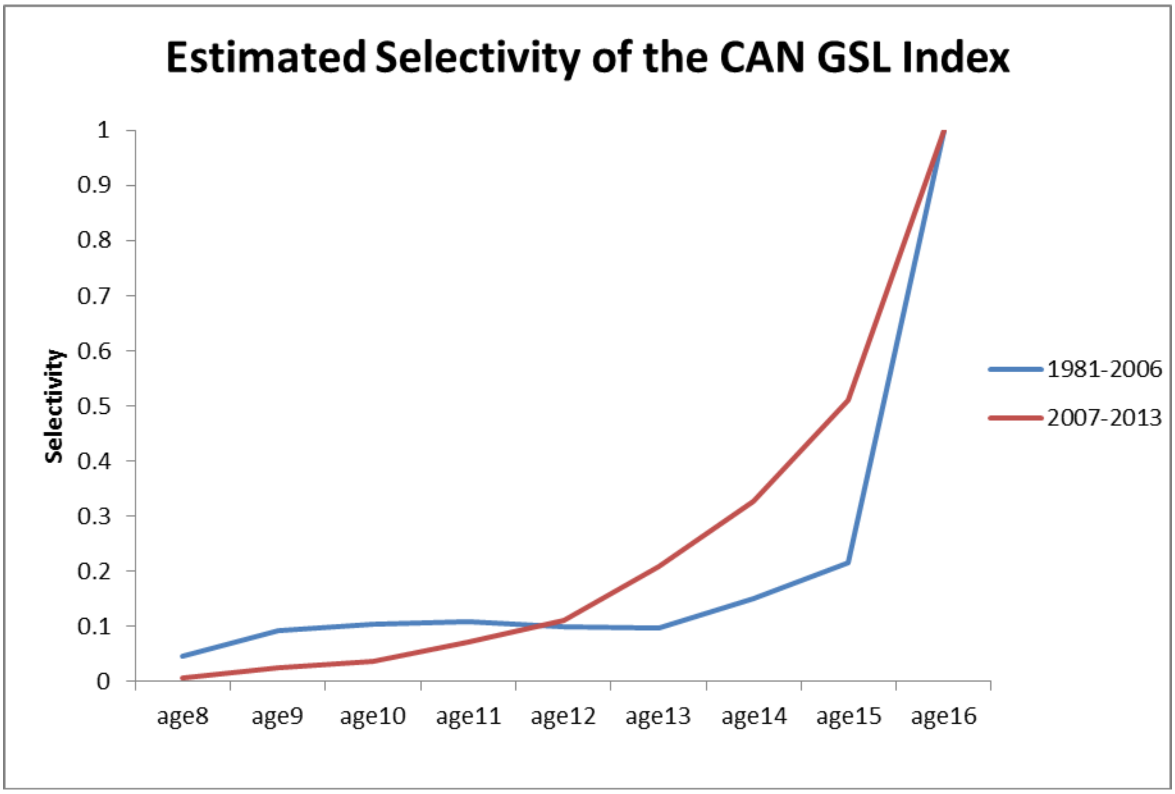


Figure 36. Western BFT: Comparison of estimated selectivity from the VPA sensitivity run that split the Canadian Gulf of St. Lawrence index into two periods, 1981-2006 and 1987-2013, to account for changes in fishery operations, specifically a shift in seasonality of the fishery.

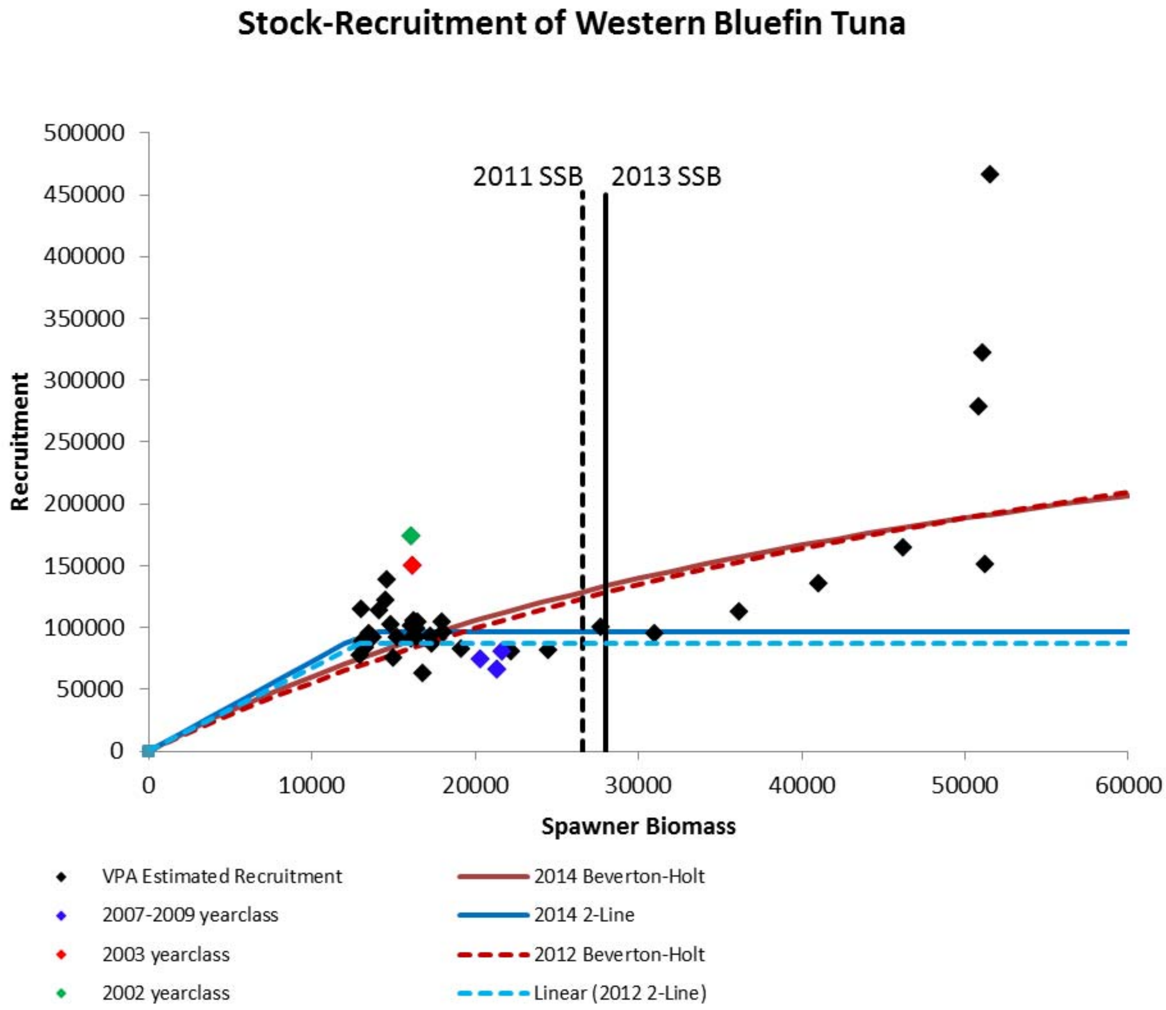


Figure 37. Western BFT: Spawner-recruit relationship fit to the 2014 base VPA (solid lines) compared to the 2012 base model fits (dashed lines). The two-line and Beverton-Holt models were used to calculate management reference points and project the population dynamics through 2019. Points represent the estimates from the 2014 base VPA, with the 2002, 2003, and recent year class estimates (2008-2010) highlighted.

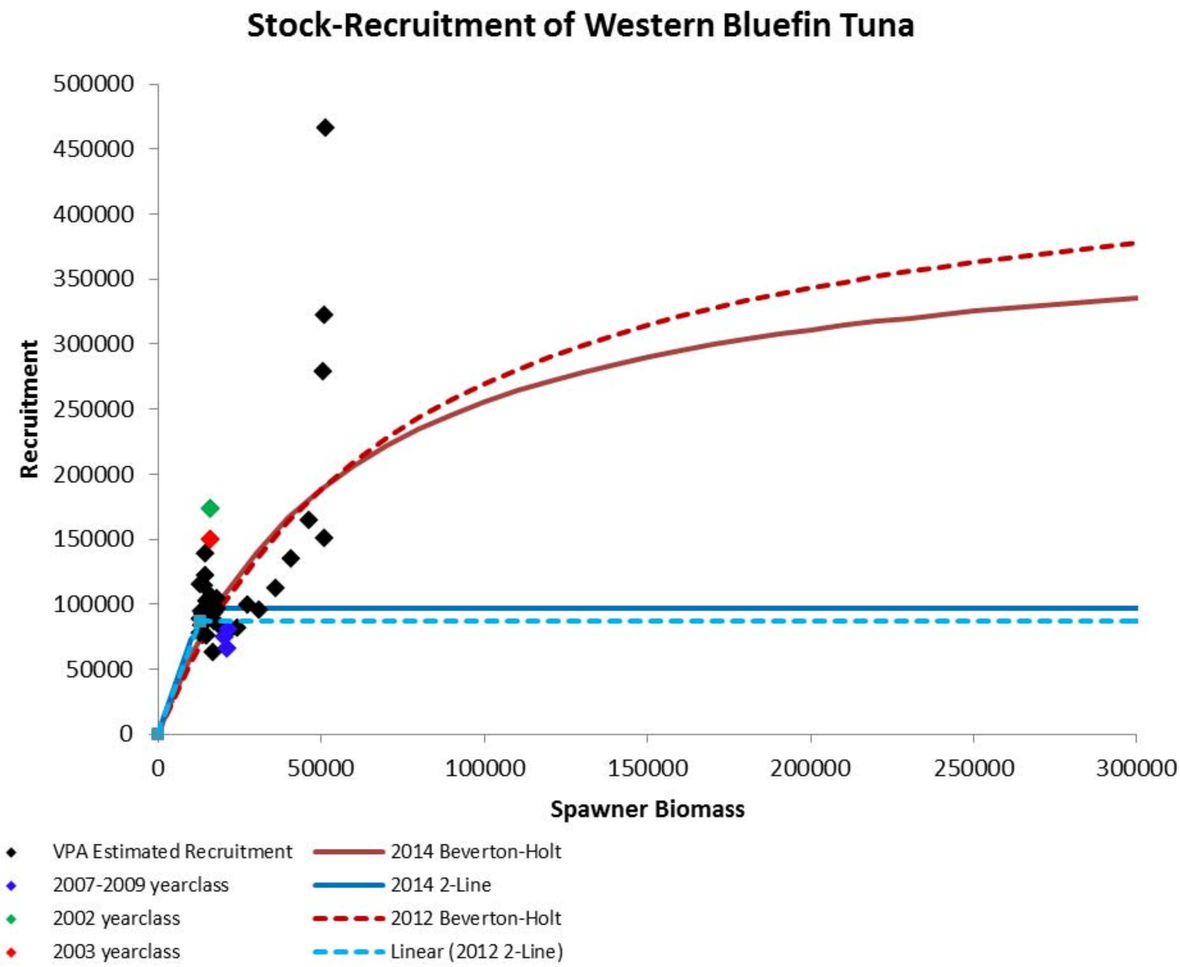


Figure 38. Western BFT: Spawner-recruit relationship fit to the 2014 base VPA (solid lines) compared to the 2012 base model fits (dashed lines). The x-axis represents spawner biomass and is extended out past the observed range to demonstrate the difference in asymptotes between the previous assessment estimates (steepness = 0.49) and 2014 update (steepness = 0.58), which resulted in differences in estimates of MSY and SSB_{MSY}. Points represent the estimates from the 2014 base VPA, with the 2002, 2003, and recent year class estimates (2008-2010) highlighted.

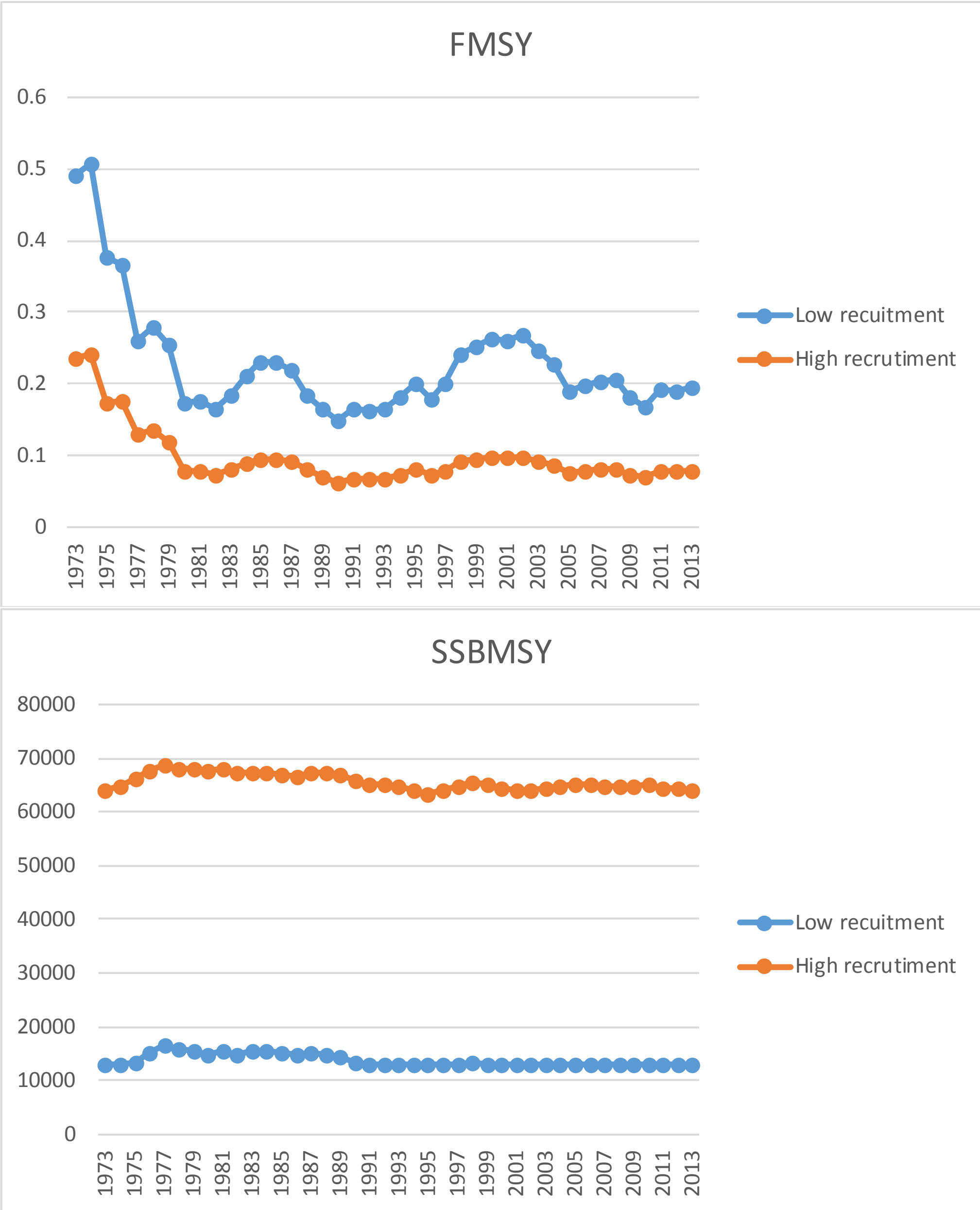


Figure 39. Time series of estimated F_{MSY} and SSB_{MSY} of western bluefin tuna, used in the estimates of stock status trends.

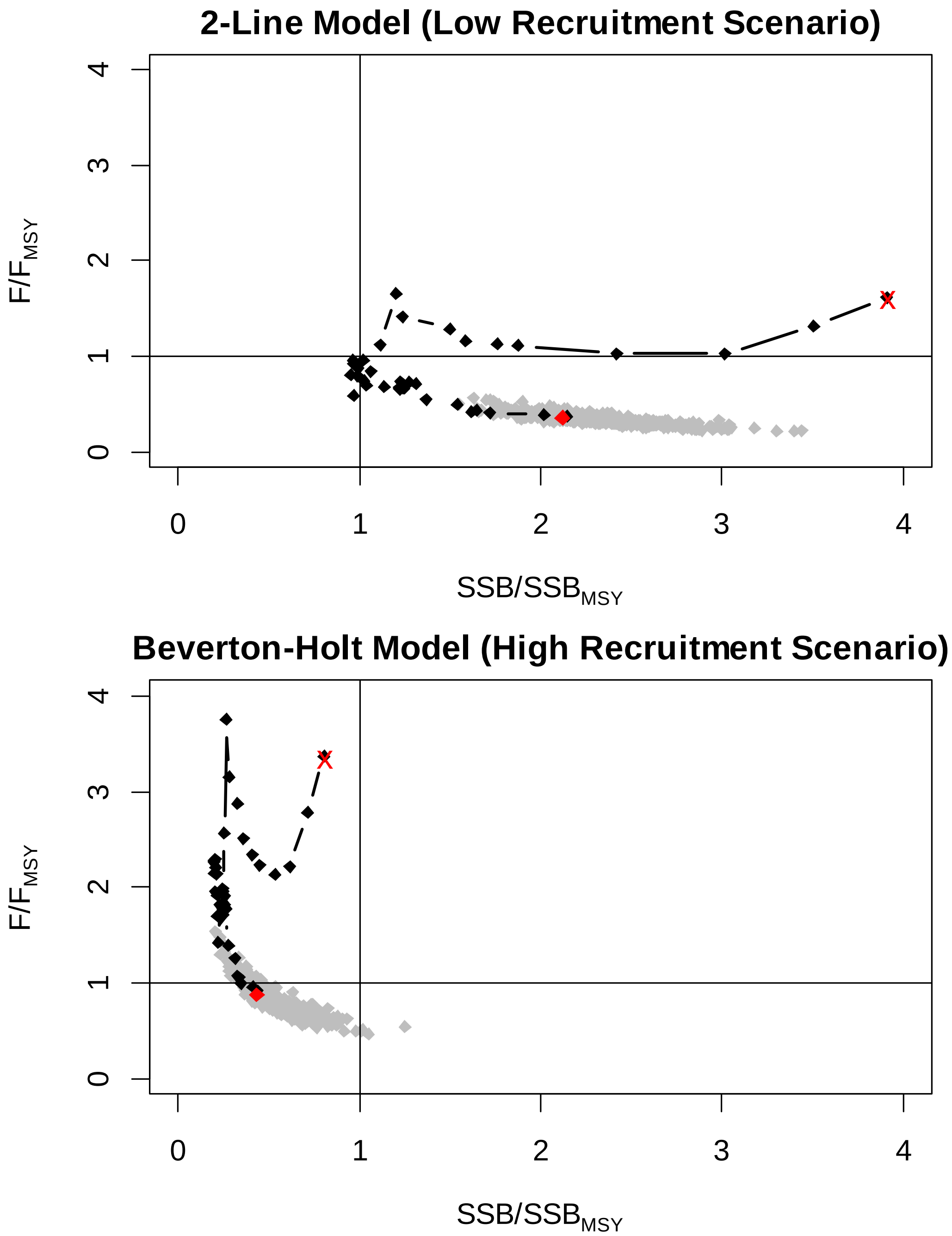


Figure 40. Estimated stock status of western BFT relative to the Convention objectives (MSY) by year (1970 to 2013). The black points and connecting line show the time series of estimates for each alternative recruitment scenario and the gray cloud of points depict the corresponding bootstrap estimates of uncertainty for the recent year, 2013. The red diamond represents the status estimate for 2013 and the red "X" represents the start year (the geometric mean fishing mortality was used as a proxy for these years, 2010-2012 for the terminal point, and 1970-1972 for the initial point).

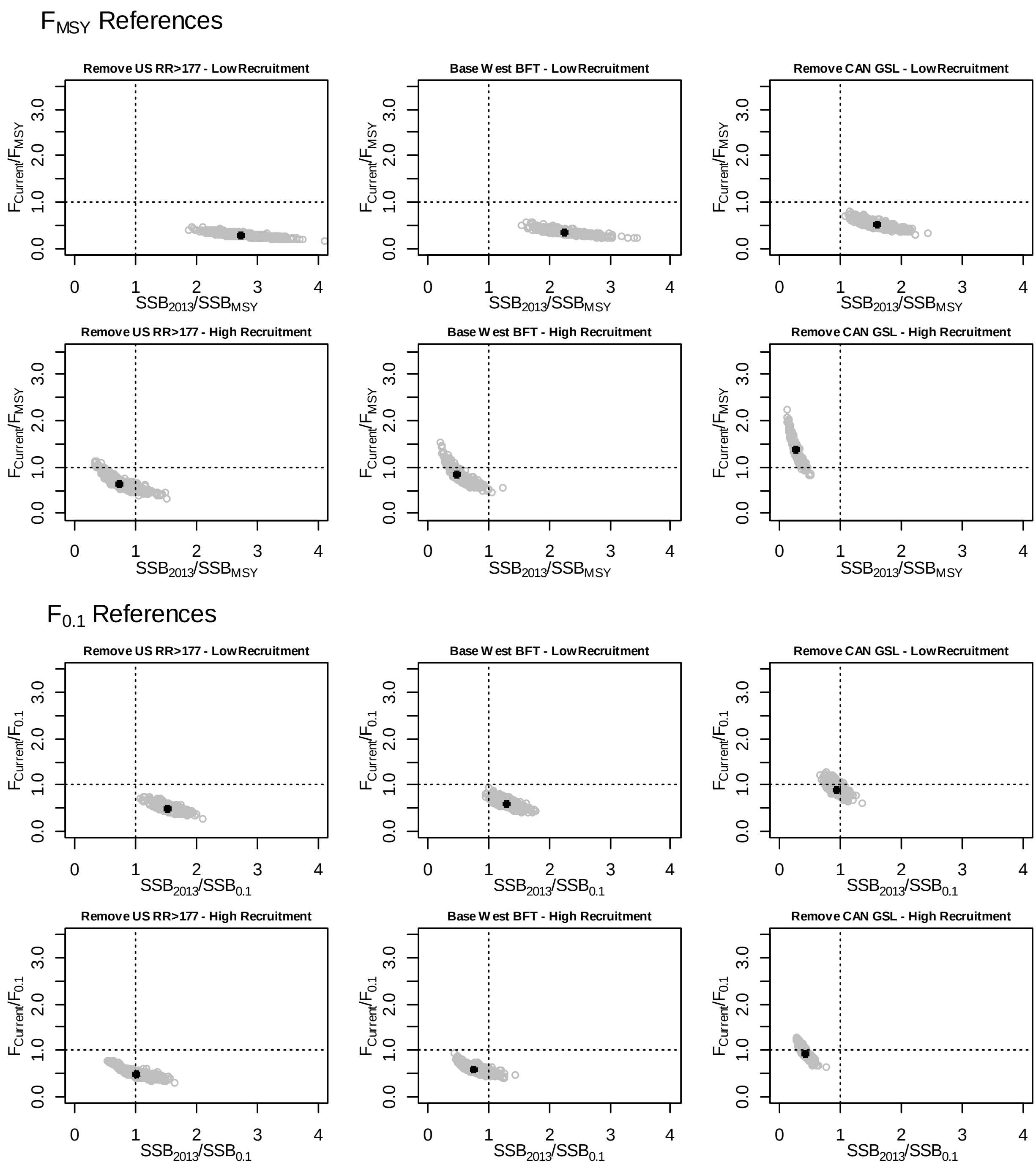


Figure 41. Western BFT stock status in 2013 estimated by the base VPA, and jackknife runs removing the Canadian GSL and USA RR>177 cm indices. Two types of stock-recruitment relationships were examined, a two-line model (low recruitment) and a Beverton-Holt model (high recruitment). F current is defined as the geometric mean fishing mortality during 2010 to 2012. The filled black circle is the median results and the open gray circles are estimates from 500 bootstrap runs. The top set of panels shows the status estimates relative to a MSY reference, whereas the bottom panels used $F_{0.1}$ as a proxy.

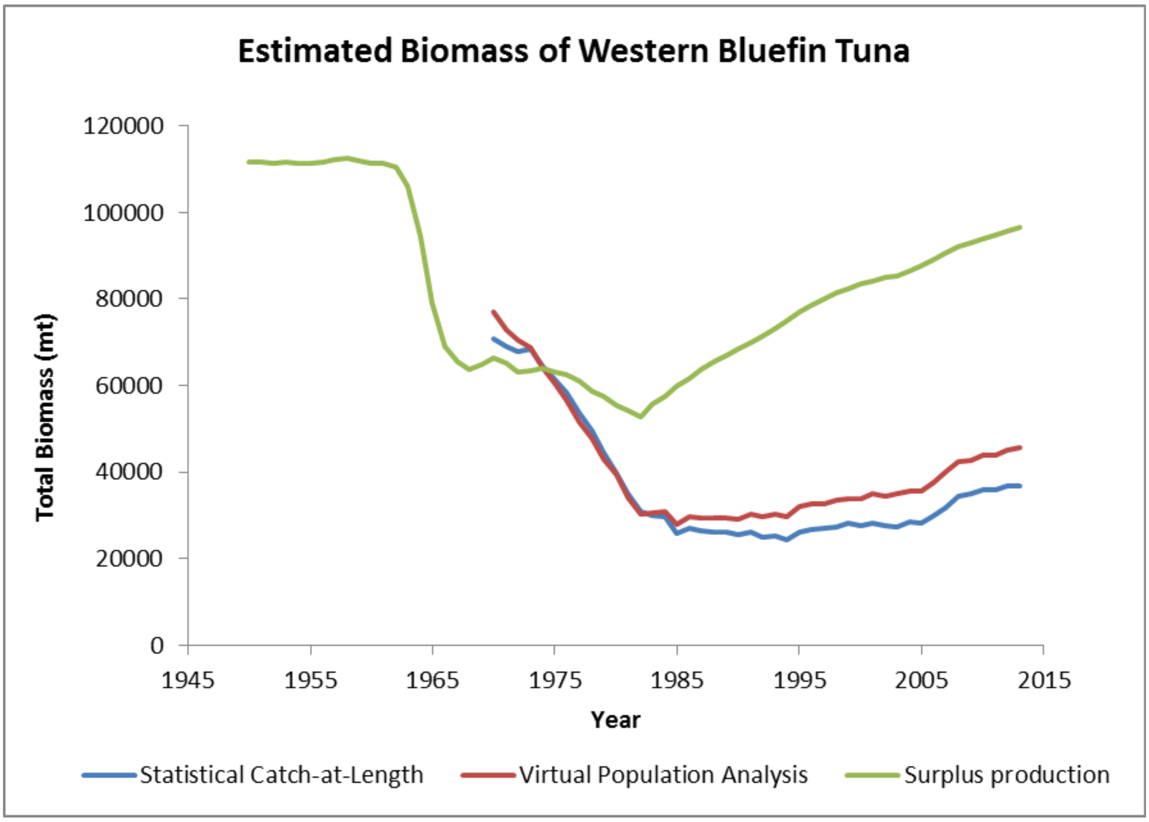


Figure 42. Multi-model comparison of estimated total biomass of western Atlantic bluefin tuna. The statistical catch-at-length model is shown in blue, the base VPA is shown in red, and the base surplus production model is shown in green.

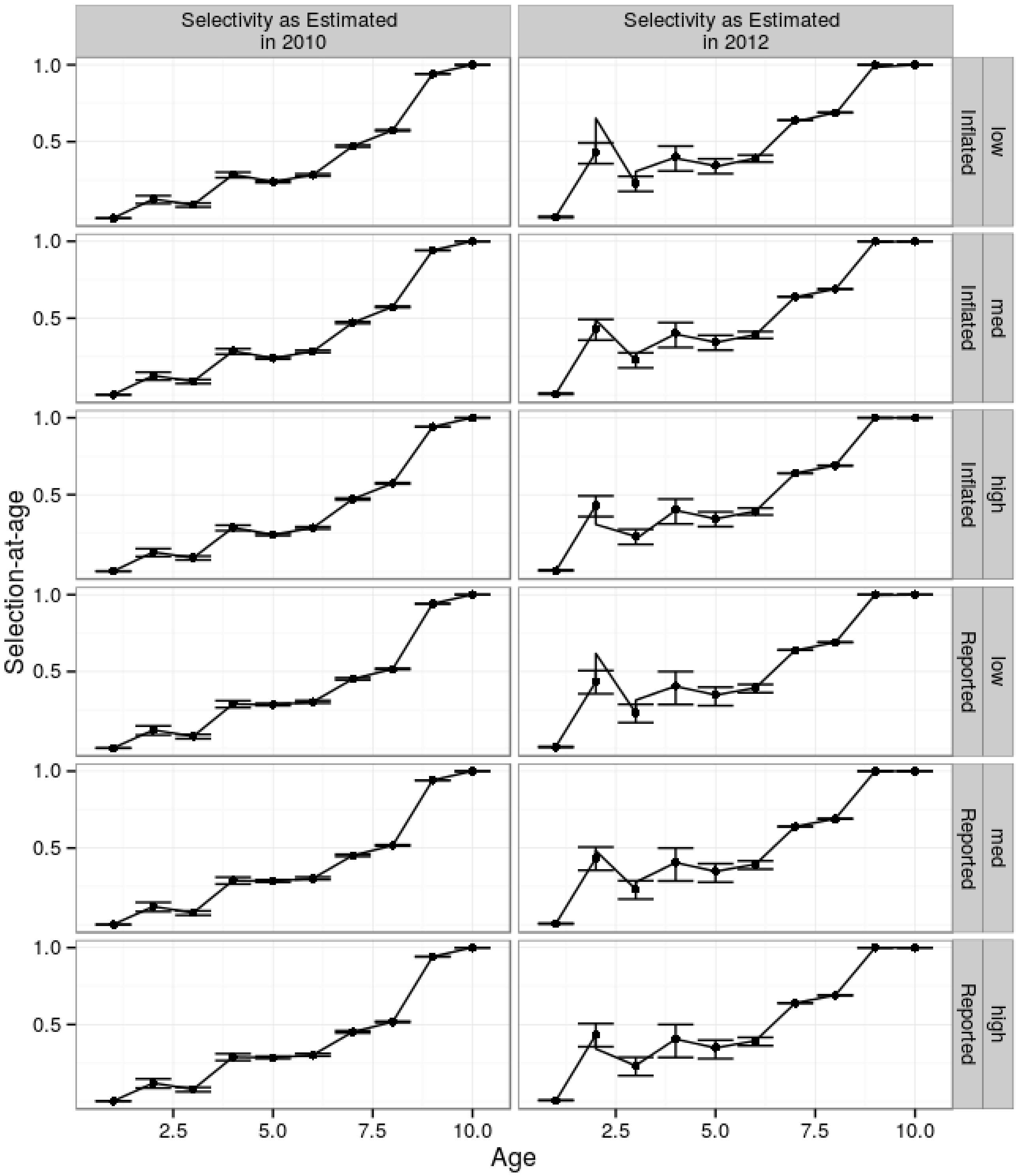


Figure 43. Eastern Atlantic bluefin tuna. Selectivity patterns used for calculation of benchmarks and projections, these show the medians (lines) and +- 1 sd (bars). Selectivity is as assumed in the 2010 (over 2007-2009, left column) and 2012 (over 2009-2011, right column) projections for the three recruitment and two catch scenarios.

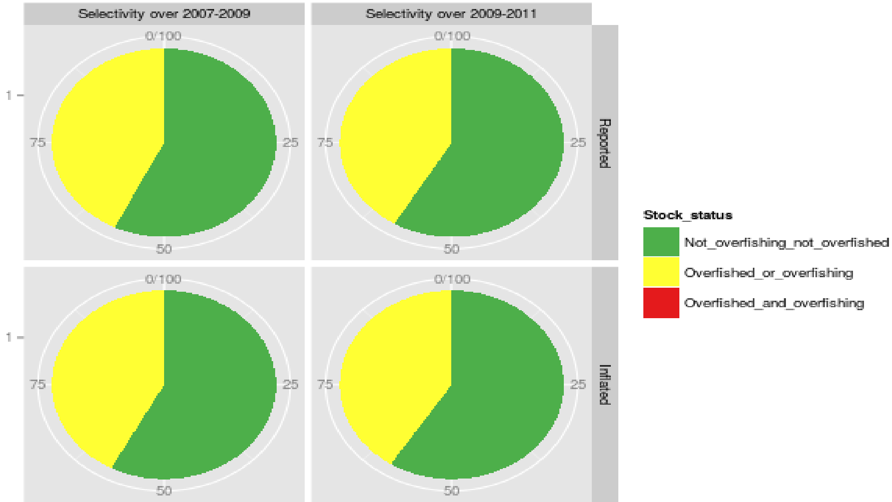


Figure 44. Eastern Atlantic bluefin tuna. Pie chart showing the proportion of the VPA continuity run results for the terminal year (2013) that are within the green quadrant of the Kobe plot chart (not overfished, no overfishing), the yellow quadrant (overfished or overfishing), and the red quadrant (overfished and overfishing). Split by catch scenario (reported and inflated) and benchmark (selectivity patterns were estimated over 2007-2009 or over 2009-2011).

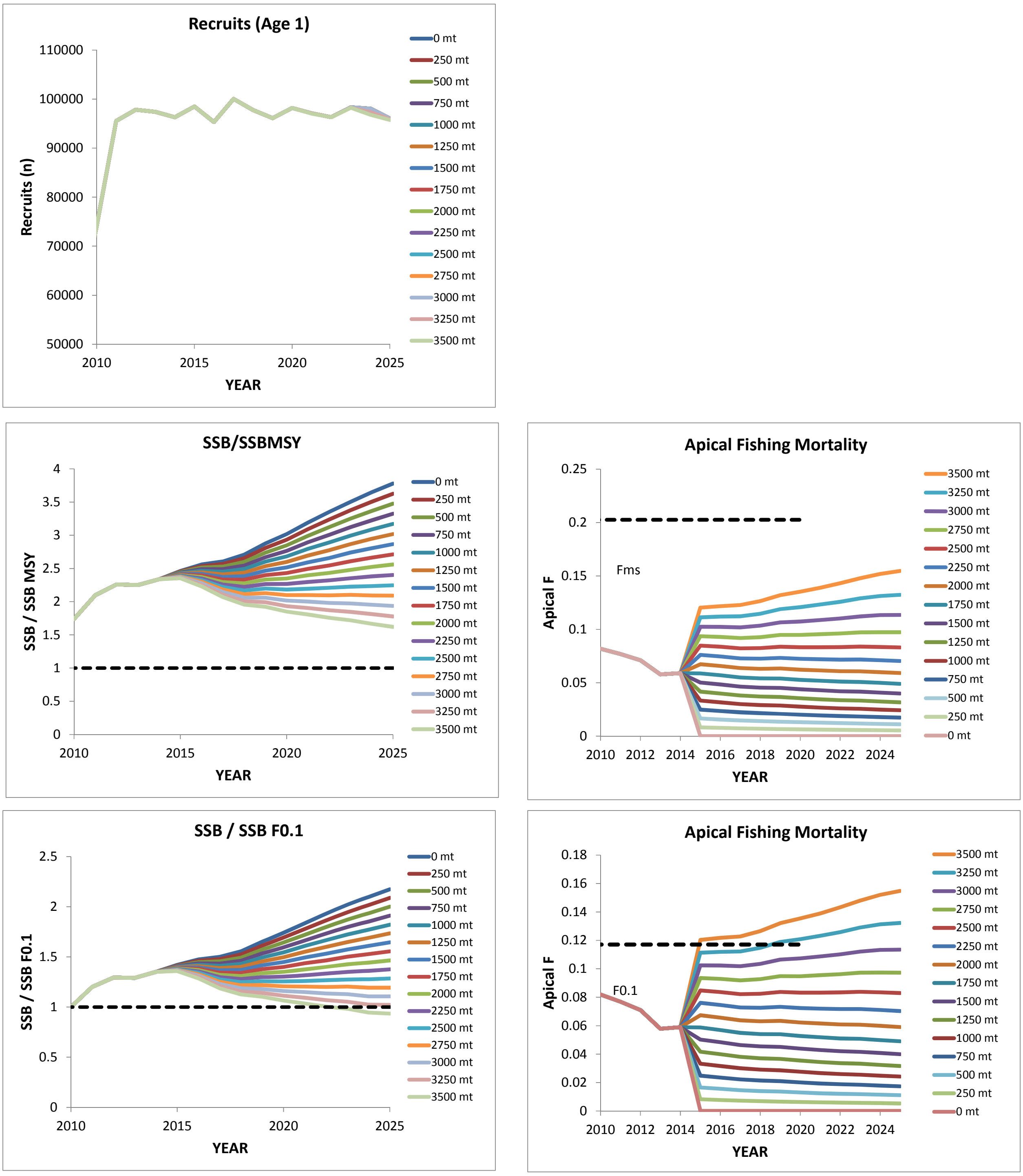


Figure 45. WBFT: Projection results for the low recruitment scenario projected at various levels of constant catch. The middle panels show the trends relative to the MSY-based reference points. The bottom panels use the alternative $F_{0.1}$-based reference points. These trajectories are the median (50%) result of 500 bootstraps.

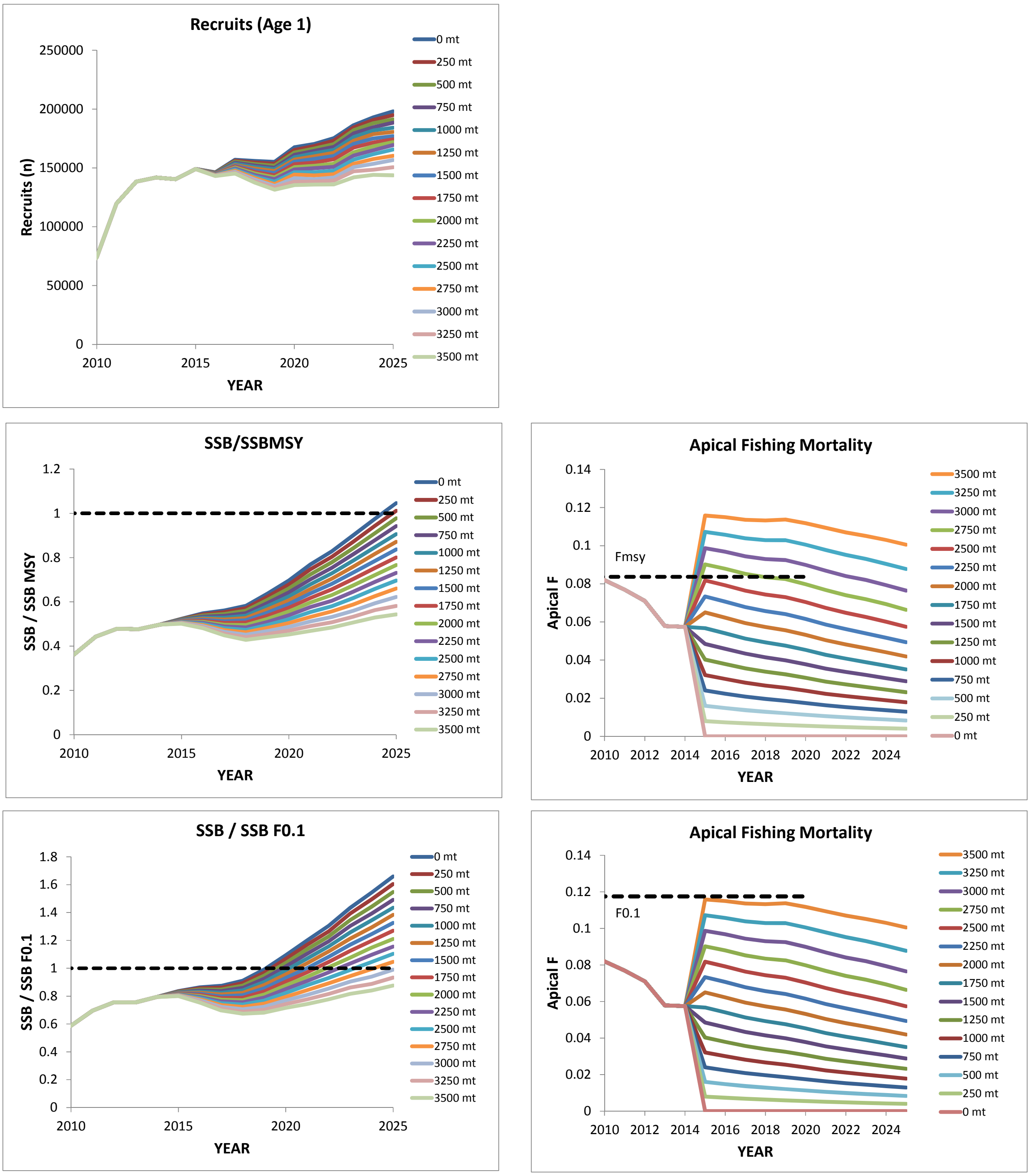
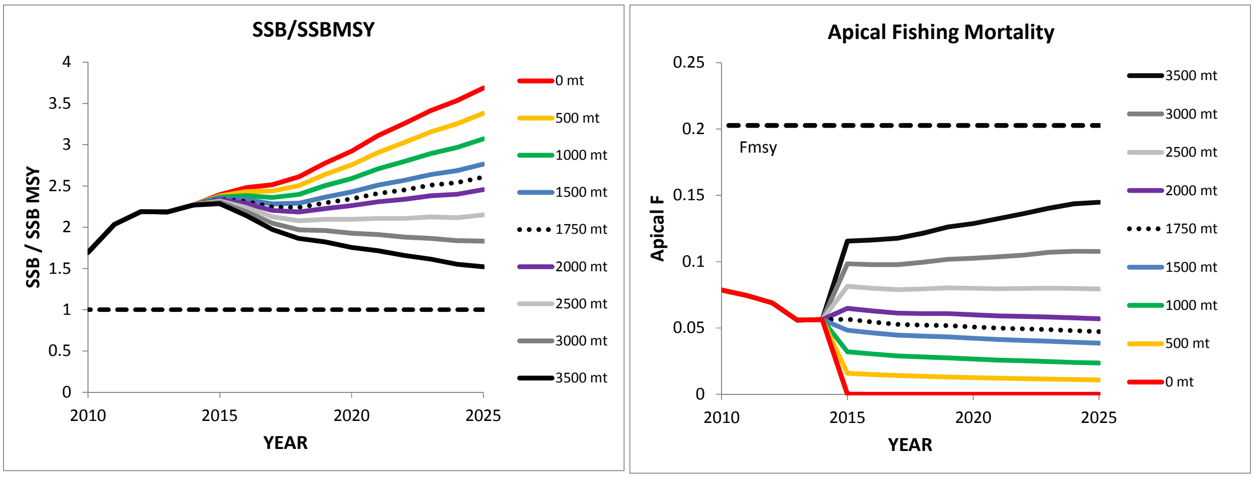


Figure 46. WBFT: Projection results for the high recruitment scenario projected at various levels of constant catch. The middle panels show the trends relative to the MSY-based reference points. The bottom panels use the alternative $F_{0.1}$-based reference points. These trajectories are the median (50^{th} quantile) result of 500 bootstraps.

60% Probability – Low Recruitment Potential



60% Probability – High Recruitment Potential

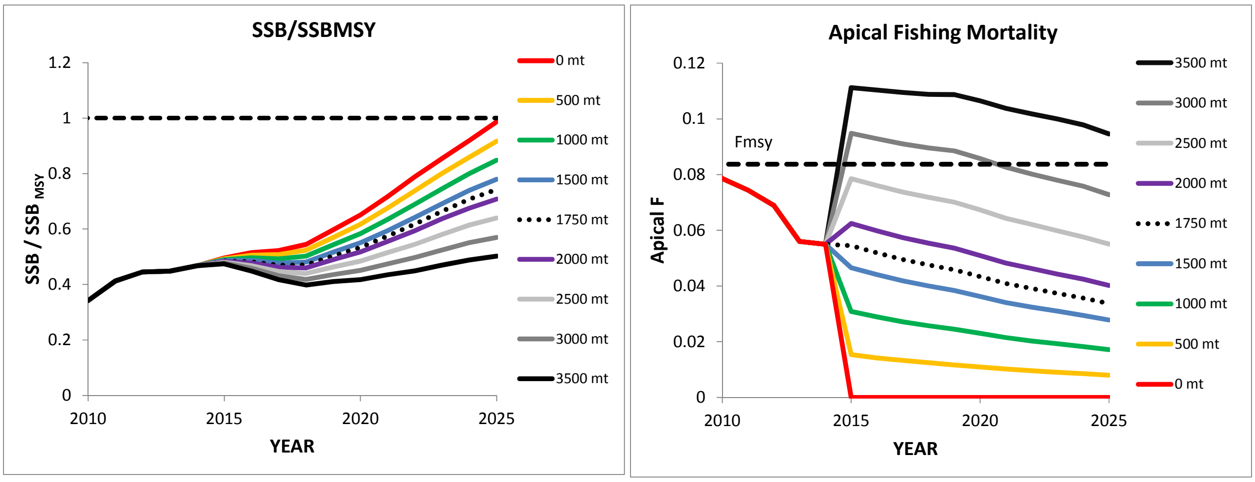


Figure 47. WBFT: The projected SSB/SSB_{MSY} and F/F_{MSY} trajectories at various catch levels for the two recruitment scenarios. These trajectories correspond to a 60% probability of achieving a given level of SSB/SSB_{MSY} or F/F_{MSY}.

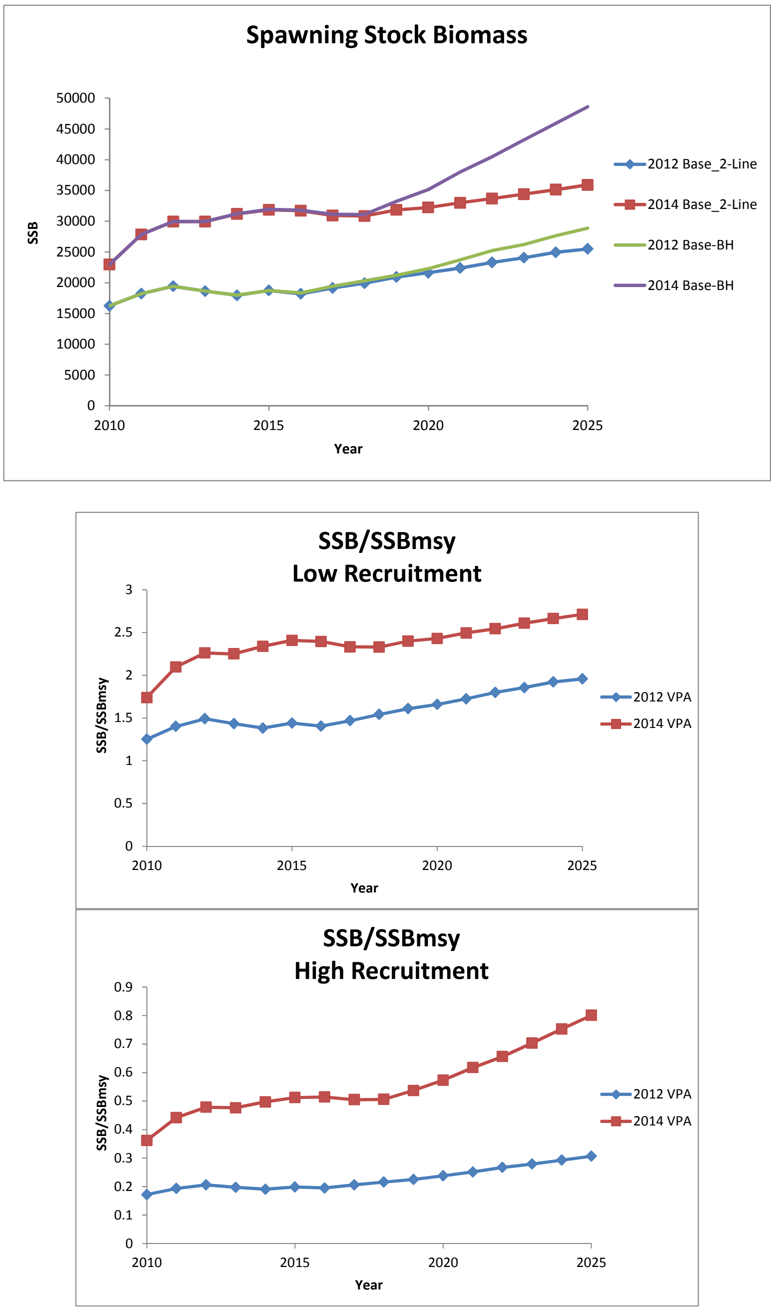


Figure 48. WBFT: Comparison of the spawning stock biomass (SSB), and SSB relative to SSB at maximum sustainable yield (MSY) for the low and high recruitment scenarios. Projections were made at the current TAC of 1,750 mt [Rec. 12-02].

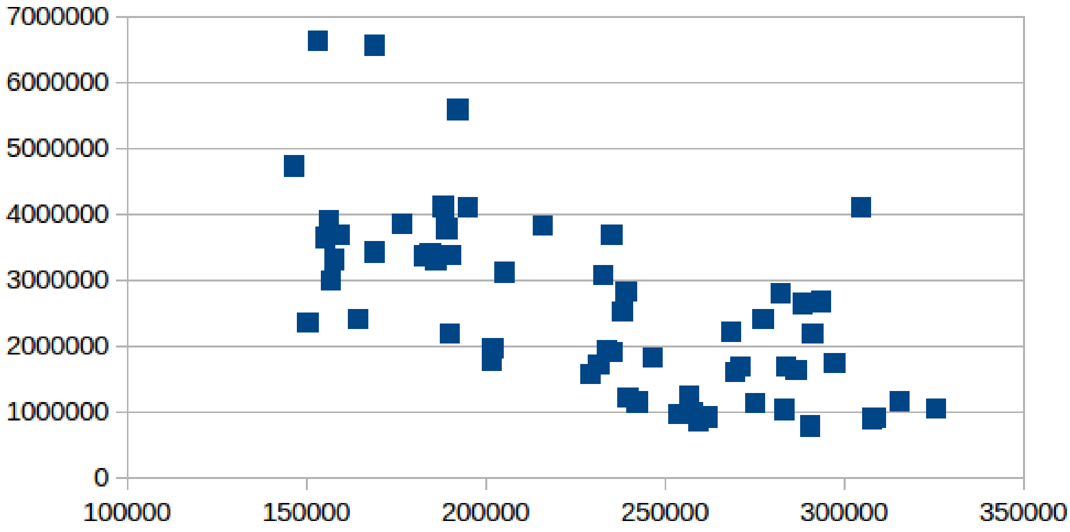


Figure 49. EBFT: Stock (x-axis) and recruitment (y-axis) estimates for East-Med Atlantic bluefin tuna from reported catch (Run 5)

Appendix 1

AGENDA

1. Opening, adoption of the Agenda and meeting arrangements
2. Review of new scientific documents for the species
3. Review of the Rebuilding Plans for Atlantic and Mediterranean bluefin tuna and previous SCRS advice
4. Summary of available data for assessment
   4.1 Biology
   4.2 Catch and other Fishery Statistics
   4.3 Relative abundance estimates
5. Methods and other data relevant to the assessment
   5.1 Eastern Atlantic and Mediterranean stock
   5.2 West Atlantic stock
6. Stock status results
   6.1 Eastern Atlantic and Mediterranean stock
   6.2 West Atlantic stock
7. Projections
   7.1 Eastern Atlantic and Mediterranean stock
   7.2 West Atlantic stock
8. Recommendations
   8.1 Research Recommendations
   8.2 Management Recommendations
9. Responses to the Commission
   9.1 Continue to explore operationally viable technologies and methodologies for determining the size and biomass at the points of capture and caging and evaluate the BFT pilot studies to estimate both the number and weight of bluefin tuna at the point of capture and caging using stereoscopical systems, Rec.[13-07] paragraph 88.
   9.2 Evaluate the BFT national observer programmes conducted by CPCs to report the Commission and to provide advice on future improvements, Rec.[13-07] paragraph 90.
   9.3 Provide updated BFT growth rates tables based in the information from BCDs and other submitted data, Rec.[13-07], paragraph. 98.
   9.4 Review the technical specifications of the use of stereoscopic cameras systems as defined in Rec. [13-08]
   9.5 Provide answer to the requests from the 2nd WG WBFT Fisheries Managers and Scientists.
10. Other matters
11. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS

SCRS/2014/072	Some Benchmarks Diagnostics. Kell L.
SCRS/2014/101	Specifying and weighting scenarios for MSE robustness trials. Levontin, P., Leach, A.W., Holt, J. and Mumford, J.D.
SCRS/2014/102	Match and mismatch: a few thoughts about the available bluefin prediction models for the Mediterranean area. Di Natale A.
SCRS/2014/103	Larval bluefin tuna trophodynamics from Balearic Sea (WM) and Gulf of Mexico spawning ecosystems by stable isotope. Laiz-Carrión R., Gerard T., Uriarte A., Malca E., Quintanilla J.M., Mulling B., Alemany F., Lamkin J.T. and García, A.
SCRS/2014/113	Update of the Eastern and Mediterranean Atlantic bluefin tuna stock Bonhommeau. S., Kimoto A., Fromentin J.M., Kell L., Arrizabalaga H., Walter J.F., Ortiz de Urbina J., Zarrad R., Kitakado T., Takeuchi Y., Ortiz M. and Palma C.
SCRS/2014/115	Catch-At-Size And Age Analyses For Atlantic Bluefin.Kell L.
SCRS/2014/131	Synopsis of regional mixing levels for Atlantic bluefin tuna estimated from otolith stable isotope analysis, 2007-2014. Secor D.H.
SCRS/2014/136	Campaña de marcado convencional y electrónico de atún rojo realizada en el estrecho de gibraltar según el diseño adoptado por el programa de investigación GBYP-ICCAT y desarrollado en el "Tagging GBYP-ICCAT 4ª fase, 2013 Serna J.M., D. Godoy, E.Belda, S. El Arraf, E. Majuelos, R.Sanchez, J. Mengual S. Saber, P.Muñoz
SCRS/2014/137	Actividad trófica del atun rojo (Thunnus thynnus) en el Estrecho de Gibraltar. variabilidad y causas. Serna J.M., D. Godoy, E. Majuelos
SCRS/2014/139	Contribution to the formulation of a report lenght/weight on biometric data recorded by the copies of tuna (Thunnus thynnus) caught in the months of May/June in the Mediterranean sea (Tyrrhenian). Cozzolino G, Pignalosa P. and Lombardo F.

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SCRS/2014/145 Eastern Bluefin tuna (Thunnus thynnus) management using a Harvest Control rule based on precautionary approach and maximum sustainable yield principles. de Cárdenas E., Urtizberea A. and García D.

SCRS/2014/147 In Situ Acoustic Observations of Atlantic Bluefin tuna Melvin G.

SCRS/2014/149 Can the parasites of the head of juvenile Thunnus thynnus help to identify its nursery areas in the Mediterranean Sea? Rodríguez-Llanos J., Palacio-Abella J., Culurgioni J., Mele S., Macías D., Garibaldi F., Rodríguez-Marín E., Sanna N., Garau S., Merella P., Garippa G., Montero F.E. and Addis P.

SCRS/2014/150 Report of the age calibration exchange within the Atlantic Wide Research Programme for bluefin tuna (GBYP). Rodríguez-Marín E., Di Natale A., Quelle P., Ruiz M., Allman R. , Bellodi A., Busawon D., Farley J., Garibaldi F., Ishihara T., Koob E., Lanteri L., Luque P.L., Marcone A., Megalofonou P., Milatou N., Pacicco A., Russo E., Sardenne F., Stagioni M., Tserpes G. and Vittori S.

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SCRS/2014/152 An application of an integrated stock assessment model (stock synthesis) to Eastern atlantic bluefin tuna stock. Irie T. and Takeuchi Y.

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SCRS/2014/158 Bluefin tuna caught by Senegalese baitboat and landed in Dakar in 2013. Ngom Sow F. and Ndaw S.

SCRS/2014/161 Bluefin tuna juveniles tagging in Croatia – some suggestions for improvement. Katavić I., Cinoti N., Grubišić L. and Tičina V.

SCRS/2014/162 Preliminary evaluations of potential growth of fattened/farmed eastern bluefin tuna (Thunnus thynnus) from ICCAT farm size database. Ortiz M.

SCRS/2014/164 Resultados de la encomienda de la SGP al IEO para el estudio del atun rojo (Thunnus thynnus) del stock del Atlántico este (que incluye el Mediterráneo) considerando las almadrabas españolas como observatorios científicos de la Serna J.M., Abascal F. Ortiz J.Mª., Godoy D. and Majuelos E.

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SCRS/2014/167	A multitude of Byzantine era bluefin tuna and swordfish bones uncovered in Istanbul, Turkey. Puncher G.N, Onar V., Toker N..Y. and Tinti F.
SCRS/2014/168	Standardized CPUE of bluefin tuna (Thunnus thynnus) caught by Moroccan traps for the period 1986- 2014 Abid N., Benchoucha S., Malouli M., El Arraf S., El Fanichi C., Bensbai J. and Ben Mhamed A.
SCRS/2014/169	An updated statistical catch-at-length assessment for eastern Atlantic bluefin tuna Butterworth D. S. and Rademeyer R. A.
SCRS/2014/170	Evaluating the effect of Atlantic bluefin tuna movement on the perception of stock units Kerr L.A., Cadrin S.X., Secor D.H. and Taylor N.
SCRS/2014/171	Synopsis of regional mixing levels for Atlantic bluefin tuna estimated from otolith stable isotope analysis, 2007-2014. Secor D.H.
SCRS/2014/172	Revision to the catch-at-size and catch-at-age estimates of western Atlantic bluefin tuna used in the 2014 update assessment. Lauretta M.
SCRS/2014/173	Feeding dynamics of Atlantic bluefin tuna (Thunnus thynnus) larvae in the Gulf of Mexico. Llopiz J.K., Muhling B.A. and Lamkin J.T.
SCRS/2014/174	Past, ongoing and future research on climate change impacts on tuna and billfishes in the western Atlantic. Muhling B.A., Liu Y, Lee S., Lamkin J.T., Malca E., Llopiz J., Ingram Jr. G.W., Quattro J.M., Walter J.F., Doering K., Roffer M.A. and Muller-Karger F.
SCRS/2014/175	Age and growth of larval Atlantic bluefin tuna, Thunnus thynnus, from the Gulf of Mexico. Malca E., Muhling B., Lamkin J., Ingram W., Gerard T., Tilley J. and Franks J.
SCRS/2014/176	Do western Atlantic bluefin tuna spawn outside of the Gulf of Mexico? Results from a larval survey in the Atlantic ocean in 2013. Lamkin J.T., Muhling B.A., Malca E., Laiz-Carrión R., Gerard T., Privoznik S., Liu Y., Lee S., Ingram Jr. G.W., Roffer M.A., Muller-Karger F., Olascoaga J., Fiorentino L., Nero W. and Richards W.J.
SCRS/2014/177	Using electronic tag data to provide transition matrices for movement inclusive population models. Galuardi B., Cadrin S.X., Kerr L., Miller .J.T and Lutcavage M.
SCRS/2014/178	Seventeen years and $3 million dollars later: performance of psat tags deployed on Atlantic bluefin and bigeye tuna. Lutcavage M.E., Lam C. and Galuardi B.
SCRS/2014/183	An assessment of the western stock of Atlantic bluefin tuna using a non-equilibrium surplus production model. Hanke, A.R.
SCRS/2014/184	The WWF/GBYP multi-annual bluefin tuna electronic tagging program (2008-2013): repercussions for management. Quílez-Badia G., Ospina-Alvarez A., Sainz Trápaga S., Di Natale A., Abid N., Cermeño P. and Tudela S.
SCRS/2014/185	Catch rates and catch size structure of the Balfegó purse seine fleet in Balearic waters from 2000 to 2014; two years of size frequency distribution based on video techniques. Gordoa A.
SCRS/2014/188	An updated statistical catch-at-length assessment for eastern Atlantic bluefin tuna. Butterworth D. S. and Rademeyer R. A.
SCRS/2014/189	Conventional tagging of adult Atlantic bluefin tunas (Thunnus thynnus) by purse-seiners in the Mediterranean – methodological notes. Mariani A.., Dell'Aquila M., Valastro M., Buzzi A.and Scardi M.
SCRS/2014/194	Time to plan for the future of GBYP. ICCAT GBYP Steering Committee

SCRS/2014/195 Updates on the SCAL assessment of eastern and western Atlantic bluefin tuna . Butterworth D. S. and Rademeyer R. A.

SCRS/2014/200 Evaluating the change in evidence of alternative recruitment scenarios between the 2012 and 2014 western Bluefin VPA using model selection criteria. WBFT Group

Appendix 4

SUMMARIES OF DOCUMENTS SUBMITTED TO THE GROUP

Biology

Compilation of summaries of the working papers presented at the 2014 bluefin tuna stock assessment meeting in relation to biology.

SCRS/2014/053 Rev. A separated analysis by Atlantic bluefin tuna (ABFT) stock was conducted for weight (round weight, RWT) – length (straight fork length, SFL) relationships.

A Sensitivity analysis was run to see the influence of variance at size in the samples. Results showed that using the inverse weighted model seemed to be more appropriate. To mitigate unbalanced sampling due to data coming from seasonal fisheries targeting different fraction of the population and using several types of measurements, conversions using robust linear fitting, were used to obtain a common type of size and weight. A comparison was carried out between the expected size sampling distribution of a simulated bluefin-like population, if it were randomly selected using a completely non-selective gear, and the actual sampling. This exercise showed that the actual sampling and size coverage for the East ABFT is quite close to simulated population. For West ABFT actual sampling is highly influenced by size regulations being adequately sampled from 180 cm CFL upwards. The chosen model included original data plus conversions and weighting with the inverse variability, using the Gauss-Newton method. There was found almost no difference between both stocks for the RWT-SFL annual relationships with a difference of 6%. To account for seasonal effect A GLM model was used, where the scaled residuals were fitted against the size and month (factor). The predicted weight by month was estimated as an additional component in the exponent of the length-weight function by stock. As expected the absolute variations in weight are greater for larger fish. It seems that the spawning and feeding behaviour of bluefin tuna is being reflected by the estimated month variations. Another sensitivity analysis was run to compare present data base versus equal number of observations per size class. Sampling proportion did influence the estimation of weight-size relationship, with bigger AIC results for equal number of observations fit. Eastern weight at size comparison of quantile non-linear fit and least squares non-linear fit showed similar prediction.

SCRS/2014/102. Several efforts have been devoted to develop prediction or descriptive models for both bluefin spawning areas and larval distribution areas in the last ten years. The review of these papers shows matches and mismatches with the current knowledge, which are mostly the results of various approaches, the development of models on limited areas or the limitation in data availability. The complexity of the behaviour of bluefin tuna is clearly driven by many factors and the major problem is the limits we still have in our knowledge and understanding of the bluefin tuna, even in the Mediterranean Sea where this species is studied since many centuries. The good results obtained by models using real-time data iodes not necessarily imply that the same models can be extended to all Mediterranean areas, because bluefin tuna seems to use different strategies in different areas, possibly taking advantage of various suitable environmental conditions. The need to develop improved approaches for having more suitable models is the clear result of this overview.

SCRS/2014/103. The present study uses stable isotopes of nitrogen and carbon (δ15N and δ13C) as trophic indicators for Atlantic bluefin tuna larvae (BFT) (6-10 mm SL) in the highly contrasting environmental conditions of the Gulf of Mexico (GOM) and the Balearic Sea (MED). The study analyzes ontogenetic changes in the food sources and trophic levels (TL) of BFT larvae from each spawning habitat. The results discuss differences in the ontogenic dietary shifts observed in the BFT larvae from the GOM and MED as well as trophodynamic differences in relation to the microzooplanktonic baselines used for estimating trophic enrichment. Significant trophic differences between the GOM and MED larvae were observed in relation to δ15N signatures in favour of the MED larvae, which may have important implications in their early life growth strategy.

SCRS/2014/137. The present paper shows the analysis performed from 264 stomach contents of bluefin tuna caught with baitboat in the Strait of Gibraltar. We grouped the results in two different periods of years: between 2008 year and 2010 year, and between 2011 year and 2013 year. The results confirmed similar composition in the diet for the two different periods of years analyzed. Thus, we observed for the three major taxa subject to predaction: fish (52%), crustaceans (24%), mollusks (15%) and others (9%). However, there are differences in the specific composition of each taxon from certain percentage of prey species present within each one and there is a decrease in prey species present in each of the three above taxa for the second period of year analyzed. In any case the Strait of Gibraltar is confirmed as a known feeding area for bluefin tuna from August to March. Also, the causes of this phenomenon are presented and its variability depends on several factors: outcrops, tidal currents, internal waves, “hileros”, etc. These results confirm the generalist and opportunistic feeding strategy of this species that accommodates feeding throughout water column.

SCRS/2014/140. The company Oceanis srl, as part of the assignment of the Ministry of Agriculture and Forestry, General Directorate of Fisheries and Aquaculture, Italy, for the implementation of the national observation program for the fishing season for bluefin tuna in 2013, has carried out on 435 bluefin tuna (*Thunnus thynnus*) caught in the Mediterranean during the months of May and June, obtaining biometric data on the length of the curve to the fork and the whole weight. Analysis of the data was converted into a relation size / weight expressed by the equation of the trend line: RWT = 2.71828 * 10-5 * CFL 2.9312, with a correlation coefficient R2 = 0.9701

SCRS/2014/149. Between 2009 and 2013, the head region of 102 juveniles of Atlantic Bluefin tuna (*Thunnus thynnus* L.) caught in four nursery areas of the Mediterranean Sea (Balearic Sea, Ionian Sea, Ligurian Sea and Tyrrhenian Sea) were analysed for parasites. Eleven parasite species were found: Capsala magronum, C. onchidiocotyle, C. paucispinosa, Nasicola klawei, Hexostoma thynni, Didymocystis sp. 2 (sensu Rodríguez-Marín et al., 2008), Didymosulcus sp. 2 (sensu Rodríguez-Marín et al. 2008), Didymosulcus wedli, Didymozoon pretiosus, Nematobothriinae gen. sp. and Wedlia sp. The prevalence of some food-borne parasites (Didymocystis sp. 2, D. pretiosus, Nematobothriinae gen. sp. and Wedlia sp.) had significant differences between localities ($p \leq 0.05$). The results showed that the parasite fauna of juvenile tunas is not homogenously distributed in the Mediterranean Sea: parasite assemblages differed between hosts from the Balearic, Ionian, Ligurian, and Tyrrhenian seas, suggesting parasites as possible tags to identify the different tuna populations from the corresponding nursery areas.

SCRS/2014/150. A good exchange participation with 21 readers from 13 laboratories contributed interpreting images of paired calcified structures, otoliths and spines, coming from the same specimen. The mean coefficient of variation and average per cent error were around 20 and 15 respectively. Precision was lower for inexperienced readers than for experienced ones, being experience a major factor in the age interpretation from otoliths viewed under reflected light and for large specimens using spines under transmitted light. There was generally good agreement in the ageing among different structures coming from the same specimen. Otoliths aged using different types of light showed a good agreement with no significant bias ($p>0.05$), while spine showed no sign of bias with respect to otoliths viewed under transmitted light ($p>0.05$) but a slight under ageing when compared with reflected light otoliths ($p<0.05$), with these differences been found in specimens older than 14 years, for which the number of samples was very small. Further standardization of age reading criteria between laboratories and a description of the annual formation of otolith edge type is needed.

SCRS/2014/151 presents a length-weight relationship for ABFT in the eastern Atlantic and Mediterranean ($RW = 0.0000192\ SFL^{3.008364}$; *Ec 1*), based on samples of ABFT pre-spawners collected by the Atlantic traps of Morocco and Spain in the Strait of Gibraltar and a set of samples of juvenile fishes from ICCAT-GBYP. The model *Ec 1*, together with the model used for the eastern stock assessment ($RW = 0.000019607\ SFL^{3.0092}$; *Ec 2*) and a new proposal ($RW = 0.0000315551\ SFL^{2.898454}$; *EAST*) are analyzed in using a bi-variant sample (*SFL* (cm), *RW* (kg)) of 474 pairs of data of pre-spawners + juveniles fish from GBYP. The result of the analysis indicates that the model *EAST* clearly underestimates the weight of spawning ABFTs and that model *Ec 2* overestimates it slightly, being model *Ec 1* that best explains the data of the sample. The result of the classical statistical analysis is confirmed by means of the quantile regression technique. Other indicators also conclude that the model *EAST* gradually underestimates the weight of ABFTs spawners (of 2-3 m) by 8-12 %, and does not meet the criterion that for *RW*= 725 kg (W_{max}), *SFL*= 319.93 ± 11.3 cm (L_{max}).

SCRS/2014/158. This paper describes bluefin tuna caught by Senegalese baitboat and landed in Dakar in 2013. Bluefin tuna were fished in Mauritania area around the latitude 18° and longitude 17° in December 2013. Biological samples were collected and used by GBYP biological studies. In total, 23 specimens were unloaded in Dakar port during the fourth quarter of 2013. The total catches were 5 800 kg. Sizes varied between 223 and 272 cm. Authors suggest that the presence of bluefin in this southern area could be linked to trophic migration of prey and environmental changes. More attention should be devoted in Mauritanian area, since in 2010 there was also accidental catch of bluefin tuna in the same area by Spanish baiboat based in Dakar (SCRS/2010/113).

SCRS/2014/171. Over the past ten years, several international groups have estimated stock mixing levels for Atlantic bluefin tuna from otolith stable isotope analysis. Mixing levels for important management regions are summarized from recent SCRS reports and publications for the period 2007-2014. Lack of mixing between the two principal stocks for Gulf of Mexico, Gulf of St. Lawrence, Eastern Atlantic, and Mediterranean samples is consistent with stock mixing patterns for samples collected 1990-2002. In contrast, recent analyses show diminished contributions by the Mediterranean population to US mid-Atlantic aggregations of juveniles and evidence of small but significant contributions by this population to Canadian fisheries, likely the result of increased selection for smaller sized fish in the Canadian Maritimes. A gap in our current understanding on mixing and western stock sustainability is lack of information for Gulf of Maine commercial category bluefin tuna. Mixing levels in the US Mid-Atlantic, Canadian Maritimes, and North Central Atlantic show non-stationary dynamics, meriting additional sampling and analysis for these regions in the coming years.

SCRS/2014/173. A surprising gap in our knowledge of the early life history of Atlantic bluefin tuna larvae spawned in the Gulf of Mexico has been an understanding of their feeding success and diets. Here we report preliminary results on the feeding habits and feeding success of bluefin larvae collected during two years in the Gulf of Mexico. Daytime feeding incidence (the proportion of larvae with prey in their guts), which can be used to indicate the degree to which larvae are feeding successfully, was 94% overall and 100% for larvae >4 mm in length. Diets shifted from copepod nauplii at the earliest stages to a mixture of prey types that predominantly consisted of calanoid copepods, cladocerans, and appendicularians—the last of these having never been observed in the diets of other bluefin species or those of Mediterranean-spawned Atlantic bluefin larvae. Piscivory (consuming other fish larvae) began at lengths ~6 mm and was observed in 71% of larvae 8–10 mm in length. Such a small size at onset of piscivory, as well as high incidence of piscivory, greatly contrasts with bluefin larvae in the Mediterranean where piscivory has not yet been observed.

SCRS/2014/174. Climate change is likely to impact migration, spawning and recruitment of Atlantic tunas and billfishes, however potential responses and mechanisms remain largely unknown. A multidisciplinary, multi-agency research group has been using a combination of historical environmental and biological data, ecological experiments and climate modeling work to begin to address this knowledge gap. A summary of research activities over the past ~4 years is presented here. Results to date suggest that responses of highly migratory tunas and billfishes are likely to be species-specific. Temperate species such as Atlantic bluefin tuna are potentially most vulnerable. In order to estimate future trends in recruitment, an understanding of the basic ecology of early life history stages is vital, but has frequently been neglected in previous research. Collaborations across disciplines between ecologists, modelers and other researchers have allowed us to link smaller-scale laboratory studies with regional-scale models of environmental change, and to move towards development of species-specific impact models.

SCRS/2014/175. Atlantic bluefin tuna (*Thunnus thynnus*) are highly pelagic, undertaking extensive migrations throughout the Atlantic. They spawn primarily in the Mediterranean Sea and Gulf of Mexico. Despite 30 years of ichthyoplankton surveys in the Gulf of Mexico little is known about bluefin early life history and larval growth. In this study, we describe preliminary age-length relationships for larval Atlantic bluefin tuna using otolith microincrement analysis. Larvae were collected from plankton tows in the Gulf of Mexico in April-May

2012. Otoliths (sagittae) were dissected from 50 larvae, ranging from 2.4 to 7.4 mm (NL or SL) with ages from 4-15 days. From these data we developed new growth curves for the Gulf of Mexico. Growth was highly variable at a given length, which likely reflects environmental variability encountered in the dynamic oceanographic environment of the Gulf of Mexico. Results will improve the annual larval index, which currently uses an age-length relationship based on specimens collected solely off South Florida more than 30 years ago.

SCRS/2014/176. In 2013, a larval survey was conducted north and east of the Bahamas aboard the NOAA Ship NANCY FOSTER. Sampling areas were selected based on larval habitat model predictions, and daily satellite analysis of surface temperature and ocean color. Samples were collected at 97 stations, and 18 larval BFT (*Thunnus thynnus*) were found at 9 stations. Six of these stations came from oceanographically complex regions characterized by cyclonic and anticyclonic gyres. Larvae ranged in size from 3.22mm to 7.58 mm, corresponding to approximately 5-12 days in age. Analysis of satellite derived surface currents and CTD data suggest that these larvae were spawned and retained in this area. Larval habitat models show areas of high predicted abundance extending east to 650 W, but the actual extent of spawning in this area remains unknown.

Appendix 5

WESTERN BLUEFIN TUNA 2014 BASE VPA PROGRAM FILES

A. VPA-2Box Control File

```
#-----------------------------------------------------------------------------
#--             CONTROL FILE FOR PROGRAM VPA-2BOX, Version 3.0           ---
#-----------------------------------------------------------------------------
#  INSTRUCTIONS: the control options are entered in the order specified.
#               Additional comment lines may be inserted anywhere in this
#               file provided they are preceded by a # symbol in the FIRST
#               column, otherwise the line is perceived as free-format data.
#-----------------------------------------------------------------------------
#
#-----------------------------------------------------------------------------
# TITLES AND FILE NAMES (MUST BE PLACED WITHIN SINGLE QUOTES)
#-----------------------------------------------------------------------------
#|--------must be 50 characters or less----------|
'BFT West 1970 to 2013 Continuity 16+ '            TITLE OF RUN
'BFTW2014.D01'                              DATA FILE NAME (INPUT)
'BFTW2014.P01'                              PARAMETER SPECIFICATION FILE (INPUT)
'BFTW2014.R01'                              RESULTS FILE NAME (OUTPUT)
'BFTW2014.E01'                              PARAMETER ESTIMATE FILE NAME (OUTPUT)
'BFTW2014.SPD'                              SPREADSHEET FRIENDLY RESULTS (OUTPUT)
'none'                              TAGGING DATA FILE (INPUT)
#-----------------------------------------------------------------------------
# MODEL TYPE OPTIONS
#-----------------------------------------------------------------------------
 1                    NUMBER OF ZONES (1 OR 2)
 1                    MODEL_TYPE (1=DIFFUSION, 2=OVERLAP)
#-----------------------------------------------------------------------------
# TAGGING DATA SWITCH
#-----------------------------------------------------------------------------
# tagging data switch (0=do not use tagging data, 1=use tagging data)
# |  weighting factor for modifying importance of tagging data in objective function
# |  |     tag timing factors
# |  |     |
  0  1.0   0     0          TAGGING MODEL CONTROLS
#-----------------------------------------------------------------------------
# SEARCH ALGORITHM CONTROLS
#-----------------------------------------------------------------------------
-677   RANDOM NUMBER SEED
 50    MAXIMUM NUMBER OF AMOEBA SIMPLEX SEARCH RESTARTS
 10    NUMBER OF CONSECUTIVE RESTARTS THAT MUST VARY BY LESS THAN 1% TO STOP
SEARCH
 0.4   PDEV (standard deviation controlling vertices for Initial simplex of each restart)
#-----------------------------------------------------------------------------
# INDEX WEIGHTING CONTROLS
#-----------------------------------------------------------------------------
 1      SCALE (DIVIDE INDEX VALUES BY THEIR MEAN)- ANY VALUE > 0 = YES
 1.0    INDEX WEIGHTING:(0)INPUT CV's, (+)DEFAULT CV, (-)DEFAULT STD. DEV., (999)MLE
 0      (0) MULTIPLICATIVE VARIANCE SCALING FACTOR or (1) ADDITIVE VARIANCE SCALING
FACTOR
#-----------------------------------------------------------------------------
# CONSTRAINT ON Vulnerability (PARTIAL RECRUITMENT)
#-----------------------------------------------------------------------------
# apply this penalty to the last N years (SET N = 0 TO IGNORE)
# |  standard deviation controlling the severity of the penalty
# |  |  first age affected
# |  |  |  last age affected
```

```
# | | | |
  3 .5  1  15    LINKS THE VULNERABILITIES IN THE LAST N YEARS
#-----------------------------------------------------------------------------
# CONSTRAINTS ON RECRUITMENT
#-----------------------------------------------------------------------------
# apply this penalty to the last N years (SET N = 0 TO IGNORE)
# |  standard deviation controlling the severity of the penalty
  0 .1          LINKS THE RECRUITMENTS IN THE LAST N YEARS
  0 .1   1      LINKS THE RECRUITMENTS OF THE TWO STOCKS
#        |
#        ratio of stock (sex) 1 to stock (sex) 2 {a value of 1 means a 1:1 ratio}
#-----------------------------------------------------------------------------
# CONSTRAINT ON SPAWNER-RECRUIT RELATIONSHIP
#-----------------------------------------------------------------------------
# PDF of spawner-recruit penalty: 0=none, 1=lognormal, 2=normal (-)=estimate sigma by MLE
# |  first and last years to use in fitting (in terms of recruits)
# | |
  0  1971 1998  PENALIZES DEPARTURES FROM BEVERTON AND HOLT STOCK-RECRUIT CURVE
#               (note: check the parameter file to make sure you are estimating the S/R
#                      parameters when pdf not 0, or not estimating them when pdf=0))
#-----------------------------------------------------------------------------
# PARAMETER ESTIMATION OPTIONS
#-----------------------------------------------------------------------------
 2            OPTION TO USE (1) F'S OR (2) N'S AS TERMINAL YEAR PARAMETERS
 -1           ESTIMATE Q IN (+) SEARCH or (<0) by concentrated MLE's
#-----------------------------------------------------------------------------
# BOOTSTRAP ANALYSES
#-----------------------------------------------------------------------------
# Number of bootstraps to run (negative value = do a parametric bootstrap)
# |   Use Stine correction to inflate bootstrap residuals (0=NO)
# |   |  File Output Toggle (- number ASCII, + number BIN)
# |   |  |
  0   1   1        BOOTSTRAP OPTION
#-----------------------------------------------------------------------------
# RETROSPECTIVE ANALYSES (CANNOT DO RETROSPECTIVE ANALYSES AND BOOTSTRAPS AT SAME TIME)
#-----------------------------------------------------------------------------
 0             NUMBER OF YEARS TO GO BACK FOR RETROSPECTIVE ANALYSES
@@EOF@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
```

B. VPA 2-Box Data File

```
##############################################################################
#  DATA FILE FOR PROGRAM VPA-2BOX, Version 3.0
#       The data and specifications are entered in the order indicated
#      by the existing comments. Additional comments must be preceded by a # symbol
#      in the first column, otherwise the line is perceived as free format input.
##############################################################################
1970 2013       FIRST   AND     LAST    YEAR
1       16      16      16      FIRST AGE, LAST AGE, PLUSGROUP AGE, Expanded plusgroup
##############################################################################
# BEGIN INPUT FOR ZONE/STOCK 1
##############################################################################

16
6               SPAWNING SEASON (elapsed months, 0 is beginning of year)
# Age 1         Age 2   Age 3   Age 4   Age 5   Age 6   Age 7   Age 8   Age 9   Age 10  Age 11  Age
12      Age 13  Age 14  Age 15  Age 16
0       0       0       0       0       0       0       0       1       1       1       1       1
        1       1       1               FECUNDITY MODIFIER (MATURITY) AT AGE
# 50 CHARACTER TITLE WITHIN SINGLE QUOTES ‘ ’ ----->]  PDF OF CATCH
# |                                     |       SIGMA CATCH
'Western Bluefin Tuna Assessment'               0       .1
#=============================================================================
# NOW ENTER THE CATCH-AT-AGE DATA. ROW=YEAR, COLUMN=AGE
#=============================================================================
#YEAR   1       2       3       4       5       6       7       8       9       10      11
        12      13      14      15      16
1970 58920      104298  127233  17510   6528    1430    463     161     43      259     435     436
        655     732     593     1299
1971 62033      152003  37948   46241   456     865     1357    1661    1180    758     805     797
        1030    1090    968     2078
1972 45351      98312   33605   2514    3963    1222    92      470     465     292     185     403
        730     1053    929     2372
1973 5065       73591   29957   5877    2254    2443    387     652     1270    829     265     506
        643     696     587     2103
1974 55806      19939   20430   5639    2972    1448    640     739     595     609     869     516
        600     2027    1425    7855
1975 43303      147653  6554    13155   907     709     283     253     419     775     1290    1058
        1080    1202    1395    4813
1976 5532       19427   71850   2576    2743    1062    200     117     702     679     480     844
        1802    2179    2176    6992
1977 1508       22182   9014    28496   7931    2699    2592    546     309     607     947     971
        830     1157    1619    8751
1978 5564       10530   18969   4889    8281    7341    1392    447     405     252     208     348
        536     588     1181    9324
1979 2828       10585   15537   8581    9754    1861    2843    1946    554     349     359     458
        771     1137    1525    8423
1980 3246       16081   9991    8124    4129    1552    2327    4658    3447    973     599     584
        620     685     1088    9286
1981 6290       9814    16530   3729    5692    3462    2613    2191    2271    2470    1392    1101
        833     737     611     7370
1982 3608       3652    1517    523     245     460     490     391     297     500     662     600
        458     239     176     1603
1983 3474       2463    3091    771     615     860     705     1102    953     773     682     585
        739     705     463     2717
1984 1126       7240    1691    1493    2005    1577    927     451     521     642     702     743
        676     858     551     1775
1985 776        5395    12162   2131    3523    3880    1957    728     480     436     457     612
        834     794     1066    2194
1986 967        5898    6478    2914    1437    1177    1136    657     436     381     303     366
        607     670     863     2701
```

1987	2326	12579	8766	4517	3830	3741	1240	1316	985	1037	507	414	441	492	501	1578
1988	4935	9303	11087	3821	3362	3299	3132	1575	1064	926	902	619	546	523	526	1765
1989	842	12925	1542	3104	2519	1480	1621	2160	1615	1090	835	900	716	641	575	1921
1990	2993	3583	17800	1798	2207	2135	1141	1308	1646	1534	885	681	611	522	531	1789
1991	4111	14055	10072	3081	1944	1484	1836	1727	1536	1457	1110	902	628	583	544	1514
1992	589	6088	1922	1053	1187	1332	871	1639	1723	935	932	980	849	663	481	1577
1993	416	1066	4385	3482	2276	1429	1644	1232	1749	1641	831	569	472	360	286	1326
1994	2052	720	1235	2140	2516	1828	1154	1519	2232	1082	937	793	469	399	257	1076
1995	933	1347	3242	2979	2860	4258	1310	609	883	1584	1015	637	505	402	366	1549
1996	526	9349	1676	4657	3341	1122	1385	2318	806	636	1015	909	671	502	429	1522
1997	249	1103	6392	928	1338	1502	1357	1816	1851	1138	605	609	736	672	537	1548
1998	341	889	3486	3483	652	1136	756	1436	2321	2586	1353	725	681	731	486	1437
1999	102	560	1946	1849	1760	799	743	1817	1402	1803	1879	1677	1096	735	577	1583
2000	98	287	1053	1174	3599	3127	1661	1321	1275	1204	1051	1140	1093	824	489	1497
2001	1430	361	2402	4352	987	1303	1748	2227	735	960	1193	1319	1282	1068	753	1481
2002	847	5559	4081	4528	4581	1305	990	2962	2542	1576	1124	949	1124	1056	957	1632
2003	283	2704	4521	3661	1874	1466	327	1314	2155	1633	853	444	585	570	648	1424
2004	814	2674	6944	2586	2752	2907	1454	1522	999	1018	769	582	492	336	331	1139
2005	721	4890	2470	2561	1083	840	688	977	840	703	992	1041	653	424	405	1146
2006	211	630	1245	1746	2452	2004	1063	1073	1373	1253	914	775	572	397	520	1380
2007	65	258	6687	9284	2119	1794	1214	664	575	353	469	402	341	270	253	856
2008	85	788	2292	2102	6401	1614	1797	1829	1190	850	677	415	376	272	364	1059
2009	72	222	2192	1194	987	4540	1559	713	986	876	705	476	337	387	409	1217
2010	66	1097	840	1830	635	632	691	1901	730	995	1094	629	439	438	471	1262
2011	3	560	1617	1592	2055	1261	556	2789	2172	643	624	614	540	431	343	1178
2012	110	404	1854	1212	466	606	692	718	1231	1614	1144	476	489	388	419	1143
2013	48	268	557	1254	196	555	588	957	601	599	923	792	509	352	354	999

-1 end of catch data

#===

NOW ENTER IN THE ABUNDANCE INDEX SPECIFICATIONS

#===

#INDEX PDF (0= do not use,1=lognormal, 2=normal)

#| | UNITS (1 = numbers, 2 = biomass)

#| | | VULNERABILITY (1=fixed, 2=frac.catches, 3=part. catches, 4=Butt. & Gero.

#| | | | TIMING (-1=average, +integer = number of months elapased}

#| | | | | FIRST TO LAST AGE INDEX TITLE (IN SINGLE QUOTES)

1 1 1 4 -1 8 16 'CAN_GSL'

2 1 1 4 -1 5 16 'CAN_SWNS'

3	1	1	4	-1	1	5	'US_RR<145'
4	1	1	4	-1	2	3	'US_RR_66_114'
5	1	1	4	-1	4	5	'US_RR_115_144'
6	0	1	4	-1	6	8	'US_RR_145_177'
7	1	1	4	-1	10	16	'US_RR>195'
8	0	1	4	-1	10	16	'US_RR>195_COMB'
9	1	1	4	-1	8	16	'US_RR>177'
10	1	1	4	0	2	16	'JLL_AREA_2_(WEST)'
11	0	1	4	0	2	16	'JLL_AREA_3_(31+32)'
12	0	1	4	0	2	16	'JLL_AREAS_17+18'
13	1	2	4	-1	9	16	'LARVAL_ZERO_INFLATED'
14	1	1	4	0	9	16	'GOM_PLL_1-6'
15	1	1	4	0	9	16	'JLL_GOM'
16	1	1	1	-1	1	3	'TAGGING'

-1 end index specifications

#==

NOW ENTER IN THE INDICES OF ABUNDANCE

#==

#ID	YEAR	INDEX	CV	INDEX_NAME
1	1970	-999	-999	'CAN_GSL'
1	1971	-999	-999	'CAN_GSL'
1	1972	-999	-999	'CAN_GSL'
1	1973	-999	-999	'CAN_GSL'
1	1974	-999	-999	'CAN_GSL'
1	1975	-999	-999	'CAN_GSL'
1	1976	-999	-999	'CAN_GSL'
1	1977	-999	-999	'CAN_GSL'
1	1978	-999	-999	'CAN_GSL'
1	1979	-999	-999	'CAN_GSL'
1	1980	-999	-999	'CAN_GSL'
1	1981	1.32	0.16	'CAN_GSL'
1	1982	0.60	0.38	'CAN_GSL'
1	1983	1.54	0.10	'CAN_GSL'
1	1984	0.85	0.09	'CAN_GSL'
1	1985	0.21	0.23	'CAN_GSL'
1	1986	0.24	0.22	'CAN_GSL'
1	1987	0.32	0.32	'CAN_GSL'
1	1988	0.53	0.25	'CAN_GSL'
1	1989	0.65	0.28	'CAN_GSL'
1	1990	0.19	0.27	'CAN_GSL'
1	1991	0.65	0.22	'CAN_GSL'
1	1992	1.45	0.20	'CAN_GSL'
1	1993	0.90	0.13	'CAN_GSL'
1	1994	0.25	0.13	'CAN_GSL'
1	1995	0.72	0.09	'CAN_GSL'
1	1996	0.08	0.20	'CAN_GSL'
1	1997	0.13	0.17	'CAN_GSL'
1	1998	0.24	0.15	'CAN_GSL'
1	1999	0.42	0.12	'CAN_GSL'
1	2000	0.32	0.13	'CAN_GSL'
1	2001	0.29	0.16	'CAN_GSL'
1	2002	0.45	0.13	'CAN_GSL'
1	2003	0.83	0.09	'CAN_GSL'
1	2004	1.08	0.10	'CAN_GSL'
1	2005	1.04	0.08	'CAN_GSL'

1	2006	1.14	0.09	'CAN_GSL'
1	2007	2.28	0.15	'CAN_GSL'
1	2008	1.74	0.11	'CAN_GSL'
1	2009	2.56	0.16	'CAN_GSL'
1	2010	-999	-999	'CAN_GSL'
1	2011	3.70	0.11	'CAN_GSL'
1	2012	5.62	0.11	'CAN_GSL'
1	2013	4.81	0.09	'CAN_GSL'
2	1970	-999	-999	'CAN_SWNS'
2	1971	-999	-999	'CAN_SWNS'
2	1972	-999	-999	'CAN_SWNS'
2	1973	-999	-999	'CAN_SWNS'
2	1974	-999	-999	'CAN_SWNS'
2	1975	-999	-999	'CAN_SWNS'
2	1976	-999	-999	'CAN_SWNS'
2	1977	-999	-999	'CAN_SWNS'
2	1978	-999	-999	'CAN_SWNS'
2	1979	-999	-999	'CAN_SWNS'
2	1980	-999	-999	'CAN_SWNS'
2	1981	-999	-999	'CAN_SWNS'
2	1982	-999	-999	'CAN_SWNS'
2	1983	-999	-999	'CAN_SWNS'
2	1984	-999	-999	'CAN_SWNS'
2	1985	-999	-999	'CAN_SWNS'
2	1986	-999	-999	'CAN_SWNS'
2	1987	-999	-999	'CAN_SWNS'
2	1988	13.86	0.19	'CAN_SWNS'
2	1989	13.03	0.18	'CAN_SWNS'
2	1990	12.32	0.18	'CAN_SWNS'
2	1991	9.51	0.19	'CAN_SWNS'
2	1992	9.41	0.18	'CAN_SWNS'
2	1993	6.09	0.19	'CAN_SWNS'
2	1994	7.28	0.18	'CAN_SWNS'
2	1995	7.04	0.19	'CAN_SWNS'
2	1996	5.56	0.18	'CAN_SWNS'
2	1997	4.48	0.17	'CAN_SWNS'
2	1998	7.95	0.17	'CAN_SWNS'
2	1999	10.82	0.18	'CAN_SWNS'
2	2000	4.66	0.18	'CAN_SWNS'
2	2001	9.37	0.19	'CAN_SWNS'
2	2002	11.49	0.18	'CAN_SWNS'
2	2003	15.90	0.18	'CAN_SWNS'
2	2004	9.15	0.19	'CAN_SWNS'
2	2005	10.55	0.17	'CAN_SWNS'
2	2006	11.66	0.18	'CAN_SWNS'
2	2007	9.48	0.18	'CAN_SWNS'
2	2008	13.65	0.20	'CAN_SWNS'
2	2009	10.57	0.18	'CAN_SWNS'
2	2010	9.18	0.21	'CAN_SWNS'
2	2011	10.43	0.21	'CAN_SWNS'
2	2012	9.66	0.20	'CAN_SWNS'
2	2013	5.34	0.19	'CAN_SWNS'
3	1970	-999	-999	'US_RR<145'
3	1971	-999	-999	'US_RR<145'
3	1972	-999	-999	'US_RR<145'
3	1973	-999	-999	'US_RR<145'
3	1974	-999	-999	'US_RR<145'
3	1975	-999	-999	'US_RR<145'
3	1976	-999	-999	'US_RR<145'
3	1977	-999	-999	'US_RR<145'
3	1978	-999	-999	'US_RR<145'
3	1979	-999	-999	'US_RR<145'
3	1980	0.80	0.43	'US_RR<145'
3	1981	0.40	0.52	'US_RR<145'
3	1982	2.10	0.33	'US_RR<145'
3	1983	1.11	0.26	'US_RR<145'
3	1984	-999	-999	'US_RR<145'
3	1985	0.63	0.64	'US_RR<145'
3	1986	0.78	0.43	'US_RR<145'
3	1987	1.22	0.40	'US_RR<145'
3	1988	0.99	0.38	'US_RR<145'
3	1989	0.99	0.43	'US_RR<145'
3	1990	0.90	0.34	'US_RR<145'
3	1991	1.26	0.35	'US_RR<145'
3	1992	0.82	0.42	'US_RR<145'

3	1993	-999	-999	'US_RR<145'
3	1994	-999	-999	'US_RR<145'
3	1995	-999	-999	'US_RR<145'
3	1996	-999	-999	'US_RR<145'
3	1997	-999	-999	'US_RR<145'
3	1998	-999	-999	'US_RR<145'
3	1999	-999	-999	'US_RR<145'
3	2000	-999	-999	'US_RR<145'
3	2001	-999	-999	'US_RR<145'
3	2002	-999	-999	'US_RR<145'
3	2003	-999	-999	'US_RR<145'
3	2004	-999	-999	'US_RR<145'
3	2005	-999	-999	'US_RR<145'
3	2006	-999	-999	'US_RR<145'
3	2007	-999	-999	'US_RR<145'
3	2008	-999	-999	'US_RR<145'
3	2009	-999	-999	'US_RR<145'
3	2010	-999	-999	'US_RR<145'
3	2011	-999	-999	'US_RR<145'
3	2012	-999	-999	'US_RR<145'
3	2013	-999	-999	'US_RR<145'
4	1970	-999	-999	'US_RR_66_114'
4	1971	-999	-999	'US_RR_66_114'
4	1972	-999	-999	'US_RR_66_114'
4	1973	-999	-999	'US_RR_66_114'
4	1974	-999	-999	'US_RR_66_114'
4	1975	-999	-999	'US_RR_66_114'
4	1976	-999	-999	'US_RR_66_114'
4	1977	-999	-999	'US_RR_66_114'
4	1978	-999	-999	'US_RR_66_114'
4	1979	-999	-999	'US_RR_66_114'
4	1980	-999	-999	'US_RR_66_114'
4	1981	-999	-999	'US_RR_66_114'
4	1982	-999	-999	'US_RR_66_114'
4	1983	-999	-999	'US_RR_66_114'
4	1984	-999	-999	'US_RR_66_114'
4	1985	-999	-999	'US_RR_66_114'
4	1986	-999	-999	'US_RR_66_114'
4	1987	-999	-999	'US_RR_66_114'
4	1988	-999	-999	'US_RR_66_114'
4	1989	-999	-999	'US_RR_66_114'
4	1990	-999	-999	'US_RR_66_114'
4	1991	-999	-999	'US_RR_66_114'
4	1992	-999	-999	'US_RR_66_114'
4	1993	1.10	0.36	'US_RR_66_114'
4	1994	0.26	0.45	'US_RR_66_114'
4	1995	1.11	0.35	'US_RR_66_114'
4	1996	1.63	0.38	'US_RR_66_114'
4	1997	2.37	0.33	'US_RR_66_114'
4	1998	1.39	0.37	'US_RR_66_114'
4	1999	1.33	0.43	'US_RR_66_114'
4	2000	0.95	0.50	'US_RR_66_114'
4	2001	0.46	0.35	'US_RR_66_114'
4	2002	1.48	0.40	'US_RR_66_114'
4	2003	0.41	0.35	'US_RR_66_114'
4	2004	2.23	0.32	'US_RR_66_114'
4	2005	2.18	0.32	'US_RR_66_114'
4	2006	0.58	0.35	'US_RR_66_114'
4	2007	0.45	0.31	'US_RR_66_114'
4	2008	0.35	0.33	'US_RR_66_114'
4	2009	0.35	0.33	'US_RR_66_114'
4	2010	0.61	0.33	'US_RR_66_114'
4	2011	0.80	0.35	'US_RR_66_114'
4	2012	0.40	0.41	'US_RR_66_114'
4	2013	0.55	0.36	'US_RR_66_114'
5	1970	-999	-999	'US_RR_115_144'
5	1971	-999	-999	'US_RR_115_144'
5	1972	-999	-999	'US_RR_115_144'
5	1973	-999	-999	'US_RR_115_144'
5	1974	-999	-999	'US_RR_115_144'
5	1975	-999	-999	'US_RR_115_144'
5	1976	-999	-999	'US_RR_115_144'
5	1977	-999	-999	'US_RR_115_144'
5	1978	-999	-999	'US_RR_115_144'
5	1979	-999	-999	'US_RR_115_144'

5	1980	-999	-999	'US_RR_115_144'
5	1981	-999	-999	'US_RR_115_144'
5	1982	-999	-999	'US_RR_115_144'
5	1983	-999	-999	'US_RR_115_144'
5	1984	-999	-999	'US_RR_115_144'
5	1985	-999	-999	'US_RR_115_144'
5	1986	-999	-999	'US_RR_115_144'
5	1987	-999	-999	'US_RR_115_144'
5	1988	-999	-999	'US_RR_115_144'
5	1989	-999	-999	'US_RR_115_144'
5	1990	-999	-999	'US_RR_115_144'
5	1991	-999	-999	'US_RR_115_144'
5	1992	-999	-999	'US_RR_115_144'
5	1993	0.99	0.41	'US_RR_115_144'
5	1994	0.26	0.55	'US_RR_115_144'
5	1995	0.63	0.41	'US_RR_115_144'
5	1996	0.73	0.48	'US_RR_115_144'
5	1997	0.24	0.48	'US_RR_115_144'
5	1998	0.90	0.38	'US_RR_115_144'
5	1999	0.77	0.51	'US_RR_115_144'
5	2000	1.27	0.56	'US_RR_115_144'
5	2001	1.36	0.39	'US_RR_115_144'
5	2002	2.60	0.45	'US_RR_115_144'
5	2003	0.59	0.39	'US_RR_115_144'
5	2004	0.67	0.38	'US_RR_115_144'
5	2005	0.63	0.38	'US_RR_115_144'
5	2006	1.46	0.38	'US_RR_115_144'
5	2007	1.48	0.35	'US_RR_115_144'
5	2008	1.38	0.36	'US_RR_115_144'
5	2009	0.39	0.40	'US_RR_115_144'
5	2010	1.24	0.37	'US_RR_115_144'
5	2011	1.27	0.41	'US_RR_115_144'
5	2012	1.11	0.46	'US_RR_115_144'
5	2013	1.04	0.43	'US_RR_115_144'
6	1970	-999	-999	'US_RR_145_177'
6	1971	-999	-999	'US_RR_145_177'
6	1972	-999	-999	'US_RR_145_177'
6	1973	-999	-999	'US_RR_145_177'
6	1974	-999	-999	'US_RR_145_177'
6	1975	-999	-999	'US_RR_145_177'
6	1976	-999	-999	'US_RR_145_177'
6	1977	-999	-999	'US_RR_145_177'
6	1978	-999	-999	'US_RR_145_177'
6	1979	-999	-999	'US_RR_145_177'
6	1980	-999	-999	'US_RR_145_177'
6	1981	-999	-999	'US_RR_145_177'
6	1982	-999	-999	'US_RR_145_177'
6	1983	-999	-999	'US_RR_145_177'
6	1984	-999	-999	'US_RR_145_177'
6	1985	-999	-999	'US_RR_145_177'
6	1986	-999	-999	'US_RR_145_177'
6	1987	-999	-999	'US_RR_145_177'
6	1988	-999	-999	'US_RR_145_177'
6	1989	-999	-999	'US_RR_145_177'
6	1990	-999	-999	'US_RR_145_177'
6	1991	-999	-999	'US_RR_145_177'
6	1992	-999	-999	'US_RR_145_177'
6	1993	0.31	3.74	'US_RR_145_177'
6	1994	0.38	3.12	'US_RR_145_177'
6	1995	1.33	1.78	'US_RR_145_177'
6	1996	0.70	2.72	'US_RR_145_177'
6	1997	0.46	3.05	'US_RR_145_177'
6	1998	0.36	3.46	'US_RR_145_177'
6	1999	1.07	2.06	'US_RR_145_177'
6	2000	0.96	2.06	'US_RR_145_177'
6	2001	3.42	2.57	'US_RR_145_177'
6	2002	-999	-999	'US_RR_145_177'
6	2003	-999	-999	'US_RR_145_177'
6	2004	-999	-999	'US_RR_145_177'
6	2005	-999	-999	'US_RR_145_177'
6	2006	-999	-999	'US_RR_145_177'
6	2007	-999	-999	'US_RR_145_177'
6	2008	-999	-999	'US_RR_145_177'
6	2009	-999	-999	'US_RR_145_177'
6	2010	-999	-999	'US_RR_145_177'

6	2011	-999	-999	'US_RR_145_177'
6	2012	-999	-999	'US_RR_145_177'
6	2013	-999	-999	'US_RR_145_177'
7	1970	-999	-999	'US_RR>195'
7	1971	-999	-999	'US_RR>195'
7	1972	-999	-999	'US_RR>195'
7	1973	-999	-999	'US_RR>195'
7	1974	-999	-999	'US_RR>195'
7	1975	-999	-999	'US_RR>195'
7	1976	-999	-999	'US_RR>195'
7	1977	-999	-999	'US_RR>195'
7	1978	-999	-999	'US_RR>195'
7	1979	-999	-999	'US_RR>195'
7	1980	-999	-999	'US_RR>195'
7	1981	-999	-999	'US_RR>195'
7	1982	-999	-999	'US_RR>195'
7	1983	2.81	0.10	'US_RR>195'
7	1984	1.25	0.19	'US_RR>195'
7	1985	0.86	0.30	'US_RR>195'
7	1986	0.50	1.10	'US_RR>195'
7	1987	0.53	0.48	'US_RR>195'
7	1988	0.94	0.36	'US_RR>195'
7	1989	0.76	0.36	'US_RR>195'
7	1990	0.63	0.34	'US_RR>195'
7	1991	0.82	0.28	'US_RR>195'
7	1992	0.91	0.28	'US_RR>195'
7	1993	-999	-999	'US_RR>195'
7	1994	-999	-999	'US_RR>195'
7	1995	-999	-999	'US_RR>195'
7	1996	-999	-999	'US_RR>195'
7	1997	-999	-999	'US_RR>195'
7	1998	-999	-999	'US_RR>195'
7	1999	-999	-999	'US_RR>195'
7	2000	-999	-999	'US_RR>195'
7	2001	-999	-999	'US_RR>195'
7	2002	-999	-999	'US_RR>195'
7	2003	-999	-999	'US_RR>195'
7	2004	-999	-999	'US_RR>195'
7	2005	-999	-999	'US_RR>195'
7	2006	-999	-999	'US_RR>195'
7	2007	-999	-999	'US_RR>195'
7	2008	-999	-999	'US_RR>195'
7	2009	-999	-999	'US_RR>195'
7	2010	-999	-999	'US_RR>195'
7	2011	-999	-999	'US_RR>195'
7	2012	-999	-999	'US_RR>195'
7	2013	-999	-999	'US_RR>195'
8	1970	-999	-999	'US_RR>195_COMB'
8	1971	-999	-999	'US_RR>195_COMB'
8	1972	-999	-999	'US_RR>195_COMB'
8	1973	-999	-999	'US_RR>195_COMB'
8	1974	-999	-999	'US_RR>195_COMB'
8	1975	-999	-999	'US_RR>195_COMB'
8	1976	-999	-999	'US_RR>195_COMB'
8	1977	-999	-999	'US_RR>195_COMB'
8	1978	-999	-999	'US_RR>195_COMB'
8	1979	-999	-999	'US_RR>195_COMB'
8	1980	-999	-999	'US_RR>195_COMB'
8	1981	-999	-999	'US_RR>195_COMB'
8	1982	-999	-999	'US_RR>195_COMB'
8	1983	-999	-999	'US_RR>195_COMB'
8	1984	-999	-999	'US_RR>195_COMB'
8	1985	-999	-999	'US_RR>195_COMB'
8	1986	-999	-999	'US_RR>195_COMB'
8	1987	-999	-999	'US_RR>195_COMB'
8	1988	-999	-999	'US_RR>195_COMB'
8	1989	-999	-999	'US_RR>195_COMB'
8	1990	-999	-999	'US_RR>195_COMB'
8	1991	-999	-999	'US_RR>195_COMB'
8	1992	-999	-999	'US_RR>195_COMB'
8	1993	-999	-999	'US_RR>195_COMB'
8	1994	-999	-999	'US_RR>195_COMB'
8	1995	-999	-999	'US_RR>195_COMB'
8	1996	-999	-999	'US_RR>195_COMB'
8	1997	-999	-999	'US_RR>195_COMB'

8	1998	-999	-999	'US_RR>195_COMB'
8	1999	-999	-999	'US_RR>195_COMB'
8	2000	-999	-999	'US_RR>195_COMB'
8	2001	-999	-999	'US_RR>195_COMB'
8	2002	-999	-999	'US_RR>195_COMB'
8	2003	-999	-999	'US_RR>195_COMB'
8	2004	-999	-999	'US_RR>195_COMB'
8	2005	-999	-999	'US_RR>195_COMB'
8	2006	-999	-999	'US_RR>195_COMB'
8	2007	-999	-999	'US_RR>195_COMB'
8	2008	-999	-999	'US_RR>195_COMB'
8	2009	-999	-999	'US_RR>195_COMB'
8	2010	-999	-999	'US_RR>195_COMB'
8	2011	-999	-999	'US_RR>195_COMB'
8	2012	-999	-999	'US_RR>195_COMB'
8	2013	-999	-999	'US_RR>195_COMB'
9	1970	-999	-999	'US_RR>177'
9	1971	-999	-999	'US_RR>177'
9	1972	-999	-999	'US_RR>177'
9	1973	-999	-999	'US_RR>177'
9	1974	-999	-999	'US_RR>177'
9	1975	-999	-999	'US_RR>177'
9	1976	-999	-999	'US_RR>177'
9	1977	-999	-999	'US_RR>177'
9	1978	-999	-999	'US_RR>177'
9	1979	-999	-999	'US_RR>177'
9	1980	-999	-999	'US_RR>177'
9	1981	-999	-999	'US_RR>177'
9	1982	-999	-999	'US_RR>177'
9	1983	-999	-999	'US_RR>177'
9	1984	-999	-999	'US_RR>177'
9	1985	-999	-999	'US_RR>177'
9	1986	-999	-999	'US_RR>177'
9	1987	-999	-999	'US_RR>177'
9	1988	-999	-999	'US_RR>177'
9	1989	-999	-999	'US_RR>177'
9	1990	-999	-999	'US_RR>177'
9	1991	-999	-999	'US_RR>177'
9	1992	-999	-999	'US_RR>177'
9	1993	0.69	0.31	'US_RR>177'
9	1994	0.94	0.29	'US_RR>177'
9	1995	1.13	0.27	'US_RR>177'
9	1996	3.33	0.26	'US_RR>177'
9	1997	1.50	0.37	'US_RR>177'
9	1998	1.62	0.26	'US_RR>177'
9	1999	1.88	0.29	'US_RR>177'
9	2000	0.63	0.28	'US_RR>177'
9	2001	1.38	0.30	'US_RR>177'
9	2002	1.94	0.24	'US_RR>177'
9	2003	0.45	0.29	'US_RR>177'
9	2004	0.74	0.28	'US_RR>177'
9	2005	0.65	0.27	'US_RR>177'
9	2006	0.43	0.38	'US_RR>177'
9	2007	0.33	0.37	'US_RR>177'
9	2008	0.40	0.36	'US_RR>177'
9	2009	0.29	0.40	'US_RR>177'
9	2010	0.94	0.27	'US_RR>177'
9	2011	0.59	0.30	'US_RR>177'
9	2012	0.65	0.27	'US_RR>177'
9	2013	0.50	0.29	'US_RR>177'
10	1970	-999	-999	'JLL_AREA_2_(WEST)'
10	1971	-999	-999	'JLL_AREA_2_(WEST)'
10	1972	-999	-999	'JLL_AREA_2_(WEST)'
10	1973	-999	-999	'JLL_AREA_2_(WEST)'
10	1974	-999	-999	'JLL_AREA_2_(WEST)'
10	1975	-999	-999	'JLL_AREA_2_(WEST)'
10	1976	0.61	0.43	'JLL_AREA_2_(WEST)'
10	1977	2.36	0.22	'JLL_AREA_2_(WEST)'
10	1978	1.14	0.29	'JLL_AREA_2_(WEST)'
10	1979	0.78	0.25	'JLL_AREA_2_(WEST)'
10	1980	1.49	0.21	'JLL_AREA_2_(WEST)'
10	1981	1.93	0.16	'JLL_AREA_2_(WEST)'
10	1982	0.71	0.25	'JLL_AREA_2_(WEST)'
10	1983	0.43	0.32	'JLL_AREA_2_(WEST)'
10	1984	1.02	0.22	'JLL_AREA_2_(WEST)'

10	1985	1.18	0.21	'JLL_AREA_2_(WEST)'
10	1986	0.09	0.60	'JLL_AREA_2_(WEST)'
10	1987	0.78	0.26	'JLL_AREA_2_(WEST)'
10	1988	1.18	0.21	'JLL_AREA_2_(WEST)'
10	1989	0.99	0.21	'JLL_AREA_2_(WEST)'
10	1990	0.82	0.24	'JLL_AREA_2_(WEST)'
10	1991	0.82	0.26	'JLL_AREA_2_(WEST)'
10	1992	1.25	0.21	'JLL_AREA_2_(WEST)'
10	1993	1.23	0.23	'JLL_AREA_2_(WEST)'
10	1994	1.14	0.22	'JLL_AREA_2_(WEST)'
10	1995	0.84	0.29	'JLL_AREA_2_(WEST)'
10	1996	2.11	0.20	'JLL_AREA_2_(WEST)'
10	1997	1.30	0.25	'JLL_AREA_2_(WEST)'
10	1998	0.61	0.29	'JLL_AREA_2_(WEST)'
10	1999	0.66	0.31	'JLL_AREA_2_(WEST)'
10	2000	0.82	0.27	'JLL_AREA_2_(WEST)'
10	2001	0.52	0.40	'JLL_AREA_2_(WEST)'
10	2002	0.61	0.31	'JLL_AREA_2_(WEST)'
10	2003	0.60	0.40	'JLL_AREA_2_(WEST)'
10	2004	0.53	0.39	'JLL_AREA_2_(WEST)'
10	2005	0.64	0.23	'JLL_AREA_2_(WEST)'
10	2006	1.10	0.23	'JLL_AREA_2_(WEST)'
10	2007	1.69	0.23	'JLL_AREA_2_(WEST)'
10	2008	0.73	0.35	'JLL_AREA_2_(WEST)'
10	2009	1.68	0.33	'JLL_AREA_2_(WEST)'
10	2010	0.61	0.37	'JLL_AREA_2_(WEST)'
10	2011	2.59	0.24	'JLL_AREA_2_(WEST)'
10	2012	3.61	0.30	'JLL_AREA_2_(WEST)'
10	2013	2.62	0.26	'JLL_AREA_2_(WEST)'
11	1970	-999	-999	'JLL_AREA_3_(31+32)'
11	1971	-999	-999	'JLL_AREA_3_(31+32)'
11	1972	-999	-999	'JLL_AREA_3_(31+32)'
11	1973	-999	-999	'JLL_AREA_3_(31+32)'
11	1974	-999	-999	'JLL_AREA_3_(31+32)'
11	1975	-999	-999	'JLL_AREA_3_(31+32)'
11	1976	-999	-999	'JLL_AREA_3_(31+32)'
11	1977	-999	-999	'JLL_AREA_3_(31+32)'
11	1978	-999	-999	'JLL_AREA_3_(31+32)'
11	1979	-999	-999	'JLL_AREA_3_(31+32)'
11	1980	-999	-999	'JLL_AREA_3_(31+32)'
11	1981	-999	-999	'JLL_AREA_3_(31+32)'
11	1982	-999	-999	'JLL_AREA_3_(31+32)'
11	1983	-999	-999	'JLL_AREA_3_(31+32)'
11	1984	-999	-999	'JLL_AREA_3_(31+32)'
11	1985	-999	-999	'JLL_AREA_3_(31+32)'
11	1986	-999	-999	'JLL_AREA_3_(31+32)'
11	1987	-999	-999	'JLL_AREA_3_(31+32)'
11	1988	-999	-999	'JLL_AREA_3_(31+32)'
11	1989	-999	-999	'JLL_AREA_3_(31+32)'
11	1990	-999	-999	'JLL_AREA_3_(31+32)'
11	1991	-999	-999	'JLL_AREA_3_(31+32)'
11	1992	-999	-999	'JLL_AREA_3_(31+32)'
11	1993	-999	-999	'JLL_AREA_3_(31+32)'
11	1994	-999	-999	'JLL_AREA_3_(31+32)'
11	1995	-999	-999	'JLL_AREA_3_(31+32)'
11	1996	-999	-999	'JLL_AREA_3_(31+32)'
11	1997	-999	-999	'JLL_AREA_3_(31+32)'
11	1998	-999	-999	'JLL_AREA_3_(31+32)'
11	1999	-999	-999	'JLL_AREA_3_(31+32)'
11	2000	-999	-999	'JLL_AREA_3_(31+32)'
11	2001	-999	-999	'JLL_AREA_3_(31+32)'
11	2002	-999	-999	'JLL_AREA_3_(31+32)'
11	2003	-999	-999	'JLL_AREA_3_(31+32)'
11	2004	-999	-999	'JLL_AREA_3_(31+32)'
11	2005	-999	-999	'JLL_AREA_3_(31+32)'
11	2006	-999	-999	'JLL_AREA_3_(31+32)'
11	2007	-999	-999	'JLL_AREA_3_(31+32)'
11	2008	-999	-999	'JLL_AREA_3_(31+32)'
11	2009	-999	-999	'JLL_AREA_3_(31+32)'
11	2010	-999	-999	'JLL_AREA_3_(31+32)'
11	2011	-999	-999	'JLL_AREA_3_(31+32)'
11	2012	-999	-999	'JLL_AREA_3_(31+32)'
11	2013	-999	-999	'JLL_AREA_3_(31+32)'
12	1970	-999	-999	'JLL_AREAS_17+18'
12	1971	-999	-999	'JLL_AREAS_17+18'

12	1972	-999	-999	'JLL_AREAS_17+18'
12	1973	-999	-999	'JLL_AREAS_17+18'
12	1974	-999	-999	'JLL_AREAS_17+18'
12	1975	-999	-999	'JLL_AREAS_17+18'
12	1976	-999	-999	'JLL_AREAS_17+18'
12	1977	-999	-999	'JLL_AREAS_17+18'
12	1978	-999	-999	'JLL_AREAS_17+18'
12	1979	-999	-999	'JLL_AREAS_17+18'
12	1980	-999	-999	'JLL_AREAS_17+18'
12	1981	-999	-999	'JLL_AREAS_17+18'
12	1982	-999	-999	'JLL_AREAS_17+18'
12	1983	-999	-999	'JLL_AREAS_17+18'
12	1984	-999	-999	'JLL_AREAS_17+18'
12	1985	-999	-999	'JLL_AREAS_17+18'
12	1986	-999	-999	'JLL_AREAS_17+18'
12	1987	-999	-999	'JLL_AREAS_17+18'
12	1988	-999	-999	'JLL_AREAS_17+18'
12	1989	-999	-999	'JLL_AREAS_17+18'
12	1990	-999	-999	'JLL_AREAS_17+18'
12	1991	-999	-999	'JLL_AREAS_17+18'
12	1992	-999	-999	'JLL_AREAS_17+18'
12	1993	-999	-999	'JLL_AREAS_17+18'
12	1994	-999	-999	'JLL_AREAS_17+18'
12	1995	-999	-999	'JLL_AREAS_17+18'
12	1996	-999	-999	'JLL_AREAS_17+18'
12	1997	-999	-999	'JLL_AREAS_17+18'
12	1998	-999	-999	'JLL_AREAS_17+18'
12	1999	-999	-999	'JLL_AREAS_17+18'
12	2000	-999	-999	'JLL_AREAS_17+18'
12	2001	-999	-999	'JLL_AREAS_17+18'
12	2002	-999	-999	'JLL_AREAS_17+18'
12	2003	-999	-999	'JLL_AREAS_17+18'
12	2004	-999	-999	'JLL_AREAS_17+18'
12	2005	-999	-999	'JLL_AREAS_17+18'
12	2006	-999	-999	'JLL_AREAS_17+18'
12	2007	-999	-999	'JLL_AREAS_17+18'
12	2008	-999	-999	'JLL_AREAS_17+18'
12	2009	-999	-999	'JLL_AREAS_17+18'
12	2010	-999	-999	'JLL_AREAS_17+18'
12	2011	-999	-999	'JLL_AREAS_17+18'
12	2012	-999	-999	'JLL_AREAS_17+18'
12	2013	-999	-999	'JLL_AREAS_17+18'
13	1970	-999	-999	'LARVAL_ZERO_INFLATED'
13	1971	-999	-999	'LARVAL_ZERO_INFLATED'
13	1972	-999	-999	'LARVAL_ZERO_INFLATED'
13	1973	-999	-999	'LARVAL_ZERO_INFLATED'
13	1974	-999	-999	'LARVAL_ZERO_INFLATED'
13	1975	-999	-999	'LARVAL_ZERO_INFLATED'
13	1976	-999	-999	'LARVAL_ZERO_INFLATED'
13	1977	2.25	0.51	'LARVAL_ZERO_INFLATED'
13	1978	4.39	0.25	'LARVAL_ZERO_INFLATED'
13	1979	-999	-999	'LARVAL_ZERO_INFLATED'
13	1980	-999	-999	'LARVAL_ZERO_INFLATED'
13	1981	0.81	0.49	'LARVAL_ZERO_INFLATED'
13	1982	1.18	0.30	'LARVAL_ZERO_INFLATED'
13	1983	0.84	0.35	'LARVAL_ZERO_INFLATED'
13	1984	0.31	0.57	'LARVAL_ZERO_INFLATED'
13	1985	-999	-999	'LARVAL_ZERO_INFLATED'
13	1986	0.35	0.43	'LARVAL_ZERO_INFLATED'
13	1987	0.31	0.47	'LARVAL_ZERO_INFLATED'
13	1988	1.11	0.35	'LARVAL_ZERO_INFLATED'
13	1989	0.62	0.38	'LARVAL_ZERO_INFLATED'
13	1990	0.33	0.36	'LARVAL_ZERO_INFLATED'
13	1991	0.30	0.61	'LARVAL_ZERO_INFLATED'
13	1992	0.42	0.36	'LARVAL_ZERO_INFLATED'
13	1993	0.44	0.69	'LARVAL_ZERO_INFLATED'
13	1994	0.54	0.35	'LARVAL_ZERO_INFLATED'
13	1995	0.22	0.54	'LARVAL_ZERO_INFLATED'
13	1996	0.79	0.52	'LARVAL_ZERO_INFLATED'
13	1997	0.33	0.39	'LARVAL_ZERO_INFLATED'
13	1998	0.11	0.55	'LARVAL_ZERO_INFLATED'
13	1999	0.46	0.53	'LARVAL_ZERO_INFLATED'
13	2000	0.25	0.54	'LARVAL_ZERO_INFLATED'
13	2001	0.46	0.33	'LARVAL_ZERO_INFLATED'
13	2002	0.24	0.65	'LARVAL_ZERO_INFLATED'

13	2003	0.79	0.40	'LARVAL_ZERO_INFLATED'
13	2004	0.55	0.71	'LARVAL_ZERO_INFLATED'
13	2005	0.18	0.30	'LARVAL_ZERO_INFLATED'
13	2006	0.47	0.35	'LARVAL_ZERO_INFLATED'
13	2007	0.39	0.45	'LARVAL_ZERO_INFLATED'
13	2008	0.31	0.39	'LARVAL_ZERO_INFLATED'
13	2009	0.58	0.34	'LARVAL_ZERO_INFLATED'
13	2010	0.39	0.52	'LARVAL_ZERO_INFLATED'
13	2011	1.02	0.40	'LARVAL_ZERO_INFLATED'
13	2012	0.30	0.49	'LARVAL_ZERO_INFLATED'
13	2013	0.98	0.36	'LARVAL_ZERO_INFLATED'
14	1970	-999	-999	'GOM_PLL_1_6'
14	1971	-999	-999	'GOM_PLL_1_6'
14	1972	-999	-999	'GOM_PLL_1_6'
14	1973	-999	-999	'GOM_PLL_1_6'
14	1974	-999	-999	'GOM_PLL_1_6'
14	1975	-999	-999	'GOM_PLL_1_6'
14	1976	-999	-999	'GOM_PLL_1_6'
14	1977	-999	-999	'GOM_PLL_1_6'
14	1978	-999	-999	'GOM_PLL_1_6'
14	1979	-999	-999	'GOM_PLL_1_6'
14	1980	-999	-999	'GOM_PLL_1_6'
14	1981	-999	-999	'GOM_PLL_1_6'
14	1982	-999	-999	'GOM_PLL_1_6'
14	1983	-999	-999	'GOM_PLL_1_6'
14	1984	-999	-999	'GOM_PLL_1_6'
14	1985	-999	-999	'GOM_PLL_1_6'
14	1986	-999	-999	'GOM_PLL_1_6'
14	1987	-999	-999	'GOM_PLL_1_6'
14	1988	-999	-999	'GOM_PLL_1_6'
14	1989	-999	-999	'GOM_PLL_1_6'
14	1990	-999	-999	'GOM_PLL_1_6'
14	1991	-999	-999	'GOM_PLL_1_6'
14	1992	0.80	0.35	'GOM_PLL_1_6'
14	1993	0.45	0.37	'GOM_PLL_1_6'
14	1994	0.33	0.39	'GOM_PLL_1_6'
14	1995	0.31	0.40	'GOM_PLL_1_6'
14	1996	0.18	0.40	'GOM_PLL_1_6'
14	1997	0.33	0.37	'GOM_PLL_1_6'
14	1998	0.36	0.37	'GOM_PLL_1_6'
14	1999	0.61	0.33	'GOM_PLL_1_6'
14	2000	0.89	0.33	'GOM_PLL_1_6'
14	2001	0.51	0.38	'GOM_PLL_1_6'
14	2002	0.48	0.39	'GOM_PLL_1_6'
14	2003	0.86	0.32	'GOM_PLL_1_6'
14	2004	0.78	0.33	'GOM_PLL_1_6'
14	2005	0.59	0.34	'GOM_PLL_1_6'
14	2006	0.41	0.39	'GOM_PLL_1_6'
14	2007	0.55	0.38	'GOM_PLL_1_6'
14	2008	1.26	0.34	'GOM_PLL_1_6'
14	2009	1.05	0.36	'GOM_PLL_1_6'
14	2010	0.89	0.34	'GOM_PLL_1_6'
14	2011	0.73	0.49	'GOM_PLL_1_6'
14	2012	1.34	0.34	'GOM_PLL_1_6'
14	2013	0.43	0.41	'GOM_PLL_1_6'
15	1970	-999	-999	'JLL_GOM'
15	1971	-999	-999	'JLL_GOM'
15	1972	-999	-999	'JLL_GOM'
15	1973	-999	-999	'JLL_GOM'
15	1974	0.968	0.266	'JLL_GOM'
15	1975	0.534	0.205	'JLL_GOM'
15	1976	0.666	0.207	'JLL_GOM'
15	1977	0.913	0.216	'JLL_GOM'
15	1978	0.876	0.225	'JLL_GOM'
15	1979	1.287	0.283	'JLL_GOM'
15	1980	1.158	0.265	'JLL_GOM'
15	1981	0.553	0.239	'JLL_GOM'
15	1982	-999	-999	'JLL_GOM'
15	1983	-999	-999	'JLL_GOM'
15	1984	-999	-999	'JLL_GOM'
15	1985	-999	-999	'JLL_GOM'
15	1986	-999	-999	'JLL_GOM'
15	1987	-999	-999	'JLL_GOM'
15	1988	-999	-999	'JLL_GOM'
15	1989	-999	-999	'JLL_GOM'

15	1990	-999	-999	'JLL_GOM'
15	1991	-999	-999	'JLL_GOM'
15	1992	-999	-999	'JLL_GOM'
15	1993	-999	-999	'JLL_GOM'
15	1994	-999	-999	'JLL_GOM'
15	1995	-999	-999	'JLL_GOM'
15	1996	-999	-999	'JLL_GOM'
15	1997	-999	-999	'JLL_GOM'
15	1998	-999	-999	'JLL_GOM'
15	1999	-999	-999	'JLL_GOM'
15	2000	-999	-999	'JLL_GOM'
15	2001	-999	-999	'JLL_GOM'
15	2002	-999	-999	'JLL_GOM'
15	2003	-999	-999	'JLL_GOM'
15	2004	-999	-999	'JLL_GOM'
15	2005	-999	-999	'JLL_GOM'
15	2006	-999	-999	'JLL_GOM'
15	2007	-999	-999	'JLL_GOM'
15	2008	-999	-999	'JLL_GOM'
15	2009	-999	-999	'JLL_GOM'
15	2010	-999	-999	'JLL_GOM'
15	2011	-999	-999	'JLL_GOM'
15	2012	-999	-999	'JLL_GOM'
15	2013	-999	-999	'JLL_GOM'
16	1970	1065132	0.2	'TAGGING'
16	1971	1001624	0.2	'TAGGING'
16	1972	431955	0.2	'TAGGING'
16	1973	183616	0.2	'TAGGING'
16	1974	341589	0.2	'TAGGING'
16	1975	554596	0.2	'TAGGING'
16	1976	253265	0.2	'TAGGING'
16	1977	257385	0.2	'TAGGING'
16	1978	121110	0.2	'TAGGING'
16	1979	98815	0.2	'TAGGING'
16	1980	192541	0.2	'TAGGING'
16	1981	337995	0.2	'TAGGING'
16	1982	-999	-999	'TAGGING'
16	1983	-999	-999	'TAGGING'
16	1984	-999	-999	'TAGGING'
16	1985	-999	-999	'TAGGING'
16	1986	-999	-999	'TAGGING'
16	1987	-999	-999	'TAGGING'
16	1988	-999	-999	'TAGGING'
16	1989	-999	-999	'TAGGING'
16	1990	-999	-999	'TAGGING'
16	1991	-999	-999	'TAGGING'
16	1992	-999	-999	'TAGGING'
16	1993	-999	-999	'TAGGING'
16	1994	-999	-999	'TAGGING'
16	1995	-999	-999	'TAGGING'
16	1996	-999	-999	'TAGGING'
16	1997	-999	-999	'TAGGING'
16	1998	-999	-999	'TAGGING'
16	1999	-999	-999	'TAGGING'
16	2000	-999	-999	'TAGGING'
16	2001	-999	-999	'TAGGING'
16	2002	-999	-999	'TAGGING'
16	2003	-999	-999	'TAGGING'
16	2004	-999	-999	'TAGGING'
16	2005	-999	-999	'TAGGING'
16	2006	-999	-999	'TAGGING'
16	2007	-999	-999	'TAGGING'
16	2008	-999	-999	'TAGGING'
16	2009	-999	-999	'TAGGING'
16	2010	-999	-999	'TAGGING'
16	2011	-999	-999	'TAGGING'
16	2012	-999	-999	'TAGGING'
16	2013	-999	-999	'TAGGING'

-1 end index data

#==

NOW ENTER IN THE Vulnerabilities OR PARTIAL CATCHES FOR THE INDICES OF ABUNDANCE

#==

#INDEX	Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
1	1970	0	0	0	0	0	0	0	0	2	1	2	7	39	51	68	170
1	1971	0	0	0	0	0	0	0	0	0	0	1	5	11	35	37	136
1	1972	0	0	0	0	0	0	1	0	0	0	0	1	5	28	46	312
1	1973	0	0	0	0	0	0	0	0	1	0	0	6	3	21	44	489
1	1974	0	0	0	0	0	3	0	0	0	0	0	1	5	15	52	748
1	1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	535
1	1976	0	0	0	0	0	0	0	0	0	0	1	0	0	2	11	842
1	1977	0	0	0	0	0	0	0	0	0	0	1	0	1	5	6	729
1	1978	0	0	0	0	0	0	0	0	0	1	1	0	0	3	6	468
1	1979	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	476
1	1980	0	0	0	0	0	0	0	0	0	0	0	1	0	4	5	620
1	1981	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	626
1	1982	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	506
1	1983	0	0	0	0	0	0	0	0	0	0	0	0	0	28	10	1012
1	1984	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	546
1	1985	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	266
1	1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	93
1	1987	0	0	0	0	0	2	1	2	2	0	1	1	1	1	2	41
1	1988	0	1	0	0	1	6	22	64	34	140	331	156	42	29	29	261
1	1989	0	0	0	0	0	1	22	399	508	391	270	210	138	118	76	524
1	1990	0	0	0	0	0	1	49	275	550	385	142	94	63	66	81	348
1	1991	0	0	0	0	0	0	0	0	0	0	2	1	21	27	10	111
1	1992	0	0	0	0	2	0	0	2	1	1	2	4	5	11	9	180
1	1993	0	0	0	0	0	0	0	0	1	1	7	4	7	4	10	339
1	1994	0	0	0	0	0	1	0	2	0	1	3	6	2	6	7	236
1	1995	0	0	0	0	0	0	2	3	1	14	12	12	12	16	16	501
1	1996	0	0	0	0	0	0	1	0	0	0	0	0	1	1	3	247
1	1997	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	221
1	1998	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	255
1	1999	0	0	1	0	1	0	0	0	1	0	2	12	6	2	7	375
1	2000	0	0	0	0	1	0	0	1	0	1	2	8	20	28	22	477
1	2001	0	0	0	0	0	0	0	0	0	0	4	1	18	37	34	291
1	2002	0	0	0	0	0	0	0	1	7	0	5	9	25	49	79	413
1	2003	0	0	0	0	0	0	0	1	8	7	14	15	17	39	51	343
1	2004	0	0	0	0	0	0	2	1	2	10	28					

	40	32	29	63	523							
1	2005	0	0	0	0	0	0	0	0	4	6	25
	60	57	49	70	521							
1	2006	0	0	0	0	0	0	1	0	2	11	19
	47	64	80	77	646							
1	2007	0	0	0	0	0	0	0	1	2	3	12
	22	41	51	58	394							
1	2008	0	0	0	0	0	0	0	0	0	5	11
	14	42	63	72	488							
1	2009	0	0	0	0	0	5	9	6	21	21	27
	29	38	62	69	373							
1	2010	0	0	0	0	0	0	14	19	5	19	22
	11	17	39	43	387							
1	2011	0	0	0	0	1	0	1	15	42	16	19
	22	44	60	50	363							
1	2012	0	0	0	0	0	0	1	7	43	100	82
	47	35	47	93	341							
1	2013	0	0	0	0	0	0	0	0	8	24	70
	86	72	60	53	358							
2	1970	0	0	0	0	0	0	0	0	2	1	2
	7	39	51	68	170							
2	1971	0	0	0	0	0	0	0	0	0	0	1
	5	11	35	37	136							
2	1972	0	0	0	0	0	0	1	0	0	0	0
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2	1973	0	0	0	0	0	0	0	0	1	0	0
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2	1974	0	0	0	0	0	3	0	0	0	0	0
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2	1975	0	0	0	0	0	0	0	0	0	0	0
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2	1976	0	0	0	0	0	0	0	0	0	0	1
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2	1980	0	0	0	0	0	0	0	0	0	0	0
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2	1981	0	0	0	0	0	0	0	0	0	0	0
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2	1982	0	0	0	0	0	0	0	0	0	0	0
	0	0	3	6	506							
2	1983	0	0	0	0	0	0	0	0	0	0	0
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2	1984	0	0	0	0	0	0	0	0	0	0	0
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2	1985	0	0	0	0	0	0	0	0	0	0	0
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2	1986	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	1	93							
2	1987	0	0	0	0	0	2	1	2	2	0	1
	1	1	1	2	41							
2	1988	0	1	0	0	1	6	22	64	34	140	331
	156	42	29	29	261							
2	1989	0	0	0	0	0	1	22	399	508	391	270
	210	138	118	76	524							
2	1990	0	0	0	0	0	1	49	275	550	385	142
	94	63	66	81	348							
2	1991	0	0	0	0	0	1	76	288	378	500	299
	116	65	45	25	16							
2	1992	0	0	0	0	1	2	32	147	187	182	238
	237	152	90	78	90							
2	1993	0	0	0	0	0	0	15	18	107	216	162
	129	127	104	60	105							
2	1994	0	0	0	0	0	3	16	102	88	152	186
	139	103	74	49	66							
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	183	117	87	63	102							
2	1996	0	0	0	0	0	0	14	40	54	70	149
	207	145	103	77	258							
2	1997	0	0	0	0	1	12	28	85	172	148	109
	89	104	91	80	269							

2	1998	0	0	0	0	0	10	12	51	226	372	328	166	154	120	93	170
2	1999	0	0	0	0	1	1	31	122	177	372	383	306	155	70	33	71
2	2000	0	0	0	0	0	3	4	20	111	142	141	159	137	99	56	56
2	2001	0	0	0	0	3	19	278	289	103	213	255	181	147	116	63	53
2	2002	0	0	0	0	0	2	42	395	483	133	129	167	130	103	47	36
2	2003	0	0	0	0	0	1	12	231	666	435	109	26	16	16	8	12
2	2004	0	0	0	0	7	21	101	345	357	264	122	99	56	18	18	5
2	2005	0	0	0	2	23	20	23	79	131	200	261	234	123	71	75	107
2	2006	0	0	0	0	12	24	133	138	209	296	283	260	187	91	46	77
2	2007	0	0	0	0	2	28	56	116	156	106	119	120	97	66	32	45
2	2008	0	2	2	63	390	774	495	374	212	67	20	2	2	0	0	0
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2	2010	0	0	0	0	0	3	22	26	38	70	71	60	68	70	54	101
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2	2012	0	0	0	0	0	5	12	52	126	66	47	47	51	41	36	72
2	2013	0	0	0	0	0	1	7	30	37	34	60	79	55	39	28	142
3	1970	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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3	1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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3	1978	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1979	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1980	786	4119	290	160	67	1	0	0	0	0	0	0	0	0	0	0
3	1981	2975	1484	422	59	20	0	0	0	0	0	0	0	0	0	0	0
3	1982	2708	3009	619	117	50	0	0	0	0	0	0	0	0	0	0	0
3	1983	1640	2344	813	115	38	0	0	0	0	0	0	0	0	0	0	0
3	1984	922	5543	1085	300	186	0	0	0	0	0	0	0	0	0	0	0
3	1985	741	5267	5482	85	50	0	0	0	0	0	0	0	0	0	0	0
3	1986	963	5764	5250	678	48	0	0	0	0	0	0	0	0	0	0	0
3	1987	2297	12228	7212	2193	669	0	0	0	0	0	0	0	0	0	0	0
3	1988	4783	8903	7322	74	148	0	0	0	0	0	0	0	0	0	0	0
3	1989	779	12589	1186	1943	1596	3	0	0	0	0	0	0	0	0	0	0
3	1990	1953	2066	13030	645	584	0	0	0	0	0	0	0	0	0	0	0
3	1991	3812	11614	8493	1502	418	0	0	0	0	0	0					

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3	1992	507	5813	1424	122	256	0	0	0	0	0	0
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	0	0	0	0	0							
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3	1996	0	0	0	0	0	0	0	0	0	0	0
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3	1997	0	0	0	0	0	0	0	0	0	0	0
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3	2005	0	0	0	0	0	0	0	0	0	0	0
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	0	0	0	0	0							
4	1980	161	4119	290	34	0	0	0	0	0	0	0
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4	1981	1702	1484	409	7	0	0	0	0	0	0	0
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4	1982	117	3009	619	50	0	0	0	0	0	0	0
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4	1983	344	2344	813	30	0	0	0	0	0	0	0
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4	1984	192	5543	1085	54	0	0	0	0	0	0	0
	0	0	0	0	0							

4	1985 0	198 0	5267 0	5482 0	0 0	0	0	0	0	0	0	0
4	1986 0	383 0	5764 0	5250 0	20 0	0	0	0	0	0	0	0
4	1987 0	889 0	12228 0	6631 0	264 0	0	0	0	0	0	0	0
4	1988 0	0 0	8903 0	7322 0	0 0	0	0	0	0	0	0	0
4	1989 0	66 0	12589 0	1186 0	246 0	0	0	0	0	0	0	0
4	1990 0	919 0	2066 0	13030 0	140 0	0	0	0	0	0	0	0
4	1991 0	1634 0	11614 0	8493 0	153 0	0	0	0	0	0	0	0
4	1992 0	429 0	5813 0	1424 0	0 0	0	0	0	0	0	0	0
4	1993 0	121 0	1016 0	3660 0	650 0	0	0	0	0	0	0	0
4	1994 0	37 0	645 0	913 0	257 0	0	0	0	0	0	0	0
4	1995 0	283 0	1288 0	2957 0	340 0	0	0	0	0	0	0	0
4	1996 0	184 0	9166 0	1104 0	458 0	0	0	0	0	0	0	0
4	1997 0	38 0	1095 0	6174 0	112 0	0	0	0	0	0	0	0
4	1998 0	80 0	880 0	3231 0	674 0	0	0	0	0	0	0	0
4	1999 0	29 0	507 0	1805 0	339 0	0	0	0	0	0	0	0
4	2000 0	0 0	249 0	572 0	47 0	0	0	0	0	0	0	0
4	2001 0	37 0	327 0	2345 0	571 0	0	0	0	0	0	0	0
4	2002 0	549 0	5477 0	4026 0	235 0	0	0	0	0	0	0	0
4	2003 0	121 0	2085 0	3481 0	347 0	0	0	0	0	0	0	0
4	2004 0	518 0	2631 0	6704 0	44 0	0	0	0	0	0	0	0
4	2005 0	372 0	4819 0	1866 0	582 0	0	0	0	0	0	0	0
4	2006 0	129 0	436 0	859 0	105 0	0	0	0	0	0	0	0
4	2007 0	9 0	210 0	3958 0	1755 0	0	0	0	0	0	0	0
4	2008 0	19 0	684 0	1994 0	118 0	0	0	0	0	0	0	0
4	2009 0	26 0	191 0	1905 0	123 0	0	0	0	0	0	0	0
4	2010 0	12 0	990 0	734 0	71 0	0	0	0	0	0	0	0
4	2011 0	0 0	393 0	1443 0	456 0	0	0	0	0	0	0	0
4	2012 0	25 0	385 0	1787 0	401 0	0	0	0	0	0	0	0
4	2013 0	4 0	265 0	550 0	329 0	0	0	0	0	0	0	0
5	1970 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0
5	1971 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0
5	1972 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0
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5	1976 0	0 0	0 0	0 0	0 0	0	0	0	0	0	0	0
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5	1980	0	0	0	126	67	1	0	0	0	0	0
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5	1982	0	0	0	67	50	0	0	0	0	0	0
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5	1983	0	0	0	85	38	0	0	0	0	0	0
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5	1984	0	0	0	246	186	0	0	0	0	0	0
	0	0	0	0	0							
5	1985	0	0	0	85	50	0	0	0	0	0	0
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5	1986	0	0	0	659	48	0	0	0	0	0	0
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5	1987	0	0	581	1929	669	0	0	0	0	0	0
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5	1992	0	0	0	122	256	0	0	0	0	0	0
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5	1995	0	0	0	1495	2171	0	0	0	0	0	0
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5	1999	0	0	0	664	514	0	0	0	0	0	0
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5	2000	0	0	0	331	256	2	0	0	0	0	0
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5	2001	0	0	0	3660	768	0	0	0	0	0	0
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5	2006	0	0	0	931	1942	9	0	0	0	0	0
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5	2007	0	0	0	5076	1173	1	0	0	0	0	0
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5	2008	0	0	0	1099	4555	6	0	0	0	0	0
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5	2009	0	0	0	864	722	4	0	0	0	0	0
	0	0	0	0	0							
5	2010	0	0	0	1393	410	0	0	0	0	0	0
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5	2013	0	0	0	920	167	0	0	0	0	0	0
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	0	0	0	0	0							
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	91	143	185	141	440							
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	130	168	168	143	307							
7	1985	0	0	0	0	0	0	0	0	9	54	70
	82	145	136	164	288							
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	51	36	55	54	135							
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	40	33	45	39	181							
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9	1981	0	0	0	0	0	0	0	1	45	139	180
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9	1982	0	0	0	0	0	0	0	11	56	101	210
	157	135	42	34	198							
9	1983	0	0	0	0	0	0	0	37	127	82	110
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	62	48	46	47	207							

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	112	76	89	105	251							
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	117	128	119	84	352							
9	1993	0	0	0	0	0	0	0	104	124	200	136
	78	70	75	73	252							
9	1994	0	0	0	0	0	0	0	296	526	163	122
	192	107	115	76	199							
9	1995	0	0	0	0	0	0	0	147	232	361	258
	163	138	144	157	450							
9	1996	0	0	0	0	0	0	0	620	253	121	139
	167	127	111	98	262							
9	1997	0	0	0	0	0	0	0	448	658	406	190
	210	278	277	233	477							
9	1998	0	0	0	0	0	0	0	280	787	243	232
	155	188	225	198	392							
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9	2000	0	0	0	0	0	0	0	37	204	232	345
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9	2001	0	0	0	0	0	0	0	308	122	185	455
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	79	80	61	38	123							
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	179	169	116	87	244							
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10	1971	13	244	31	132	89	272	830	1525	1114	699	679
	538	393	229	112	240							
10	1972	27	49	52	15	131	50	41	94	327	188	46
	66	67	60	24	108							
10	1973	84	427	543	458	666	250	218	572	1077	670	170
	276	301	261	86	237							
10	1974	104	2549	2669	1556	494	97	449	599	517	493	439
	419	388	247	257	324							
10	1975	2	37	54	76	187	20	16	159	335	614	1146
	910	855	821	842	1837							
10	1976	175	1176	5491	2375	2502	982	173	104	617	570	346
	676	1462	1817	1664	4157							
10	1977	58	411	5173	9269	2230	1777	1702	394	152	239	208
	331	467	929	1351	5898							
10	1978	79	187	1392	2719	2454	2611	967	385	309	169	172
	316	453	460	906	6193							
10	1979	47	332	1410	1209	669	1537	2513	1713	510	299	296
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10	1980	134	477	1753	2661	1222	1322	2257	4582	3070	768	484
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10	1981	354	1453	8404	3335	4345	3033	2514	2043	1679	1005	439
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10	1983	6	120	2151	577	550	774	560	922	529	365	223

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10	1984	56	1523	602	1189	1805	1481	767	352	308	277	179
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10	1985	35	128	6653	2013	3463	3695	1740	590	358	245	155
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	39	55	38	28	73							
10	1987	7	346	1436	1959	3020	3437	1023	990	720	621	165
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10	1989	0	177	129	461	633	749	730	764	519	205	90
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	165	92	22	7	109							
10	1992	10	14	255	284	743	803	525	811	843	201	139
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10	1993	0	10	323	861	1009	1283	1183	490	540	444	188
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	62	23	9	0	5							
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	236	148	85	115	245							
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	80	32	29	15	58							
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	238	217	68	73	103							
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	162	159	98	53	111							
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	80	78	51	47	79							
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	328	212	124	76	86							
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11	1971	13	244	31	132	89	272	830	1525	1114	699	679
	538	393	229	112	240							
11	1972	27	49	52	15	131	50	41	94	327	188	46
	66	67	60	24	108							
11	1973	84	427	543	458	666	250	218	572	1077	670	170
	276	301	261	86	237							
11	1974	104	2549	2669	1556	494	97	449	599	517	493	439
	419	388	247	257	324							
11	1975	2	37	54	76	187	20	16	159	335	614	1146
	910	855	821	842	1837							
11	1976	175	1176	5491	2375	2502	982	173	104	617	570	346
	676	1462	1817	1664	4157							

11	1977	58	411	5173	9269	2230	1777	1702	394	152	239	208
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11	1978	79	187	1392	2719	2454	2611	967	385	309	169	172
	316	453	460	906	6193							
11	1979	47	332	1410	1209	669	1537	2513	1713	510	299	296
	390	650	910	1105	4976							
11	1980	134	477	1753	2661	1222	1322	2257	4582	3070	768	484
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11	1981	354	1453	8404	3335	4345	3033	2514	2043	1679	1005	439
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11	1984	56	1523	602	1189	1805	1481	767	352	308	277	179
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11	1987	7	346	1436	1959	3020	3437	1023	990	720	621	165
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11	1988	56	260	3309	3227	2768	2413	2486	1133	741	332	159
	80	84	23	56	134							
11	1989	0	177	129	461	633	749	730	764	519	205	90
	72	64	42	18	95							
11	1990	0	92	698	329	1225	1187	740	574	599	388	211
	73	73	9	23	103							
11	1991	0	148	461	822	1385	1179	1370	908	421	302	184
	165	92	22	7	109							
11	1992	10	14	255	284	743	803	525	811	843	201	139
	74	80	63	38	87							
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11	2001	24	6	15	29	101	214	812	842	296	269	172
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11	2004	0	0	0	231	1378	2208	1047	488	200	238	70
	85	15	46	1	15							
11	2005	0	40	590	606	641	396	500	580	304	108	176
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11	2006	0	128	271	542	328	1141	586	549	905	563	271
	236	148	85	115	245							
11	2007	0	3	2430	1895	666	604	365	214	153	66	70
	80	32	29	15	58							
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	238	217	68	73	103							
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15	1990	0	0	0	0	0	0	0	0	0	0	0
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15	1991	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1992	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1993	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1994	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1995	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1996	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1997	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1998	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	1999	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2000	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2001	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2002	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2003	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2004	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2005	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2006	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2007	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2008	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2009	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2010	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2011	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2012	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
15	2013	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1970	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1971	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1972	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1973	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1974	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1975	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1976	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1977	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1978	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1979	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1980	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							
16	1981	1	1	1	0	0	0	0	0	0	0	0
	0	0	0	0	0							

16 1982 1 1 1 0 0 0 0 0 0 0 0
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16 1983 1 1 1 0 0 0 0 0 0 0 0
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16 1988 1 1 1 0 0 0 0 0 0 0 0
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16 1990 1 1 1 0 0 0 0 0 0 0 0
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16 1991 1 1 1 0 0 0 0 0 0 0 0
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16 1994 1 1 1 0 0 0 0 0 0 0 0
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16 1996 1 1 1 0 0 0 0 0 0 0 0
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16 1998 1 1 1 0 0 0 0 0 0 0 0
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16 2000 1 1 1 0 0 0 0 0 0 0 0
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16 2004 1 1 1 0 0 0 0 0 0 0 0
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16 2006 1 1 1 0 0 0 0 0 0 0 0
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16 2007 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0
16 2008 1 1 1 0 0 0 0 0 0 0 0
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16 2009 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0
16 2010 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0
16 2011 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0
16 2012 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0
16 2013 1 1 1 0 0 0 0 0 0 0 0
0 0 0 0 0
-1 end index selectivities

#==

NOW ENTER IN THE WEIGHTS AT AGE FOR THE INDICES OF ABUNDANCE (row=year, col=age)

#==

13	1970	3.20	8.32	16.89	35.53	47.69	67.01	85.42	113.30	145.53	154.62
	173.72	198.66	223.25	247.98	264.63	327.72					
13	1971	3.48	8.30	20.89	31.44	51.20	69.88	86.65	106.89	126.82	149.12
	172.48	198.50	224.12	248.76	272.98	317.23					
13	1972	4.39	9.67	19.16	37.67	51.60	62.39	90.02	112.49	129.30	149.55
	176.77	202.21	227.65	246.89	271.55	330.94					
13	1973	3.74	8.86	20.70	38.19	47.93	69.19	89.03	115.65	134.10	152.95
	179.96	208.23	230.76	249.75	277.68	333.91					
13	1974	3.64	10.04	17.09	34.89	49.38	64.21	87.67	101.47	131.83	151.27
	169.97	196.81	219.92	247.50	263.25	323.11					
13	1975	3.86	8.63	22.42	32.61	47.14	66.90	83.76	110.46	134.72	152.31
	168.00	193.83	216.42	243.31	264.63	321.65					
13	1976	4.01	10.20	18.75	32.08	45.09	64.23	91.77	113.95	144.21	160.36
	176.03	195.67	218.10	236.65	256.84	322.16					
13	1977	4.77	10.26	20.48	33.84	45.65	63.04	81.33	102.93	128.31	150.47
	172.98	195.58	218.15	241.28	258.37	325.90					
13	1978	5.14	10.94	21.48	30.99	47.02	64.38	83.55	108.92	138.73	163.12
	185.70	200.09	219.03	242.24	259.19	339.25					
13	1979	5.29	11.23	21.63	35.67	44.23	65.72	84.76	108.11	133.88	160.37
	183.17	202.12	220.03	239.99	260.03	337.85					
13	1980	5.03	12.21	20.70	32.53	46.78	69.48	91.69	112.92	136.22	167.63
	191.76	215.43	237.19	255.17	267.43	343.01					
13	1981	5.57	11.05	21.53	32.18	45.47	65.46	85.67	108.94	133.87	158.13
	183.98	205.00	226.06	240.89	259.84	371.83					
13	1982	4.12	10.81	20.79	31.57	52.63	68.14	89.17	113.21	139.44	160.58
	186.81	208.75	233.71	250.95	271.81	392.38					
13	1983	3.99	10.10	19.59	33.63	50.48	66.93	91.45	115.44	140.46	163.89
	188.31	213.90	236.55	257.03	279.26	377.54					
13	1984	5.27	11.31	22.88	35.72	50.98	74.31	92.85	114.86	139.74	162.14
	186.85	208.02	234.01	262.67	281.77	382.24					
13	1985	4.57	10.21	17.17	31.22	43.60	61.94	79.63	101.58	125.71	152.56
	178.75	201.84	223.01	246.50	265.01	337.83					
13	1986	5.28	10.27	19.68	38.09	50.58	70.12	91.86	114.91	137.95	162.73
	182.25	204.62	229.21	253.11	278.64	350.40					
13	1987	5.08	9.82	22.26	36.63	49.94	67.19	85.61	109.71	130.38	155.50
	180.41	202.51	230.00	258.81	279.73	349.06					
13	1988	3.87	11.19	20.06	34.56	49.80	67.74	86.98	110.54	132.99	157.72
	182.83	208.51	232.25	251.74	280.53	354.36					
13	1989	4.53	11.06	21.45	35.96	47.78	68.37	89.97	111.91	133.99	160.88
	182.93	205.20	229.78	254.88	277.00	356.31					
13	1990	5.24	12.23	18.84	35.12	47.04	66.41	85.78	112.04	138.01	162.77
	185.16	206.44	231.34	253.26	278.50	347.01					
13	1991	5.38	13.46	19.63	36.89	53.42	70.16	93.31	114.29	142.16	166.12
	184.45	205.67	232.92	255.70	277.58	348.73					
13	1992	5.94	12.72	19.04	35.88	50.11	71.08	88.61	110.29	134.87	160.84
	183.60	205.63	231.70	252.07	275.39	347.62					
13	1993	5.10	11.57	23.82	33.36	51.24	66.94	89.28	110.87	135.71	157.85
	182.17	204.81	227.22	250.52	275.46	364.06					
13	1994	4.71	12.03	22.14	31.87	45.52	62.76	82.88	109.25	132.38	157.32
	183.82	203.76	226.70	249.73	269.64	350.71					
13	1995	4.90	13.62	22.44	35.13	48.60	71.02	89.57	109.22	137.50	160.01
	182.17	204.74	228.28	251.22	273.36	369.78					
13	1996	5.15	11.08	22.82	34.79	48.72	69.94	92.56	113.19	137.70	159.85
	187.90	209.75	234.84	257.75	282.53	361.90					
13	1997	5.05	12.66	20.26	36.31	51.22	68.43	91.24	112.02	135.70	157.20
	183.61	207.67	233.38	257.23	276.85	356.01					
13	1998	4.99	11.75	20.51	32.71	52.63	68.77	90.94	116.61	139.29	162.02
	182.95	207.52	233.18	254.40	275.06	352.47					
13	1999	5.42	11.22	21.77	35.53	53.96	71.60	93.71	113.88	136.24	159.02
	184.11	206.73	230.95	254.11	276.93	355.41					
13	2000	4.81	11.79	19.09	34.07	46.49	73.15	90.76	110.77	138.97	159.48
	188.69	211.82	236.15	264.28	284.54	376.50					
13	2001	4.72	12.80	22.48	33.89	49.13	68.23	95.00	116.01	141.83	166.01
	190.73	215.14	242.84	265.54	289.89	352.62					
13	2002	6.33	10.93	19.91	35.15	48.00	63.66	90.69	114.11	137.95	160.88
	186.75	209.61	238.08	265.79	284.83	352.40					
13	2003	5.66	11.51	21.60	34.02	50.70	69.17	92.12	115.31	137.43	158.80
	184.14	210.24	241.65	265.21	286.90	342.31					
13	2004	6.33	11.94	21.93	35.51	46.15	64.95	89.10	111.40	134.73	158.94
	184.57	210.08	230.56	259.66	277.51	344.93					
13	2005	5.38	9.80	19.79	30.70	47.55	62.27	82.59	105.75	132.23	160.12
	183.99	207.86	231.99	254.63	276.59	349.01					
13	2006	5.52	12.63	17.81	33.27	46.90	64.04	84.60	109.63	128.02	155.10
	182.21	206.80	231.96	255.90	269.42	348.34					
13	2007	4.51	11.76	22.41	30.40	49.64	63.54	82.38	111.84	136.63	162.07

186.44 211.78 237.65 262.72 278.79 365.83
13 2008 4.56 11.92 21.83 36.66 49.11 70.13 93.26 114.70 138.27 157.86
179.43 207.84 231.34 259.44 278.87 377.80
13 2009 5.39 13.24 21.76 34.43 51.29 69.43 83.92 112.09 133.36 156.42
180.31 207.54 235.55 260.51 277.31 372.46
13 2010 5.12 11.01 22.02 35.60 49.02 67.91 89.40 112.96 133.56 157.33
182.60 210.61 237.15 264.11 286.54 366.28
13 2011 4.88 10.77 23.04 31.74 48.20 63.95 87.78 110.99 135.13 159.59
184.86 211.25 239.99 263.70 286.75 361.16
13 2012 5.19 13.07 21.96 34.06 47.77 73.65 89.05 114.08 137.19 163.41
185.83 212.36 236.08 262.05 283.80 359.29
13 2013 5.24 12.22 22.48 32.68 47.83 64.47 90.57 111.06 133.01 161.57
188.18 216.72 241.04 266.07 282.79 362.64
-1

#==

NOW ENTER IN THE FECUNDITY AT AGE FOR THE SPAWNING STOCK BIOMASS (row=year, col=age)

#==

Year Age 1 Age 2 Age 3 Age 4 Age 5 Age 6 Age 7 Age 8 Age 9 Age 10 Age
11 Age 12 Age 13 Age 14 Age 15 Age 16
1970 3.20 8.32 16.89 35.53 47.69 67.01 85.42 113.30 145.53 154.62 173.72
198.66 223.25 247.98 264.63 327.72
1971 3.48 8.30 20.89 31.44 51.20 69.88 86.65 106.89 126.82 149.12 172.48
198.50 224.12 248.76 272.98 317.23
1972 4.39 9.67 19.16 37.67 51.60 62.39 90.02 112.49 129.30 149.55 176.77
202.21 227.65 246.89 271.55 330.94
1973 3.74 8.86 20.70 38.19 47.93 69.19 89.03 115.65 134.10 152.95 179.96
208.23 230.76 249.75 277.68 333.91
1974 3.64 10.04 17.09 34.89 49.38 64.21 87.67 101.47 131.83 151.27 169.97
196.81 219.92 247.50 263.25 323.11
1975 3.86 8.63 22.42 32.61 47.14 66.90 83.76 110.46 134.72 152.31 168.00
193.83 216.42 243.31 264.63 321.65
1976 4.01 10.20 18.75 32.08 45.09 64.23 91.77 113.95 144.21 160.36 176.03
195.67 218.10 236.65 256.84 322.16
1977 4.77 10.26 20.48 33.84 45.65 63.04 81.33 102.93 128.31 150.47 172.98
195.58 218.15 241.28 258.37 325.90
1978 5.14 10.94 21.48 30.99 47.02 64.38 83.55 108.92 138.73 163.12 185.70
200.09 219.03 242.24 259.19 339.25
1979 5.29 11.23 21.63 35.67 44.23 65.72 84.76 108.11 133.88 160.37 183.17
202.12 220.03 239.99 260.03 337.85
1980 5.03 12.21 20.70 32.53 46.78 69.48 91.69 112.92 136.22 167.63 191.76
215.43 237.19 255.17 267.43 343.01
1981 5.57 11.05 21.53 32.18 45.47 65.46 85.67 108.94 133.87 158.13 183.98
205.00 226.06 240.89 259.84 371.83
1982 4.12 10.81 20.79 31.57 52.63 68.14 89.17 113.21 139.44 160.58 186.81
208.75 233.71 250.95 271.81 392.38
1983 3.99 10.10 19.59 33.63 50.48 66.93 91.45 115.44 140.46 163.89 188.31
213.90 236.55 257.03 279.26 377.54
1984 5.27 11.31 22.88 35.72 50.98 74.31 92.85 114.86 139.74 162.14 186.85
208.02 234.01 262.67 281.77 382.24
1985 4.57 10.21 17.17 31.22 43.60 61.94 79.63 101.58 125.71 152.56 178.75
201.84 223.01 246.50 265.01 337.83
1986 5.28 10.27 19.68 38.09 50.58 70.12 91.86 114.91 137.95 162.73 182.25
204.62 229.21 253.11 278.64 350.40
1987 5.08 9.82 22.26 36.63 49.94 67.19 85.61 109.71 130.38 155.50 180.41
202.51 230.00 258.81 279.73 349.06
1988 3.87 11.19 20.06 34.56 49.80 67.74 86.98 110.54 132.99 157.72 182.83
208.51 232.25 251.74 280.53 354.36
1989 4.53 11.06 21.45 35.96 47.78 68.37 89.97 111.91 133.99 160.88 182.93
205.20 229.78 254.88 277.00 356.31
1990 5.24 12.23 18.84 35.12 47.04 66.41 85.78 112.04 138.01 162.77 185.16
206.44 231.34 253.26 278.50 347.01
1991 5.38 13.46 19.63 36.89 53.42 70.16 93.31 114.29 142.16 166.12 184.45
205.67 232.92 255.70 277.58 348.73
1992 5.94 12.72 19.04 35.88 50.11 71.08 88.61 110.29 134.87 160.84 183.60
205.63 231.70 252.07 275.39 347.62
1993 5.10 11.57 23.82 33.36 51.24 66.94 89.28 110.87 135.71 157.85 182.17
204.81 227.22 250.52 275.46 364.06
1994 4.71 12.03 22.14 31.87 45.52 62.76 82.88 109.25 132.38 157.32 183.82

```
     203.76   226.70   249.73   269.64   350.71
1995 4.90     13.62    22.44    35.13    48.60    71.02   89.57   109.22   137.50   160.01   182.17
     204.74   228.28   251.22   273.36   369.78
1996 5.15     11.08    22.82    34.79    48.72    69.94   92.56   113.19   137.70   159.85   187.90
     209.75   234.84   257.75   282.53   361.90
1997 5.05     12.66    20.26    36.31    51.22    68.43   91.24   112.02   135.70   157.20   183.61
     207.67   233.38   257.23   276.85   356.01
1998 4.99     11.75    20.51    32.71    52.63    68.77   90.94   116.61   139.29   162.02   182.95
     207.52   233.18   254.40   275.06   352.47
1999 5.42     11.22    21.77    35.53    53.96    71.60   93.71   113.88   136.24   159.02   184.11
     206.73   230.95   254.11   276.93   355.41
2000 4.81     11.79    19.09    34.07    46.49    73.15   90.76   110.77   138.97   159.48   188.69
     211.82   236.15   264.28   284.54   376.50
2001 4.72     12.80    22.48    33.89    49.13    68.23   95.00   116.01   141.83   166.01   190.73
     215.14   242.84   265.54   289.89   352.62
2002 6.33     10.93    19.91    35.15    48.00    63.66   90.69   114.11   137.95   160.88   186.75
     209.61   238.08   265.79   284.83   352.40
2003 5.66     11.51    21.60    34.02    50.70    69.17   92.12   115.31   137.43   158.80   184.14
     210.24   241.65   265.21   286.90   342.31
2004 6.33     11.94    21.93    35.51    46.15    64.95   89.10   111.40   134.73   158.94   184.57
     210.08   230.56   259.66   277.51   344.93
2005 5.38     9.80     19.79    30.70    47.55    62.27   82.59   105.75   132.23   160.12   183.99
     207.86   231.99   254.63   276.59   349.01
2006 5.52     12.63    17.81    33.27    46.90    64.04   84.60   109.63   128.02   155.10   182.21
     206.80   231.96   255.90   269.42   348.34
2007 4.51     11.76    22.41    30.40    49.64    63.54   82.38   111.84   136.63   162.07   186.44
     211.78   237.65   262.72   278.79   365.83
2008 4.56     11.92    21.83    36.66    49.11    70.13   93.26   114.70   138.27   157.86   179.43
     207.84   231.34   259.44   278.87   377.80
2009 5.39     13.24    21.76    34.43    51.29    69.43   83.92   112.09   133.36   156.42   180.31
     207.54   235.55   260.51   277.31   372.46
2010 5.12     11.01    22.02    35.60    49.02    67.91   89.40   112.96   133.56   157.33   182.60
     210.61   237.15   264.11   286.54   366.28
2011 4.88     10.77    23.04    31.74    48.20    63.95   87.78   110.99   135.13   159.59   184.86
     211.25   239.99   263.70   286.75   361.16
2012 5.19     13.07    21.96    34.06    47.77    73.65   89.05   114.08   137.19   163.41   185.83
     212.36   236.08   262.05   283.80   359.29
2013 5.24     12.22    22.48    32.68    47.83    64.47   90.57   111.06   133.01   161.57   188.18
     216.72   241.04   266.07   282.79   362.64
-1

@end of the data input file
```

C. VPA 2-Box Parameter File

```
#-----------------------------------------------------------------------------
# PARAMETER FILE FOR PROGRAM VPA_2BOX, Version 3.0
#          The specifications are entered in the order indicated
#          by the existing comments. Additional comments must be preceded by a # symbol
#          in the first column, otherwise the line is perceived as free format input.
#
#          Each parameter in the model must have its own specification line unless a $
#          symbol is placed in the first column followed by an integer value (n), which
#          tells the program that the next n parameters abide by the same specifications.
#
#          The format of each specification line is as follows
#
#          column 1
#          |  number of parameters to which these specifications apply
#          |  |  lower bound
#          |  |  |    best estimate (prior expectation)
#          |  |  |    |    upper bound
#          |  |  |    |    |    method of estimation
#          |  |  |    |    |    |    standard deviation of prior
#          $  5  0    1.2  2.0  1    0.1
#
#   The methods of estimation include:
#   0       set equal to the value given for the best estimate (a fixed constant)
#   1       estimate in the usual frequentist (non-Bayesian) sense
#   2(0.1)  estimate as a random deviation from the previous parameter
```

```
#     3(0.2)     estimate as a random deviation from the previous constant or type 1 parameter
#     4(0.3)     estimate as random deviation from the best estimate.
#     -0.1       set equal to the value of the closest previous estimated parameter
#     -n         set equal to the value of the nth parameter in the list (estimated or not)
#-----------------------------------------------------------------------------
#===============================================================================
==
# TERMINAL F PARAMETERS: (lower bound, best estimate, upper bound, indicator, reference age)
#     Note 1: the method indicator for the terminal F parameters is unique in that if it is
#     zero but the best estimate is set to a value < 9, then the 'best estimate'
#     is taken to be the vulnerability relative to the reference age in the last
#     (fifth) column.  Otherwise these parameters are treated the same as the
#     others below and the fifth column is the standard deviation of the prior.
#     Note 2: the last age is represented by an F-ratio parameter (below), so the number
#     of entries here should be 1 fewer than the number of ages
#-----------------------------------------------------------------------------
 0          9869               5000000       1             0.1  Age 1
 0          31233              5000000       1             0.1  Age 2
 0          70437              5000000       1             0.1  Age 3
 0          17391              5000000       1             0.1  Age 4
 0          14446              1000000       1             0.1  Age 5
 0          27115              1000000       1             0.1  Age 6
 0          22619              1000000       1             0.1  Age 7
 0          6716               100000        1             0.1  Age 8
 0          23940              100000        1             0.1  Age 9
 0          23940              100000        1             0.1  Age 10
 0          23940              100000        1             0.1  Age 11
 0          10000              100000        1             0.1  Age 12
 0          9000               100000        1             0.1  Age 13
 0          8500               100000        1             0.1  Age 14
 0          8000               100000        1             0.1  Age 15
#===============================================================================
==
# F-RATIO PARAMETERS F{oldest}/F{oldest-1} one parameter (set of specifications) for each year
#-----------------------------------------------------------------------------
$ 44   0.00  1.000   4.0          0               0.2
#===============================================================================
==
# NATURAL MORTALITY PARAMETERS: one parameter (set of specifications) for each age
#-----------------------------------------------------------------------------
$ 16 0  0.14 1.0  0  0.1
#===============================================================================
==
# MIXING PARAMETERS: one parameter (set of specifications) for each age
#-----------------------------------------------------------------------------
$ 16 0  0.0  1.0  0  .1
#===============================================================================
==
# STOCK-RECRUITMENT PARAMETERS: five parameters so 5 sets of specifications
#-----------------------------------------------------------------------------
 0  220982.5   1.D20   0  0.4                          maximum recruitment
 0  16441.44   1.D20   0  0.0                          spawning biomass scaling parameter
 0  0.000              0.9           0  0.0                          extra parameter (not used yet)
 0  0.5       1        0  0                            autocorrelation parameter
 0  10        1000     0  0   (0.3464)    variance of random component (discounting the autocorrelation)
#===============================================================================
==
# VARIANCE SCALING PARAMETER (lower bound, best estimate, upper bound, indicator, std. dev.)
#   this parameter scales the input variance up or down as desired
#   In principal, if you estimate this you should obtain more accurate estimates of the
```

```
#   magnitude of the parameter variances-- all other things being equal.
#-----------------------------------------------------------------------------
$ 1  0  0.4  1.0  1    .1
$ 15 0  0.4  1.0  -.1  .1
@ END PARAMETER INPUT
```

D. VPA-2Box Base Model Report File

****

VPA-2BOX

SUMMARY STATISTICS AND DIAGNOSTIC OUTPUT

****

BFT West 1970 to 2013 Continuity 16+
9:24, 26 September 2014

===

Total objective function = 0.67
(with constants) = 236.84
Number of parameters (P) = 28
Number of data points (D)= 257
AIC : 2*objective+2P = 529.68
AICc: 2*objective+2P(...)= 536.80
BIC : 2*objective+Plog(D)= 629.05
Chi-square discrepancy = 233.10

Loglikelihoods (deviance)= 2.80 (257.02)
effort data = 2.80 (257.02)

Log-posteriors = 0.00
catchability = 0.00
f-ratio = 0.00
natural mortality = 0.00
mixing coeff. = 0.00

Constraints = -3.47
terminal F = -3.47
stock-rec./sex ratio = 0.00

Out of bounds penalty = 0.00

===

TABLE 1. FISHING MORTALITY RATE FOR Western Bluefin Tuna Assessment

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1970	0.190	0.827	0.908	0.517	0.189	0.034	0.013	0.004	0.001	0.006	0.018	0.015	0.023	0.031	0.037	0.037
1971	0.230	0.958	0.774	0.962	0.021	0.032	0.038	0.055	0.034	0.018	0.023	0.040	0.043	0.045	0.049	0.049
1972	0.191	0.634	0.529	0.094	0.175	0.066	0.004	0.016	0.018	0.010	0.005	0.014	0.043	0.053	0.046	0.046
1973	0.037	0.498	0.373	0.152	0.107	0.146	0.025	0.033	0.050	0.039	0.010	0.016	0.025	0.050	0.035	0.035
1974	0.137	0.185	0.231	0.103	0.100	0.087	0.049	0.058	0.036	0.029	0.049	0.024	0.023	0.098	0.128	0.128
1975	0.330	0.589	0.080	0.214	0.020	0.029	0.021	0.023	0.040	0.057	0.074	0.073	0.060	0.054		

0.085 0.085
1976 0.045 0.226 0.596 0.038 0.059 0.028 0.010 0.010 0.077 0.078 0.043 0.059 0.160 0.154
0.122 0.122
1977 0.014 0.237 0.145 0.466 0.149 0.071 0.083 0.031 0.031 0.083 0.140 0.107 0.072 0.137
0.154 0.154
1978 0.065 0.124 0.305 0.103 0.222 0.187 0.045 0.017 0.027 0.030 0.035 0.066 0.074 0.062
0.189 0.189
1979 0.031 0.158 0.254 0.205 0.285 0.067 0.096 0.077 0.025 0.028 0.051 0.093 0.190 0.208
0.213 0.213
1980 0.044 0.229 0.205 0.191 0.135 0.062 0.104 0.211 0.177 0.053 0.057 0.104 0.165 0.241
0.294 0.294
1981 0.087 0.169 0.362 0.103 0.186 0.150 0.133 0.126 0.141 0.174 0.094 0.133 0.197 0.282
0.327 0.327
1982 0.048 0.063 0.033 0.016 0.008 0.019 0.027 0.025 0.021 0.039 0.060 0.050 0.071 0.075
0.094 0.094
1983 0.036 0.039 0.065 0.020 0.022 0.034 0.035 0.073 0.073 0.066 0.065 0.065 0.076 0.139
0.190 0.190
1984 0.013 0.093 0.032 0.038 0.062 0.068 0.044 0.026 0.042 0.061 0.075 0.088 0.094 0.111
0.144 0.144
1985 0.008 0.075 0.208 0.049 0.112 0.154 0.106 0.041 0.033 0.042 0.052 0.081 0.126 0.143
0.184 0.184
1986 0.010 0.077 0.114 0.066 0.040 0.046 0.058 0.044 0.029 0.031 0.035 0.051 0.101 0.132
0.214 0.214
1987 0.028 0.165 0.147 0.102 0.109 0.129 0.059 0.082 0.081 0.085 0.050 0.057 0.075 0.104
0.129 0.129
1988 0.039 0.138 0.201 0.083 0.096 0.121 0.142 0.093 0.083 0.096 0.093 0.075 0.094 0.112
0.145 0.145
1989 0.007 0.127 0.029 0.075 0.068 0.052 0.075 0.129 0.123 0.108 0.110 0.119 0.109 0.143
0.163 0.163
1990 0.029 0.037 0.241 0.040 0.066 0.071 0.049 0.075 0.128 0.154 0.113 0.116 0.104 0.102
0.158 0.158
1991 0.048 0.170 0.131 0.056 0.052 0.054 0.075 0.091 0.112 0.150 0.149 0.151 0.140 0.128
0.137 0.137
1992 0.008 0.087 0.030 0.017 0.026 0.043 0.038 0.084 0.116 0.086 0.127 0.178 0.193 0.201
0.139 0.139
1993 0.006 0.016 0.078 0.064 0.043 0.037 0.064 0.065 0.113 0.145 0.097 0.100 0.114 0.110
0.117 0.117
1994 0.025 0.012 0.022 0.047 0.057 0.042 0.035 0.073 0.151 0.089 0.108 0.118 0.105 0.125
0.100 0.100
1995 0.009 0.019 0.062 0.063 0.076 0.121 0.036 0.022 0.052 0.143 0.106 0.093 0.097 0.115
0.152 0.152
1996 0.006 0.107 0.028 0.112 0.087 0.036 0.049 0.077 0.035 0.045 0.120 0.122 0.126 0.123
0.163 0.163
1997 0.004 0.015 0.093 0.019 0.040 0.048 0.053 0.079 0.077 0.059 0.052 0.092 0.129 0.168
0.176 0.176
1998 0.004 0.015 0.056 0.063 0.015 0.041 0.029 0.068 0.129 0.137 0.087 0.076 0.133 0.172
0.165 0.165
1999 0.001 0.007 0.038 0.036 0.039 0.022 0.032 0.085 0.083 0.132 0.131 0.138 0.147 0.193
0.186 0.186
2000 0.001 0.003 0.015 0.027 0.086 0.084 0.054 0.068 0.074 0.089 0.099 0.103 0.118 0.148
0.178 0.178
2001 0.017 0.005 0.033 0.074 0.027 0.038 0.058 0.090 0.046 0.069 0.112 0.163 0.151 0.152

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
															0.183	0.183
2002	0.009	0.079	0.066	0.076	0.098	0.043	0.034	0.123	0.132	0.124	0.101	0.115	0.191	0.167	0.185	0.185
2003	0.002	0.032	0.080	0.073	0.038	0.039	0.013	0.055	0.116	0.110	0.086	0.050	0.090	0.131	0.138	0.138
2004	0.006	0.019	0.102	0.056	0.068	0.072	0.046	0.070	0.051	0.069	0.065	0.073	0.067	0.065	0.098	0.098
2005	0.012	0.041	0.021	0.047	0.028	0.025	0.021	0.037	0.047	0.043	0.084	0.111	0.103	0.071	0.097	0.097
2006	0.003	0.013	0.012	0.017	0.054	0.063	0.038	0.038	0.063	0.087	0.068	0.082	0.077	0.079	0.110	0.110
2007	0.001	0.004	0.167	0.114	0.025	0.048	0.046	0.028	0.024	0.019	0.040	0.036	0.044	0.044	0.062	0.062
2008	0.001	0.010	0.038	0.068	0.100	0.022	0.058	0.086	0.060	0.043	0.044	0.042	0.040	0.042	0.073	0.073
2009	0.001	0.004	0.033	0.024	0.039	0.090	0.025	0.028	0.057	0.054	0.042	0.037	0.041	0.050	0.077	0.077
2010	0.001	0.021	0.016	0.033	0.015	0.030	0.017	0.036	0.034	0.071	0.083	0.045	0.041	0.065	0.075	0.075
2011	0.000	0.009	0.036	0.036	0.044	0.035	0.031	0.081	0.050	0.035	0.054	0.057	0.047	0.049	0.063	0.063
2012	0.001	0.013	0.034	0.032	0.012	0.015	0.023	0.048	0.044	0.045	0.077	0.050	0.056	0.041	0.057	0.057
2013	0.001	0.002	0.021	0.027	0.006	0.017	0.018	0.037	0.048	0.025	0.031	0.065	0.065	0.048	0.044	0.044

==

TABLE 2. ABUNDANCE AT THE BEGINNING OF THE YEAR [BY AREA] FOR Western Bluefin Tuna Assessment

==

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1970	363640.	196737.	226168.	46175.	40543.	46224.	38706.	43491.	52645.	43532.	25807.	30879.	31241.	25666.	17378.	38068.
1971	322392.	261362.	74788.	79315.	23928.	29178.	38853.	33218.	37660.	45728.	37604.	22030.	26439.	26549.	21631.	46436.
1972	278521.	222638.	87151.	29978.	26345.	20377.	24561.	32514.	27332.	31641.	39048.	31941.	18410.	22025.	22066.	56341.
1973	150973.	199978.	102631.	44649.	23722.	19219.	16577.	21267.	27829.	23328.	27235.	33774.	27393.	15325.	18168.	65087.
1974	465746.	126533.	105687.	61435.	33351.	18526.	14436.	14051.	17881.	23010.	19509.	23430.	28890.	23215.	12675.	69867.
1975	164391.	352992.	91467.	72898.	48162.	26228.	14758.	11954.	11527.	14991.	19437.	16151.	19889.	24557.	18296.	63126.
1976	135241.	102727.	170253.	73417.	51150.	41025.	22141.	12566.								

10157. 9631. 12311. 15697. 13056. 16285. 20230. 65004.
1977 112512. 112422. 71256. 81533. 61427. 41914. 34676. 19063.
10815. 8176. 7741. 10256. 12861. 9675. 12131. 65570.
1978 95145. 96409. 77126. 53563. 44477. 46026. 33926. 27734. 16064.
9115. 6543. 5849. 8012. 10408. 7335. 57907.
1979 99656. 77535. 74018. 49441. 42016. 30971. 33189. 28197. 23694.
13588. 7689. 5495. 4761. 6467. 8501. 46952.
1980 81299. 84003. 57563. 49916. 35006. 27470. 25193. 26208. 22702.
20083. 11488. 6351. 4351. 3422. 4565. 38963.
1981 80599. 67656. 58087. 40757. 35843. 26592. 22437. 19736. 18455.
16532. 16553. 9429. 4977. 3206. 2339. 28210.
1982 82285. 64215. 49692. 35163. 31963. 25869. 19898. 17075. 15120.
13932. 12075. 13095. 7173. 3553. 2103. 19151.
1983 104287. 68176. 52427. 41787. 30082. 27559. 22061. 16843. 14480.
12868. 11646. 9882. 10826. 5810. 2866. 16820.
1984 93252. 87428. 56976. 42700. 35610. 25579. 23158. 18523. 13616.
11701. 10467. 9490. 8046. 8724. 4395. 14158.
1985 98867. 80021. 69269. 47958. 35731. 29091. 20770. 19269. 15683.
11352. 9575. 8446. 7559. 6366. 6786. 13966.
1986 102505. 85228. 64545. 48916. 39708. 27786. 21682. 16235. 16074.
13187. 9463. 7899. 6773. 5795. 4796. 15009.
1987 91424. 88213. 68604. 50085. 39813. 33183. 23060. 17792. 13503.
13568. 11109. 7945. 6526. 5323. 4415. 13906.
1988 138821. 77313. 64992. 51489. 39339. 31048. 25368. 18893. 14243.
10822. 10830. 9186. 6522. 5263. 4170. 13993.
1989 121629. 116090. 58560. 46196. 41206. 31071. 23923. 19141.
14959. 11392. 8546. 8576. 7410. 5161. 4089. 13660.
1990 114105. 104955. 88900. 49473. 37272. 33478. 25634. 19289.
14631. 11502. 8890. 6653. 6618. 5775. 3891. 13109.
1991 94800. 96411. 87908. 60749. 41336. 30348. 27117. 21223. 15551.
11188. 8573. 6905. 5150. 5185. 4535. 12622.
1992 83580. 78587. 70747. 67054. 49944. 34126. 25002. 21865. 16843.
12091. 8371. 6421. 5164. 3893. 3965. 13001.
1993 77333. 72112. 62654. 59715. 57313. 42314. 28427. 20924. 17483.
13039. 9641. 6411. 4671. 3700. 2768. 12835.
1994 88548. 66842. 61698. 50388. 48672. 47706. 35455. 23183. 17044.
13572. 9810. 7608. 5044. 3621. 2882. 12065.
1995 114612. 75069. 57439. 52487. 41812. 39971. 39771. 29749. 18740.
12741. 10792. 7656. 5876. 3948. 2777. 11753.
1996 92054. 98770. 64007. 46917. 42857. 33688. 30788. 33356. 25295.
15470. 9604. 8438. 6063. 4639. 3059. 10851.
1997 75317. 79537. 77167. 54084. 36455. 34148. 28242. 25476. 26840.
21240. 12857. 7405. 6490. 4647. 3566. 10279.
1998 101446. 65246. 68119. 61138. 46154. 30447. 28289. 23289. 20458.
21611. 17406. 10614. 5871. 4957. 3415. 10097.
1999 104719. 87875. 55894. 55974. 49908. 39517. 25411. 23889. 18910.
15626. 16382. 13872. 8552. 4470. 3630. 9959.
2000 90853. 90944. 75874. 46780. 46940. 41749. 33610. 21399. 19077.
15134. 11907. 12494. 10500. 6416. 3203. 9805.
2001 91803. 78892. 78795. 64980. 39575. 37458. 33384. 27673. 17374.
15398. 12037. 9374. 9801. 8112. 4811. 9463.
2002 105420. 78478. 68250. 66264. 52440. 33486. 31351. 27396. 21985.

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14420.     12493.     9354.     6923.     7328.     6059.     10332.
 2003     173337.     90858.     63052.     55535.     53393.     41326.     27896.     26333.     21061.
16748.     11070.     9815.     7249.     4973.     5389.     11843.
 2004     149469.     150428.     76471.     50606.     44872.     44672.     34562.     23947.
21669.     16305.     13041.     8830.     8119.     5758.     3794.     13054.
 2005     63186.     129184.     128286.     60019.     41588.     36448.     36130.     28693.
19402.     17908.     13227.     10621.     7135.     6600.     4693.     13279.
 2006     86729.     54260.     107754.     109226.     49793.     35146.     30904.     30769.
24035.     16085.     14914.     10576.     8265.     5595.     5343.     14181.
 2007     96287.     75202.     46584.     92516.     93330.     41005.     28689.     25877.     25750.
19617.     12817.     12115.     8473.     6653.     4494.     15206.
 2008     74561.     83648.     65137.     34280.     71792.     79164.     33978.     23810.     21878.
21851.     16725.     10706.     10158.     7048.     5532.     16096.
 2009     65547.     64741.     71986.     54493.     27845.     56457.     67318.     27866.     18997.
17912.     18205.     13910.     8921.     8481.     5874.     17479.
 2010     80317.     56916.     56076.     60540.     46262.     23288.     44856.     57072.     23561.
15597.     14756.     15170.     11649.     7442.     7012.     18789.
 2011     38038.     69763.     48459.     47968.     50927.     39627.     19657.     38352.     47846.
19803.     12634.     11810.     12602.     9719.     6062.     20819.
 2012     183981.     33066.     60127.     40622.     40218.     42360.     33276.     16572.     30746.
39573.     16617.     10402.     9695.     10453.     8048.     21954.
 2013     94120.     159843.     28370.     50546.     34187.     34530.     36262.     28284.     13738.
25583.     32900.     13382.     8600.     7974.     8726.     24626.
 2014               81779.     138711.     24145.     42774.     29538.     29502.     30977.     23698.
11384.     21683.     27742.     10896.     7003.     6604.     27735.
==================================================================================
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==========================================================================


TABLE 3. CATCH OF Western Bluefin Tuna Assessment
==================================================================================
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==========================================================================
          1          2          3          4          5          6          7          8          9          10          11          12
13          14          15          16
------------------------------------------------------------------------------------------------------------------------
-------------------------------------------------------------------------------------
 1970     58920.     104298.     127233.     17510.     6528.     1430.     463.     161.     43.
259.     435.     436.     655.     732.     593.     1299.
 1971     62033.     152003.     37948.     46241.     456.     865.     1357.     1661.     1180.
758.     805.     797.     1030.     1090.     968.     2078.
 1972     45351.     98312.     33605.     2514.     3963.     1222.     92.     470.     465.
292.     185.     403.     730.     1053.     929.     2372.
 1973     5065.     73591.     29957.     5877.     2254.     2443.     387.     652.     1270.
829.     265.     506.     643.     696.     587.     2103.
 1974     55806.     19939.     20430.     5639.     2972.     1448.     640.     739.     595.
609.     869.     516.     600.     2027.     1425.     7855.
 1975     43303.     147653.     6554.     13155.     907.     709.     283.     253.     419.
775.     1290.     1058.     1080.     1202.     1395.     4813.
 1976     5532.     19427.     71850.     2576.     2743.     1062.     200.     117.     702.
679.     480.     844.     1802.     2179.     2176.     6992.
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1977 1508. 22182. 9014. 28496. 7931. 2699. 2592. 546. 309.
607. 947. 971. 830. 1157. 1619. 8751.
1978 5564. 10530. 18969. 4889. 8281. 7341. 1392. 447. 405.
252. 208. 348. 536. 588. 1181. 9324.
1979 2828. 10585. 15537. 8581. 9754. 1861. 2843. 1946. 554.
349. 359. 458. 771. 1137. 1525. 8423.
1980 3246. 16081. 9991. 8124. 4129. 1552. 2327. 4658. 3447.
973. 599. 584. 620. 685. 1088. 9286.
1981 6290. 9814. 16530. 3729. 5692. 3462. 2613. 2191. 2271.
2470. 1392. 1101. 833. 737. 611. 7370.
1982 3608. 3652. 1517. 523. 245. 460. 490. 391. 297. 500.
662. 600. 458. 239. 176. 1603.
1983 3474. 2463. 3091. 771. 615. 860. 705. 1102. 953.
773. 682. 585. 739. 705. 463. 2717.
1984 1126. 7240. 1691. 1493. 2005. 1577. 927. 451. 521.
642. 702. 743. 676. 858. 551. 1775.
1985 776. 5395. 12162. 2131. 3523. 3880. 1957. 728. 480.
436. 457. 612. 834. 794. 1066. 2194.
1986 967. 5898. 6478. 2914. 1437. 1177. 1136. 657. 436.
381. 303. 366. 607. 670. 863. 2701.
1987 2326. 12579. 8766. 4517. 3830. 3741. 1240. 1316. 985.
1037. 507. 414. 441. 492. 501. 1578.
1988 4935. 9303. 11087. 3821. 3362. 3299. 3132. 1575. 1064.
926. 902. 619. 546. 523. 526. 1765.
1989 842. 12925. 1542. 3104. 2519. 1480. 1621. 2160. 1615.
1090. 835. 900. 716. 641. 575. 1921.
1990 2993. 3583. 17800. 1798. 2207. 2135. 1141. 1308. 1646.
1534. 885. 681. 611. 522. 531. 1789.
1991 4111. 14055. 10072. 3081. 1944. 1484. 1836. 1727. 1536.
1457. 1110. 902. 628. 583. 544. 1514.
1992 589. 6088. 1922. 1053. 1187. 1332. 871. 1639. 1723.
935. 932. 980. 849. 663. 481. 1577.
1993 416. 1066. 4385. 3482. 2276. 1429. 1644. 1232. 1749.
1641. 831. 569. 472. 360. 286. 1326.
1994 2052. 720. 1235. 2140. 2516. 1828. 1154. 1519. 2232.
1082. 937. 793. 469. 399. 257. 1076.
1995 933. 1347. 3242. 2979. 2860. 4258. 1310. 609. 883.
1584. 1015. 637. 505. 402. 366. 1549.
1996 526. 9349. 1676. 4657. 3341. 1122. 1385. 2318. 806.
636. 1015. 909. 671. 502. 429. 1522.
1997 249. 1103. 6392. 928. 1338. 1502. 1357. 1816. 1851.
1138. 605. 609. 736. 672. 537. 1548.
1998 341. 889. 3486. 3483. 652. 1136. 756. 1436. 2321.
2586. 1353. 725. 681. 731. 486. 1437.
1999 102. 560. 1946. 1849. 1760. 799. 743. 1817. 1402.
1803. 1879. 1677. 1096. 735. 577. 1583.
2000 98. 287. 1053. 1174. 3599. 3127. 1661. 1321. 1275.
1204. 1051. 1140. 1093. 824. 489. 1497.
2001 1430. 361. 2402. 4352. 987. 1303. 1748. 2227. 735.
960. 1193. 1319. 1282. 1068. 753. 1481.
2002 847. 5559. 4081. 4528. 4581. 1305. 990. 2962. 2542.
1576. 1124. 949. 1124. 1056. 957. 1632.

2003	283.	2704.	4521.	3661.	1874.	1466.	327.	1314.	2155.	1633.	853.	444.	585.	570.	648.	1424.
2004	814.	2674.	6944.	2586.	2752.	2907.	1454.	1522.	999.	1018.	769.	582.	492.	336.	331.	1139.
2005	721.	4890.	2470.	2561.	1083.	840.	688.	977.	840.	703.	992.	1041.	653.	424.	405.	1146.
2006	211.	630.	1245.	1746.	2452.	2004.	1063.	1073.	1373.	1253.	914.	775.	572.	397.	520.	1380.
2007	65.	258.	6687.	9284.	2119.	1794.	1214.	664.	575.	353.	469.	402.	341.	270.	253.	856.
2008	85.	788.	2292.	2102.	6401.	1614.	1797.	1829.	1190.	850.	677.	415.	376.	272.	364.	1059.
2009	72.	222.	2192.	1194.	987.	4540.	1559.	713.	986.	876.	705.	476.	337.	387.	409.	1217.
2010	66.	1097.	840.	1830.	635.	632.	691.	1901.	730.	995.	1094.	629.	439.	438.	471.	1262.
2011	3.	560.	1617.	1592.	2055.	1261.	556.	2789.	2172.	643.	624.	614.	540.	431.	343.	1178.
2012	110.	404.	1854.	1212.	466.	606.	692.	718.	1231.	1614.	1144.	476.	489.	388.	419.	1143.
2013	48.	268.	557.	1254.	196.	555.	588.	957.	601.	599.	923.	792.	509.	352.	354.	999.

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TABLE 4. SPAWNING STOCK FECUNDITY AND RECRUITMENT OF Western Bluefin Tuna Assessment

year	spawning biomass	recruits from VPA
1970	51113.	363640.
1971	50857.	322392.
1972	51266.	278521.
1973	51539.	150973.
1974	46241.	465746.
1975	41025.	164391.
1976	36159.	135241.
1977	31021.	112512.
1978	27718.	95145.
1979	24534.	99656.
1980	22252.	81299.
1981	19138.	80599.
1982	18020.	82285.
1983	17279.	104287.
1984	16438.	93252.
1985	14850.	98867.
1986	15239.	102505.
1987	14630.	91424.
1988	14523.	138821.

1989	14103.	121629.
1990	13546.	114105.
1991	13283.	94800.
1992	12927.	83580.
1993	13133.	77333.
1994	13055.	88548.
1995	13721.	114612.
1996	14996.	92054.
1997	16121.	75317.
1998	16494.	101446.
1999	16136.	104719.
2000	16445.	90853.
2001	16249.	91803.
2002	16103.	105420.
2003	16178.	173337.
2004	16797.	149469.
2005	17324.	63186.
2006	18047.	86729.
2007	20301.	96287.
2008	21323.	74561.
2009	21706.	65547.
2010	22700.	80317.
2011	26607.	38038.
2012	28318.	183981.
2013	27966.	94120.

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TABLE 5. FITS TO INDEX DATA FOR Western Bluefin Tuna Assessment

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5.1 CAN_GSL

Lognormal dist.
average numbers
Ages 8 - 16
log-likelihood = -17.39
deviance = 67.48
Chi-sq. discrepancy= 72.32

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1981	0.645	0.358	0.286	0.600	0.329E-04	1.320	0.991	0.029
1982	-0.144	0.155	-0.299	0.600	0.329E-04	0.600	0.809	0.334
1983	0.799	0.048	0.751	0.600	0.329E-04	1.540	0.727	1.367
1984	0.205	-0.034	0.238	0.600	0.329E-04	0.850	0.670	0.008
1985	-1.193	-0.051	-1.143	0.600	0.329E-04	0.210	0.659	1.242
1986	-1.060	-0.042	-1.017	0.600	0.329E-04	0.240	0.664	1.125
1987	-0.772	-0.072	-0.700	0.600	0.329E-04	0.320	0.644	0.790
1988	-0.268	-0.082	-0.186	0.600	0.329E-04	0.530	0.638	0.216

1989	-0.064	-0.113	0.049	0.600	0.329E-04	0.650	0.619	0.035
1990	-1.294	-0.147	-1.147	0.600	0.329E-04	0.190	0.598	1.246
1991	-0.064	-0.165	0.101	0.600	0.329E-04	0.650	0.587	0.013
1992	0.739	-0.157	0.895	0.600	0.329E-04	1.450	0.592	2.521
1993	0.262	-0.161	0.423	0.600	0.329E-04	0.900	0.590	0.175
1994	-1.019	-0.179	-0.840	0.600	0.329E-04	0.250	0.579	0.944
1995	0.039	-0.174	0.213	0.600	0.329E-04	0.720	0.582	0.003
1996	-2.159	-0.160	-1.998	0.600	0.329E-04	0.080	0.590	1.815
1997	-1.673	-0.152	-1.521	0.600	0.329E-04	0.130	0.595	1.543
1998	-1.060	-0.157	-0.903	0.600	0.329E-04	0.240	0.592	1.010
1999	-0.500	-0.182	-0.318	0.600	0.329E-04	0.420	0.577	0.355
2000	-0.772	-0.199	-0.574	0.600	0.329E-04	0.320	0.568	0.647
2001	-0.871	-0.196	-0.674	0.600	0.329E-04	0.290	0.569	0.762
2002	-0.431	-0.151	-0.280	0.600	0.329E-04	0.450	0.595	0.314
2003	0.181	-0.086	0.267	0.600	0.329E-04	0.830	0.636	0.019
2004	0.444	-0.022	0.466	0.600	0.329E-04	1.080	0.678	0.253
2005	0.406	0.015	0.391	0.600	0.329E-04	1.040	0.703	0.127
2006	0.498	0.073	0.425	0.600	0.329E-04	1.140	0.745	0.179
2007	1.191	0.142	1.050	0.600	0.329E-04	2.280	0.798	4.434
2008	0.921	0.189	0.732	0.600	0.329E-04	1.740	0.837	1.253
2009	1.307	0.244	1.063	0.600	0.329E-04	2.560	0.884	4.645
2011	1.675	0.443	1.232	0.600	0.329E-04	3.700	1.079	8.026
2012	2.093	0.478	1.615	0.600	0.329E-04	5.620	1.117	23.664
2013	1.938	0.536	1.402	0.600	0.329E-04	4.810	1.184	13.231

Selectivities by age

Year	8	9	10	11	12	13	14	15	16
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1981	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1982	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1983	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1984	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1985	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1986	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1987	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1988	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1989	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1990	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1991	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1992	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1993	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1994	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1995	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1996	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1997	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1998	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
1999	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2000	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2001	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2002	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2003	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2004	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000

2005	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2006	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2007	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2008	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2009	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2011	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2012	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000
2013	0.045	0.090	0.102	0.112	0.107	0.115	0.173	0.250	1.000

5.2 CAN_SWNS

Lognormal dist.
average numbers
Ages 5 - 16
log-likelihood = 7.48
deviance = 11.61
Chi-sq. discrepancy= 7.77

Year	Observed	Residuals Predicted	Standard (Obs-pred)	Q Deviation	Untransfrmd Catchabil.	Untransfrmd Observed	Chi-square Predicted	Discrepancy
1988	0.423	-0.225	0.648	0.600	0.109E-03	13.860	7.252	0.821
1989	0.361	-0.254	0.615	0.600	0.109E-03	13.030	7.044	0.686
1990	0.305	-0.281	0.586	0.600	0.109E-03	12.320	6.856	0.579
1991	0.047	-0.290	0.337	0.600	0.109E-03	9.510	6.790	0.067
1992	0.036	-0.287	0.323	0.600	0.109E-03	9.410	6.811	0.055
1993	-0.399	-0.261	-0.138	0.600	0.109E-03	6.090	6.993	0.171
1994	-0.221	-0.215	-0.005	0.600	0.109E-03	7.280	7.319	0.066
1995	-0.254	-0.146	-0.109	0.600	0.109E-03	7.040	7.848	0.145
1996	-0.490	-0.056	-0.434	0.600	0.109E-03	5.560	8.580	0.486
1997	-0.706	0.004	-0.710	0.600	0.109E-03	4.480	9.113	0.802
1998	-0.133	0.015	-0.147	0.600	0.109E-03	7.950	9.213	0.180
1999	0.176	-0.013	0.189	0.600	0.109E-03	10.820	8.960	0.000
2000	-0.667	-0.036	-0.631	0.600	0.109E-03	4.660	8.756	0.712
2001	0.032	-0.037	0.068	0.600	0.109E-03	9.370	8.750	0.026
2002	0.236	-0.039	0.275	0.600	0.109E-03	11.490	8.727	0.023
2003	0.561	-0.036	0.596	0.600	0.109E-03	15.900	8.758	0.615
2004	0.008	-0.005	0.013	0.600	0.109E-03	9.150	9.035	0.055
2005	0.150	0.042	0.109	0.600	0.109E-03	10.550	9.463	0.011
2006	0.250	0.087	0.164	0.600	0.109E-03	11.660	9.900	0.001
2007	0.043	0.140	-0.097	0.600	0.109E-03	9.480	10.444	0.135
2008	0.408	0.187	0.221	0.600	0.109E-03	13.650	10.948	0.004
2009	0.152	0.228	-0.076	0.600	0.109E-03	10.570	11.405	0.118
2010	0.011	0.312	-0.301	0.600	0.109E-03	9.180	12.405	0.337
2011	0.139	0.381	-0.242	0.600	0.109E-03	10.430	13.285	0.273
2012	0.062	0.397	-0.335	0.600	0.109E-03	9.660	13.506	0.374
2013	-0.531	0.387	-0.918	0.600	0.109E-03	5.340	13.373	1.025

Selectivities by age

Year	5	6	7	8	9	10	11	12	13	14	15	16

1988	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1989	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1990	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1991	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1992	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1993	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1994	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1995	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1996	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1997	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1998	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
1999	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2000	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2001	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2002	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2003	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2004	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2005	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2006	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2007	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2008	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2009	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2010	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2011	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2012	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620
2013	0.016	0.037	0.123	0.405	0.706	0.932	1.000	0.986	0.918	0.865	0.822	0.620

5.3 US_RR<145

Lognormal dist.
average numbers
Ages 1 - 5
log-likelihood = 3.42
deviance = 5.41
Chi-sq. discrepancy= 6.49

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1980	-0.148	-0.101	-0.047	0.600	0.593E-05	0.800	0.839	0.095
1981	-0.841	-0.223	-0.619	0.600	0.593E-05	0.400	0.743	0.698
1982	0.817	-0.223	1.040	0.600	0.593E-05	2.100	0.742	4.292
1983	0.179	-0.131	0.310	0.600	0.593E-05	1.110	0.814	0.045
1985	-0.387	0.000	-0.387	0.600	0.593E-05	0.630	0.928	0.432
1986	-0.174	0.030	-0.204	0.600	0.593E-05	0.780	0.956	0.235
1987	0.274	0.021	0.252	0.600	0.593E-05	1.220	0.948	0.013
1988	0.065	0.018	0.047	0.600	0.593E-05	0.990	0.945	0.036
1989	0.065	0.186	-0.121	0.600	0.593E-05	0.990	1.117	0.156
1990	-0.031	0.233	-0.263	0.600	0.593E-05	0.900	1.171	0.296

1991	0.306	0.161	0.144	0.600	0.593E-05	1.260	1.090	0.003
1992	-0.124	0.029	-0.153	0.600	0.593E-05	0.820	0.956	0.185

Selectivities by age

Year	1	2	3	4	5
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1980	0.269	1.000	0.831	0.173	0.111
1981	0.269	1.000	0.831	0.173	0.111
1982	0.269	1.000	0.831	0.173	0.111
1983	0.269	1.000	0.831	0.173	0.111
1985	0.269	1.000	0.831	0.173	0.111
1986	0.269	1.000	0.831	0.173	0.111
1987	0.269	1.000	0.831	0.173	0.111
1988	0.269	1.000	0.831	0.173	0.111
1989	0.269	1.000	0.831	0.173	0.111
1990	0.269	1.000	0.831	0.173	0.111
1991	0.269	1.000	0.831	0.173	0.111
1992	0.269	1.000	0.831	0.173	0.111

5.4 US_RR_66_114

Lognormal dist.
average numbers
Ages 2 - 3
log-likelihood = 0.14
deviance = 21.17
Chi-sq. discrepancy= 14.66

Year	Observed	Residuals Predicted	Standard (Obs-pred)	Q Deviation	Untransfrmd Catchabil.	Untransfrmd Observed	Chi-square Predicted	Discrepancy
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1993	0.314	-0.090	0.404	0.600	0.836E-05	1.100	0.734	0.146
1994	-1.128	-0.108	-1.020	0.600	0.836E-05	0.260	0.721	1.127
1995	0.324	-0.125	0.449	0.600	0.836E-05	1.110	0.708	0.220
1996	0.708	0.042	0.666	0.600	0.836E-05	1.630	0.838	0.902
1997	1.082	0.076	1.006	0.600	0.836E-05	2.370	0.866	3.813
1998	0.548	-0.061	0.610	0.600	0.836E-05	1.390	0.756	0.665
1999	0.504	-0.068	0.572	0.600	0.836E-05	1.330	0.750	0.533
2000	0.168	0.138	0.030	0.600	0.836E-05	0.950	0.922	0.045
2001	-0.557	0.108	-0.665	0.600	0.836E-05	0.460	0.895	0.751
2002	0.611	-0.012	0.623	0.600	0.836E-05	1.480	0.794	0.718
2003	-0.672	-0.001	-0.671	0.600	0.836E-05	0.410	0.802	0.758
2004	1.021	0.329	0.692	0.600	0.836E-05	2.230	1.116	1.032
2005	0.998	0.595	0.403	0.600	0.836E-05	2.180	1.457	0.144
2006	-0.326	0.253	-0.578	0.600	0.836E-05	0.580	1.034	0.652
2007	-0.579	-0.272	-0.307	0.600	0.836E-05	0.450	0.612	0.343
2008	-0.831	0.002	-0.833	0.600	0.836E-05	0.350	0.805	0.936
2009	-0.831	-0.016	-0.815	0.600	0.836E-05	0.350	0.791	0.917
2010	-0.275	-0.225	-0.050	0.600	0.836E-05	0.610	0.641	0.098
2011	-0.004	-0.247	0.243	0.600	0.836E-05	0.800	0.627	0.010

2012	-0.697	-0.321	-0.376	0.600	0.836E-05	0.400	0.583	0.420
2013	-0.379	0.004	-0.383	0.600	0.836E-05	0.550	0.807	0.428

Selectivities by age

Year	2	3
1993	0.471	1.000
1994	0.471	1.000
1995	0.471	1.000
1996	0.471	1.000
1997	0.471	1.000
1998	0.471	1.000
1999	0.471	1.000
2000	0.471	1.000
2001	0.471	1.000
2002	0.471	1.000
2003	0.471	1.000
2004	0.471	1.000
2005	0.471	1.000
2006	0.471	1.000
2007	0.471	1.000
2008	0.471	1.000
2009	0.471	1.000
2010	0.471	1.000
2011	0.471	1.000
2012	0.471	1.000
2013	0.471	1.000

5.5 US_RR_115_144

Lognormal dist.
average numbers
Ages 4 - 5
log-likelihood = 2.81
deviance = 15.84
Chi-sq. discrepancy= 9.89

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1993	0.136	0.111	0.025	0.600	0.961E-05	0.990	0.966	0.048
1994	-1.201	-0.054	-1.147	0.600	0.961E-05	0.260	0.819	1.246
1995	-0.316	-0.106	-0.210	0.600	0.961E-05	0.630	0.777	0.241
1996	-0.169	-0.175	0.006	0.600	0.961E-05	0.730	0.726	0.059
1997	-1.281	-0.121	-1.160	0.600	0.961E-05	0.240	0.765	1.257
1998	0.041	0.037	0.004	0.600	0.961E-05	0.900	0.896	0.060
1999	-0.115	0.022	-0.137	0.600	0.961E-05	0.770	0.883	0.170
2000	0.385	-0.112	0.497	0.600	0.961E-05	1.270	0.773	0.322
2001	0.454	0.010	0.443	0.600	0.961E-05	1.360	0.873	0.210
2002	1.102	0.116	0.985	0.600	0.961E-05	2.600	0.971	3.532

2003	-0.382	0.038	-0.420	0.600	0.961E-05	0.590	0.898	0.470
2004	-0.254	-0.093	-0.161	0.600	0.961E-05	0.670	0.787	0.193
2005	-0.316	-0.013	-0.303	0.600	0.961E-05	0.630	0.853	0.338
2006	0.524	0.452	0.073	0.600	0.961E-05	1.460	1.357	0.024
2007	0.538	0.564	-0.026	0.600	0.961E-05	1.480	1.520	0.080
2008	0.468	-0.026	0.494	0.600	0.961E-05	1.380	0.842	0.314
2009	-0.796	-0.210	-0.586	0.600	0.961E-05	0.390	0.701	0.661
2010	0.361	0.041	0.321	0.600	0.961E-05	1.240	0.900	0.053
2011	0.385	-0.053	0.438	0.600	0.961E-05	1.270	0.820	0.200
2012	0.250	-0.244	0.495	0.600	0.961E-05	1.110	0.677	0.316
2013	0.185	-0.184	0.370	0.600	0.961E-05	1.040	0.719	0.101

Selectivities by age

Year	4	5
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1993	1.000	0.888
1994	1.000	0.888
1995	1.000	0.888
1996	1.000	0.888
1997	1.000	0.888
1998	1.000	0.888
1999	1.000	0.888
2000	1.000	0.888
2001	1.000	0.888
2002	1.000	0.888
2003	1.000	0.888
2004	1.000	0.888
2005	1.000	0.888
2006	1.000	0.888
2007	1.000	0.888
2008	1.000	0.888
2009	1.000	0.888
2010	1.000	0.888
2011	1.000	0.888
2012	1.000	0.888
2013	1.000	0.888

5.6 US_RR_145_177

Not used

5.7 US_RR>195

Lognormal dist.
average numbers
Ages 10 - 16
log-likelihood = 2.49
deviance = 5.24
Chi-sq. discrepancy= 6.08

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1983	1.165	0.132	1.033	0.600	0.286E-04	2.810	1.001	4.181
1984	0.355	0.114	0.240	0.600	0.286E-04	1.250	0.983	0.009
1985	-0.019	0.083	-0.102	0.600	0.286E-04	0.860	0.953	0.140
1986	-0.562	0.034	-0.596	0.600	0.286E-04	0.500	0.907	0.672
1987	-0.504	0.018	-0.522	0.600	0.286E-04	0.530	0.893	0.587
1988	0.069	-0.002	0.071	0.600	0.286E-04	0.940	0.875	0.025
1989	-0.143	-0.034	-0.109	0.600	0.286E-04	0.760	0.847	0.145
1990	-0.331	-0.075	-0.256	0.600	0.286E-04	0.630	0.814	0.288
1991	-0.067	-0.113	0.046	0.600	0.286E-04	0.820	0.783	0.037
1992	0.037	-0.158	0.195	0.600	0.286E-04	0.910	0.749	0.001

Selectivities by age

Year	10	11	12	13	14	15	16
1983	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1984	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1985	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1986	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1987	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1988	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1989	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1990	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1991	0.247	0.295	0.453	0.569	0.781	1.000	0.907
1992	0.247	0.295	0.453	0.569	0.781	1.000	0.907

5.8 US_RR>195_COMB

Not used

5.9 US_RR>177

Lognormal dist.
average numbers
Ages 8 - 16
log-likelihood = -5.77
deviance = 32.99
Chi-sq. discrepancy= 39.33

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1993	-0.161	-0.325	0.164	0.600	0.168E-04	0.690	0.586	0.001
1994	0.148	-0.303	0.451	0.600	0.168E-04	0.940	0.599	0.224
1995	0.333	-0.236	0.568	0.600	0.168E-04	1.130	0.640	0.520
1996	1.413	-0.151	1.564	0.600	0.168E-04	3.330	0.697	20.669

1997	0.616	-0.121	0.737	0.600	0.168E-04	1.500	0.718	1.282
1998	0.693	-0.118	0.811	0.600	0.168E-04	1.620	0.720	1.784
1999	0.842	-0.118	0.960	0.600	0.168E-04	1.880	0.720	3.223
2000	-0.252	-0.124	-0.128	0.600	0.168E-04	0.630	0.716	0.162
2001	0.532	-0.091	0.623	0.600	0.168E-04	1.380	0.740	0.717
2002	0.873	-0.085	0.958	0.600	0.168E-04	1.940	0.744	3.202
2003	-0.588	-0.094	-0.494	0.600	0.168E-04	0.450	0.737	0.555
2004	-0.091	-0.072	-0.019	0.600	0.168E-04	0.740	0.754	0.075
2005	-0.220	-0.016	-0.204	0.600	0.168E-04	0.650	0.797	0.235
2006	-0.634	0.041	-0.675	0.600	0.168E-04	0.430	0.844	0.762
2007	-0.898	0.083	-0.981	0.600	0.168E-04	0.330	0.880	1.089
2008	-0.706	0.126	-0.832	0.600	0.168E-04	0.400	0.919	0.935
2009	-1.028	0.173	-1.200	0.600	0.168E-04	0.290	0.963	1.293
2010	0.148	0.311	-0.162	0.600	0.168E-04	0.940	1.106	0.194
2011	-0.317	0.382	-0.700	0.600	0.168E-04	0.590	1.188	0.790
2012	-0.220	0.360	-0.580	0.600	0.168E-04	0.650	1.161	0.654
2013	-0.483	0.378	-0.861	0.600	0.168E-04	0.500	1.183	0.966

Selectivities by age

Year	8	9	10	11	12	13	14	15	16
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1993	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
1994	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
1995	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
1996	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
1997	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
1998	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
1999	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2000	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2001	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2002	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2003	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2004	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2005	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2006	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2007	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2008	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2009	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2010	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2011	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2012	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764
2013	0.225	0.314	0.291	0.402	0.466	0.614	0.853	1.000	0.764

5.10 JLL_AREA_2_(WEST)

Lognormal dist.

month 0 numbers

Ages 2 - 16

log-likelihood = -1.14

deviance = 41.12

Chi-sq. discrepancy= 30.41

Year	Observed	Residuals Predicted	Standard (Obs-pred)	Q Deviation	Untransfrmd Catchabil.	Untransfrmd Observed	Chi-square Predicted	Discrepancy
1976	-0.454	0.350	-0.804	0.600	0.355E-05	0.610	1.364	0.906
1977	0.899	0.240	0.658	0.600	0.355E-05	2.360	1.222	0.868
1978	0.171	0.153	0.018	0.600	0.355E-05	1.140	1.120	0.052
1979	-0.208	0.067	-0.275	0.600	0.355E-05	0.780	1.027	0.308
1980	0.439	-0.058	0.496	0.600	0.355E-05	1.490	0.907	0.320
1981	0.698	-0.171	0.869	0.600	0.355E-05	1.930	0.810	2.268
1982	-0.302	-0.298	-0.005	0.600	0.355E-05	0.710	0.713	0.066
1983	-0.804	-0.259	-0.545	0.600	0.355E-05	0.430	0.742	0.614
1984	0.060	-0.225	0.285	0.600	0.355E-05	1.020	0.767	0.028
1985	0.206	-0.172	0.377	0.600	0.355E-05	1.180	0.809	0.110
1986	-2.368	-0.182	-2.186	0.600	0.355E-05	0.090	0.801	1.895
1987	-0.208	-0.145	-0.063	0.600	0.355E-05	0.780	0.831	0.108
1988	0.206	-0.154	0.360	0.600	0.355E-05	1.180	0.823	0.090
1989	0.030	-0.171	0.201	0.600	0.355E-05	0.990	0.810	0.001
1990	-0.158	-0.098	-0.060	0.600	0.355E-05	0.820	0.871	0.105
1991	-0.158	-0.064	-0.095	0.600	0.355E-05	0.820	0.901	0.133
1992	0.263	-0.054	0.317	0.600	0.355E-05	1.250	0.911	0.050
1993	0.247	-0.026	0.273	0.600	0.355E-05	1.230	0.936	0.022
1994	0.171	-0.023	0.194	0.600	0.355E-05	1.140	0.939	0.000
1995	-0.134	-0.030	-0.104	0.600	0.355E-05	0.840	0.932	0.141
1996	0.787	-0.034	0.821	0.600	0.355E-05	2.110	0.929	1.862
1997	0.302	-0.025	0.328	0.600	0.355E-05	1.300	0.937	0.059
1998	-0.454	-0.030	-0.424	0.600	0.355E-05	0.610	0.932	0.475
1999	-0.376	-0.033	-0.343	0.600	0.355E-05	0.660	0.930	0.383
2000	-0.158	0.006	-0.164	0.600	0.355E-05	0.820	0.966	0.196
2001	-0.614	0.029	-0.643	0.600	0.355E-05	0.520	0.989	0.726
2002	-0.454	0.036	-0.490	0.600	0.355E-05	0.610	0.996	0.551
2003	-0.471	0.018	-0.489	0.600	0.355E-05	0.600	0.978	0.549
2004	-0.595	0.056	-0.650	0.600	0.355E-05	0.530	1.016	0.735
2005	-0.406	0.153	-0.559	0.600	0.355E-05	0.640	1.119	0.630
2006	0.135	0.217	-0.082	0.600	0.355E-05	1.100	1.194	0.122
2007	0.565	0.208	0.357	0.600	0.355E-05	1.690	1.183	0.086
2008	-0.275	0.210	-0.484	0.600	0.355E-05	0.730	1.185	0.544
2009	0.559	0.181	0.378	0.600	0.355E-05	1.680	1.151	0.111
2010	-0.454	0.139	-0.593	0.600	0.355E-05	0.610	1.104	0.669
2011	0.992	0.113	0.879	0.600	0.355E-05	2.590	1.075	2.364
2012	1.324	0.068	1.256	0.600	0.355E-05	3.610	1.028	8.628
2013	1.003	0.010	0.993	0.600	0.355E-05	2.620	0.970	3.638

Selectivities by age

Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1976	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1977	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1978	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	

															0.767
1979	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1980	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1981	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1982	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1983	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1984	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1985	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1986	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1987	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1988	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1989	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1990	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1991	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1992	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1993	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1994	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1995	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1996	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1997	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1998	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
1999	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
2000	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
2001	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
2002	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
2003	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	0.767
2004	0.073	0.555	0.622	0.823	1.000	0.946	0.926	0.857	0.671	0.461	0.552	0.717	0.816	0.905	

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2012 0.073 0.555 0.622 0.823 1.000 0.946 0.926 0.857 0.671 0.461 0.552 0.717 0.816 0.905
0.767
2013 0.073 0.555 0.622 0.823 1.000 0.946 0.926 0.857 0.671 0.461 0.552 0.717 0.816 0.905
0.767

5.11 JLL_AREA_3_(31+32)

Not used

5.12 JLL_AREAS_17+18

Not used

5.13 LARVAL_ZERO_INFLATED

Lognormal dist.
average biomass
Ages 9 - 16
log-likelihood = 2.22
deviance = 30.31
Chi-sq. discrepancy= 27.93

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1977	1.512	1.006	0.506	0.600	0.727E-07	2.250	1.356	0.344
1978	2.181	0.843	1.338	0.600	0.727E-07	4.390	1.152	11.007
1981	0.491	0.177	0.314	0.600	0.727E-07	0.810	0.592	0.047
1982	0.867	0.074	0.793	0.600	0.727E-07	1.180	0.534	1.655
1983	0.527	0.024	0.503	0.600	0.727E-07	0.840	0.508	0.335
1984	-0.470	0.005	-0.475	0.600	0.727E-07	0.310	0.498	0.533
1986	-0.348	-0.099	-0.249	0.600	0.727E-07	0.350	0.449	0.281
1987	-0.470	-0.130	-0.340	0.600	0.727E-07	0.310	0.435	0.379

1988	0.806	-0.132	0.938	0.600	0.727E-07	1.110	0.434	2.968
1989	0.223	-0.158	0.382	0.600	0.727E-07	0.620	0.423	0.116
1990	-0.407	-0.210	-0.197	0.600	0.727E-07	0.330	0.402	0.228
1991	-0.502	-0.228	-0.274	0.600	0.727E-07	0.300	0.395	0.307
1992	-0.166	-0.276	0.110	0.600	0.727E-07	0.420	0.376	0.011
1993	-0.119	-0.305	0.185	0.600	0.727E-07	0.440	0.366	0.000
1994	0.085	-0.338	0.423	0.600	0.727E-07	0.540	0.354	0.175
1995	-0.813	-0.315	-0.498	0.600	0.727E-07	0.220	0.362	0.559
1996	0.466	-0.320	0.786	0.600	0.727E-07	0.790	0.360	1.601
1997	-0.407	-0.314	-0.093	0.600	0.727E-07	0.330	0.362	0.132
1998	-1.506	-0.293	-1.213	0.600	0.727E-07	0.110	0.370	1.304
1999	-0.075	-0.251	0.176	0.600	0.727E-07	0.460	0.386	0.000
2000	-0.685	-0.192	-0.492	0.600	0.727E-07	0.250	0.409	0.553
2001	-0.075	-0.161	0.086	0.600	0.727E-07	0.460	0.422	0.019
2002	-0.726	-0.144	-0.581	0.600	0.727E-07	0.240	0.429	0.656
2003	0.466	-0.137	0.603	0.600	0.727E-07	0.790	0.432	0.640
2004	0.104	-0.126	0.230	0.600	0.727E-07	0.550	0.437	0.006
2005	-1.013	-0.068	-0.945	0.600	0.727E-07	0.180	0.463	1.053
2006	-0.054	-0.018	-0.035	0.600	0.727E-07	0.470	0.487	0.087
2007	-0.240	0.071	-0.311	0.600	0.727E-07	0.390	0.532	0.348
2008	-0.470	0.168	-0.638	0.600	0.727E-07	0.310	0.587	0.720
2009	0.157	0.232	-0.075	0.600	0.727E-07	0.580	0.625	0.117
2010	-0.240	0.312	-0.552	0.600	0.727E-07	0.390	0.677	0.621
2011	0.721	0.359	0.362	0.600	0.727E-07	1.020	0.710	0.092
2012	-0.502	0.429	-0.932	0.600	0.727E-07	0.300	0.762	1.039
2013	0.681	0.516	0.165	0.600	0.727E-07	0.980	0.831	0.001

Selectivities by age

Year	9	10	11	12	13	14	15	16
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1977	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1978	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1981	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1982	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1983	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1984	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1986	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1987	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1988	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1989	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1990	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1991	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1992	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1993	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1994	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1995	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1996	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1997	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1998	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
1999	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2000	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2001	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718

2002	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2003	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2004	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2005	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2006	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2007	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2008	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2009	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2010	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2011	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2012	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718
2013	0.019	0.059	0.143	0.231	0.425	0.437	1.000	0.718

5.14 GOM_PLL_1-6

Lognormal dist.
month 0 numbers
Ages 9 - 16
log-likelihood = 5.83
deviance = 10.81
Chi-sq. discrepancy= 6.85

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1992	0.335	-0.257	0.593	0.600	0.266E-04	0.800	0.442	0.602
1993	-0.240	-0.321	0.081	0.600	0.266E-04	0.450	0.415	0.021
1994	-0.550	-0.313	-0.238	0.600	0.266E-04	0.330	0.419	0.269
1995	-0.613	-0.287	-0.326	0.600	0.266E-04	0.310	0.429	0.364
1996	-1.156	-0.261	-0.896	0.600	0.266E-04	0.180	0.441	1.002
1997	-0.550	-0.162	-0.388	0.600	0.266E-04	0.330	0.487	0.434
1998	-0.463	-0.103	-0.361	0.600	0.266E-04	0.360	0.516	0.403
1999	0.064	-0.079	0.143	0.600	0.266E-04	0.610	0.529	0.003
2000	0.442	-0.117	0.559	0.600	0.266E-04	0.890	0.509	0.489
2001	-0.115	-0.049	-0.066	0.600	0.266E-04	0.510	0.545	0.110
2002	-0.176	-0.018	-0.157	0.600	0.266E-04	0.480	0.562	0.189
2003	0.408	-0.058	0.465	0.600	0.266E-04	0.860	0.540	0.252
2004	0.310	-0.068	0.378	0.600	0.266E-04	0.780	0.534	0.111
2005	0.031	-0.008	0.039	0.600	0.266E-04	0.590	0.567	0.040
2006	-0.333	0.062	-0.395	0.600	0.266E-04	0.410	0.609	0.442
2007	-0.039	0.058	-0.098	0.600	0.266E-04	0.550	0.606	0.136
2008	0.789	0.181	0.608	0.600	0.266E-04	1.260	0.686	0.660
2009	0.607	0.229	0.378	0.600	0.266E-04	1.050	0.720	0.110
2010	0.442	0.281	0.161	0.600	0.266E-04	0.890	0.758	0.001
2011	0.244	0.317	-0.074	0.600	0.266E-04	0.730	0.786	0.116
2012	0.851	0.434	0.417	0.600	0.266E-04	1.340	0.883	0.166
2013	-0.286	0.539	-0.825	0.600	0.266E-04	0.430	0.981	0.928

Selectivities by age

Year	9	10	11	12	13	14	15	16

Year	9	10	11	12	13	14	15	16
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1992	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1993	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1994	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1995	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1996	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1997	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1998	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
1999	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2000	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2001	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2002	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2003	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2004	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2005	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2006	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2007	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2008	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2009	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2010	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2011	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2012	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394
2013	0.037	0.084	0.274	0.126	0.323	0.290	1.000	0.394

5.15 JLL_GOM

Lognormal dist.
month 0 numbers
Ages 9 - 16
log-likelihood = 1.11
deviance = 5.95
Chi-sq. discrepancy= 4.28

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
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1974	0.153	0.454	-0.302	0.600	0.113E-04	0.968	1.309	0.337
1975	-0.442	0.386	-0.828	0.600	0.113E-04	0.534	1.222	0.931
1976	-0.221	0.318	-0.539	0.600	0.113E-04	0.666	1.142	0.607
1977	0.094	0.168	-0.073	0.600	0.113E-04	0.913	0.982	0.115
1978	0.053	-0.022	0.075	0.600	0.113E-04	0.876	0.812	0.023
1979	0.438	-0.207	0.645	0.600	0.113E-04	1.287	0.675	0.809
1980	0.332	-0.430	0.762	0.600	0.113E-04	1.158	0.541	1.438
1981	-0.407	-0.667	0.260	0.600	0.113E-04	0.553	0.426	0.016

Selectivities by age

Year	9	10	11	12	13	14	15	16
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1974	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856
1975	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856

1976	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856
1977	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856
1978	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856
1979	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856
1980	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856
1981	0.031	0.067	0.104	0.299	0.604	0.638	1.000	0.856

5.16 TAGGING

Lognormal dist.
average numbers
Ages 1 - 3
log-likelihood = 1.59
deviance = 9.08
Chi-sq. discrepancy= 7.09

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
1970	1.232	0.545	0.686	0.600	0.931E+00	1065132.000	536220.973	1.003
1971	1.170	0.357	0.813	0.600	0.931E+00	1001624.000	444197.230	1.802
1972	0.329	0.311	0.018	0.600	0.931E+00	431955.000	424194.423	0.052
1973	-0.526	0.093	-0.620	0.600	0.931E+00	183616.000	341262.415	0.700
1974	0.094	0.591	-0.497	0.600	0.931E+00	341589.000	561527.986	0.558
1975	0.579	0.329	0.250	0.600	0.931E+00	554596.000	431903.249	0.012
1976	-0.205	-0.012	-0.193	0.600	0.931E+00	253265.000	307263.452	0.224
1977	-0.189	-0.250	0.062	0.600	0.931E+00	257385.000	241994.349	0.029
1978	-0.943	-0.360	-0.583	0.600	0.931E+00	121110.000	216958.797	0.658
1979	-1.146	-0.418	-0.728	0.600	0.931E+00	98815.000	204684.106	0.822
1980	-0.479	-0.547	0.068	0.600	0.931E+00	192541.000	179878.526	0.026
1981	0.084	-0.640	0.724	0.600	0.931E+00	337995.000	163849.383	1.207

Selectivities by age

Year	1	2	3
1970	1.000	1.000	1.000
1971	1.000	1.000	1.000
1972	1.000	1.000	1.000
1973	1.000	1.000	1.000
1974	1.000	1.000	1.000
1975	1.000	1.000	1.000
1976	1.000	1.000	1.000
1977	1.000	1.000	1.000
1978	1.000	1.000	1.000
1979	1.000	1.000	1.000
1980	1.000	1.000	1.000
1981	1.000	1.000	1.000

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TOTAL NUMBER OF FUNCTION EVALUATIONS = 14329