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REPORT OF THE 2012
ATLANTIC BLUEFIN TUNA STOCK ASSESSMENT SESSION

(Madrid, Spain – September 4 to 11, 2012)

1. Opening, adoption of the Agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid. Mr. Driss Meski, ICCAT Executive Secretary, opened the meeting and welcomed participants.

Drs. Clay Porch (USA) and Jean-Marc Fromentin (EC-France), BFT Rapporteurs for the western and eastern stocks, respectively co-chaired the meeting. Drs. Porch and Fromentin 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	P. Pallarés
3	C. Porch, J-M- Fromentin
4.1	J. Neilson, E. Rodríguez-Marín
4.2	G. Díaz, S. Deguara
4.3	A. Kimoto, J.M. Ortiz de Urbina, W. Ingram
4.4	J. Neilson, E. Rodríguez-Marín, M. Lauretta
4.5	S. Deguara
5	C. Porch, S. Cadrin, H. Arrizabalaga
6	M. Lauretta, S. Cass-Calay, C. Porch, J. Walter, S. Bonhommeau, JM Fromentin
7	L. Kell, J. Walter, J.M. Fromentin, M. Lauretta, S. Cass-Calay, C. Porch
8	C. Porch, J.M. Fromentin

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 re-structured 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

The Commission's Rebuilding Plans for Atlantic and Mediterranean bluefin were reviewed.

Eastern Atlantic and Mediterranean Rebuilding Plans. Recommendation 08-05 (which replaced Rec-06-05)called for a 15-year rebuilding period, 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 underregulations 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 F0.1 (or another adequate FMSY 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 B_{MSY} 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 B_{MSY} with probabilities ranging from 50-90% taking into account [Res09-12].

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 limts) and strengthened several control mechanisms to ensure the management measures would be respected and to ensure the traceability of all the catches.

In the case of western Atlantic bluefin tuna, the Committee advised 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 and 2012 [Rec. 10-03].

4. Summary of available data for assessment

4.1 Biology

The Group reviewed 14 working papers describing recent advances in our understanding of 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.

Apart from these new contributions, a summary of the current assumptions concerning life history attributes as used in the assessment is provided in the table below for the West Atlantic and East Atlantic and

Mediterranean stocks:

Life history attribute	*Assumption used by the SCRS*	*Source (also see ICCAT Manual)*	*Notes*
Growth (length at age)	von Bertalanffy growth West: K=0.089; L_∞=315 cm; t_0= -1.13 East & Med: K= 0.093; L_∞=319 cm; t_0=-0.97	Restrepo *et al.* (2011) Cort (1991)	For the west, the SCRS adopted the growth curve of Restrepo *et al.* (2011) in 2009, and the current assessment uses it for the base case.
Growth (length-weight)	West: Area and season specific conversions are used, East & Med. < 101 cm: $W=2.95.10^{-5}*FL^{2.899}$ East & Med. >100 cm: $W=1.96.10^{-5}*FL^{3.009}$	ICCAT conversion factors ICCAT conversion factors	2008 Assessment noted a need to review conversions for the West.
Natural mortality	West - M assumed age-independent (=0.14yr^{-1}) East & Med. Starting at age 1: 0.49, 0.24, 0.24, 0.24, 0.24, 0.20, 0.175, 0.15, 0.125, 0.10	Anon. (1997)	Anon. (1997) An age-specific vector for M is applied for ages 1 to 10+, (Anon. 1997).
Longevity	East: > 20 yr West: 32 yr	Fromentin and Fonteneau (2001) Neilson and Campana (2008)	Based on tagging data. Based on radiocarbon traces.
Maturity	West 100% maturity: Formerly age 8, now age 9 using Restrepo *et al.* (2011) growth model. East & Med. 50% maturity: Age 4 (115 cm / 30 kg).	Baglin (1982) Anon. 1997	Diaz (2011) suggest later age at 50% maturity (age 15-16), but Goldstein *et al.* (2007) suggest for the west asynchronous reproductive schedule and smaller size at maturity. Recent findings indicate fish were mature at age 5 (SCRS/2012/161) M50 at 105cm, (age 3.5) from Corriero et al. (2005)
Spawning area	West: Gulf of Mexico. East & Med.: Around Balearic Islands, Tyrrhenian Sea, central Mediterranean and Levantine Sea.	Multiple sources, see Rooker *et al.* (2007) and Fromentin and Powers (2005) or Mather *et al.* (1995) for reviews.	Other spawning areas have been hypothesized, but not yet demonstrated. See presentation 2012/149 for further information on spawning in the Mediterranean.
Spawning season	West: April to mid-June. East & Med.: mid-May to mid-July.	As above.	Timing of the spawning season can change from year to year due to environmental conditions.

Biometrics, size structure, sex ratio and growth

SCRS 2012/104, 105, 128 and presentation 2012/141 provide relationships that improve the limited ICCAT conversion factors and some of the new estimated length - weight relationships may significantly modify the estimation of catches in weight in the Mediterranean area. Furthermore, SCRS 2012/104 provides length-weight relationships at a higher level of temporal resolution (monthly) than the previously-available relationships. This may also affect the raised estimation of catch weight.

SCRS 2012/114 indicated that maximum L_{max} found in a review of available data was 330 cm, and that both bluefin tuna Western and Eastern growth curves have a $L_{infinity}$ that lies within the confidence limits of 319.93±11.3 cm. The authors suggested the method described in Doc. SCRS/2012/132 to recognize and remove outliers from ICCAT database. The Group cautioned that the removal of outliers was a subjective process, and the occurrence of larger individuals could be expected with natural variability in the population.

SCRS/ 2012/117 and 128 described the sex ratios of Mediterranean bluefin tuna caught in purse seiners and by longliners based on large samples, and found that males dominate the first and last length classes, while females dominate the intermediate length classes.

Mixing and Stock Structure

SCRS 2012/101 considered the development of the 2003 year class. The Group noted that the size frequency of the samples from 2007 to 2009 showed a decrease in the west, and an opposite trend in the east. This could reflect a change in sampling effort as opposed to relative strengths of the year-class between the east and the west. The authors agreed that changes in the fishing distribution of the Japanese fleet did occur (see also SCRS 2012/130) and are important to consider.

Presentation 2012/142 considered the large historic catches of bluefin tuna off Brazil, and discussed the state of knowledge concerning the stock origin of those fish. Definitive conclusions on stock origin are not possible at this time, as biological samples have not yet been located (although it was suggested that such material might still exist in national archives). However, analyses of monthly catch patterns in other western Atlantic fisheries indicates that the catches off Brazil may have been from the western stock. The Group also noted that small catches of bluefin tuna have been made recently in the same area as the larger historic catches. Obtaining otolith or tissue samples from these and other south Atlantic fisheries was suggested as a priority for GBYP activities. The Group asked if PSATs provide further insight or “close kin” analyses as completed in some Southern Bluefin Tuna studies (Bravington and Grewe 2007). This approach requires many samples, but can provide an orthogonal comparison with microconstituent analyses. The Group recalled that despite intensive deployments in the west, it is still difficult to reach certain conclusions about spawning locations. The approach of genetic tagging may be of utility, because it partially avoids the problem of reporting of the tag.

The Group noted that in contrast to historical estimates of nil to very low rates of eastern stock contribution to Gulf of Mexico spawners (reported in SCRS/2012/155), an 8.3% (±4.6% SD) estimate occurred for the recent period (2009-2010). This estimate, based on otolith chemical analysis, was not statistically different from nil. The issue was raised that any eastern contribution to Gulf of Mexico spawners would be inconsistent with genetic separation between the two stocks. The Group also cautioned that with mixed stock analyses, there can be a bias towards higher proportions of the relatively rare stock in cases where there are large differences in the size of the mixing stocks, as is the case for Atlantic bluefin tuna. In such situations, it is difficult to be confident regarding mixing levels without large samples. The authors also clarified that the fish used for establishing the baselines for the Gulf of Mexico and the Mediterranean were 14-18 months of age. It was asked if fish could move out of the natal area within that time window. The authors responded that movements of that nature would likely impact the variability of the conclusions but not necessarily the ability to resolve mixing. SCRS/2012/155 also indicated that the extent of western stock membership in fish caught in western fisheries may be declining over time, although it was acknowledged that the sample sizes were small. The Group agreed with the concern regarding sample size, and encouraged continued analyses of historical samples. Integration of these results with tagging studies may allow better insight into mixing issues (see work proposed in SCRS/2012/138). SCRS/2012/156 reported that for the 2003 year-class, the estimated contribution rate of Gulf of Mexico members was 49.2% ± 13.2% SD, indicating important contributions from both natal regions.

SCRS/2012/152 presented first results on the natal origin of 470 juvenile and adult Bluefin tuna caught in the Bay of Biscay during 2009-2011. Maximum likelihood estimates of proportions of origin indicated that a large fraction (95-100%) of the Atlantic bluefin tuna caught in the Bay of Biscay fishery originated in the Mediterranean. However, it was noted that individuals with most depleted $\delta^{18}O$ values were all caught at similar times, suggesting that intermittent west to east migration pulses might occur, but such migrations are unquantified and could involve relatively few fish. The Group cautioned that the sample size was not enough to quantify interannual variation and further observations would be required to support the inference of intermittent trans-Atlantic recruitment. It was noted that the hypothesis of intermittent trans-Atlantic migration of juveniles was previously found in conventional tagging studies (Rooker et al. 2007). This hypothesis, if confirmed, would probably have minor implications for the eastern stock assessment, but potentially important implications for the western stock assessment.

Reproduction/Maturity/Larval Studies

SCRS 2012/161 provided new information on the reproductive and sexual maturity of 529 Atlantic bluefin tuna sampled from 2004–2010 on NW Atlantic foraging grounds off New England, Canada, and young of the year from Virginia. The study indicated that individuals as small as 134 cm were mature, in contrast with the current assumption of the SCRS. The Group discussed possible biases associated with mixing of eastern origin fish. The presenter responded that determinations of natal origin were not made. However, the Group recalled that existing data on natal origin from the regions referred to in SCRS 2012/161 indicated that the fish are largely western origin (Rooker et al. 2008). The Group also noted the work of Mather et al. (1995), who reported results consistent with the current study which found fish to be mature at age 5.

SCRS 2012/115 described the MEDIAS surveys, undertaken in June-July during the Mediterranean peak spawning season and optimal for sampling bluefin larvae in the Balearic Sea. These surveys occurred from 2009 to 2011 and continued an earlier survey (2001 to 2005). A more complete survey covering peak spawning times was undertaken in 2012. The Group recognizes the importance of fishery independent surveys such as these to provide important information on larval distribution and abundance.

General Biological Papers

The main research achievements obtained by the GBYP “Biological Sampling and Analysis” program were presented to the Group. While there was insufficient time to fully review the results, the progress appeared substantial (see, as examples, the results pertaining to stock structure and direct age estimations).

The Group recommended that the new biological information presented in this section should be carefully considered during a special intersessional meeting proposed for 2013, in order to validate the methodology and evaluate the influence in the stock assessment.

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 2011 were provided to the Group during the meeting. Task I for EU-Spain was not available at the time of the assessment, preliminary estimates were provided by EU-scientists at the meeting.

The revised annual bluefin nominal catches (Task I) from 1950 to 2011 presented by the Secretariat and summarized in **Table 1** and **Figure 1** shows the spatial distribution of bluefin catches (1950-2009) by gear and decade. **Figures 2** and **3** shows the reported annual bluefin catches by area and main gear.

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 have been 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 and has induced a deterioration of bluefin tuna catch at size. Task I data reported catch by country and fishing region, for 2008 and 2011 were reviewed during the meeting.
Catch-at-size (CAS) and catch-at-age (CAA)

The substitution scheme for missing size/CAS was reviewed and adopted during the bluefin data preparatory meeting in 2010. The Secretariat presented the substitution tables for the updated CAS in 2012 (**Tables 2, 3 and 4**). During this meeting the following changes to the CAS were adopted by the WG:

1. To add the size data for Mexico 2010 and 2011 provided by the scientist during the meeting
2. After review of the 2011 size data from Turkey it was recommended not to use this data to estimate CAS, because it represents samples from farms with a very different size frequency. Thus the WG decided to use the size substitution of 2009/2010 (EU_France purse seine).

The Group reviewed the substitution scheme u in the 2010 bluefin tuna data preparatory meeting. The level of substitution continues to be high in particular for the Mediterranean purse seine fisheries (with substitution on the last two decades of 30% in the East Atlantic unit and 70% in the Mediterranean unit, SCRS/2010/119). It was noted that in the West, the size sampling is much better and that the more important fisheries and CPCs provide size samples or CAS data. Some analyses were presented during the stock assessment session and have stressed that there are serious deficiencies in the available data that the Group must use to estimate both the CAS and CAA for the eastern stock (SCRS/2012/116). Most of these problems are due to the low number of size samples that leads to high levels of raising and substitution among years, fleets and areas. For instance, since the late 1990s size samples cannot be obtained from Mediterranean purse seiners due to farming. Progress has been made over the last years, but current information that consists in individual weight after fattening remain too uncertain to be used within stock assessment models. Therefore, CAS is currently produced from logbook information back transforming mean weight in size (Fromentin, 2004). This method is used for a single fleet, so that this mean weight information is then used to raise all Mediterranean PS fleets. Consequently, the resulting CAS exhibits a size distribution that slices all cohort information and further blurs all the age structure in the catches. These large errors in the CAA strongly affect the VPA performances (see below section 5). For the substitution, the same rules have been applied for the most recent years, i.e. 2010 and 2011. Conversion of the CAS to CAA use the same age slicing procedure and algorithms used and adopted by the Group in the 2010 assessment (SCRS/2010/120). .

Document SCRS/2012/116 presented a review of the size data available in the ICCAT data base (DB) and the sized data collected under the G-BYP . The document concluded that size frequency distributions statistically varied by year, month, gear and fleet. Thus size sampling or CAS should at least be provided at this level of stratification. It was also concluded that there were no differences between size frequency samples obtained under the G-BYP and the samples available in the ICCAT DB. Finally it was recommended that if size samples were to be used as direct input for integrated models, such as catch statistical models, they need to be reviewed in collaboration with CPC scientists to clarify any doubtful series in the ICCAT size data. It is recommended by the Group that this new material, some of which is already available, should be analysed in the near future to understand the implications of the data and determine how it can be incorporated into the next SCRS BFT assessment.

Document SCRS/2012/109 analysed how the implementation of regulatory measures of the Atlantic bluefin tuna Recovery Plan in 2007 resulted in changes in the fishing strategy of the bait boat fishery in the Bay of Biscay due to market conditions. The results showed that the catch at age since the implementation of regulatory measures of the Recovery Plan in 2007 comprised a larger proportion of older specimens than in the previous time period. This trend became more evident when 1 year old specimens were excluded from the analysis. A strong year class signal from 1994 and 2003 cohorts was observed in the data series but this last year class signal did not explain the general trend of the last five years.

Document SCRS/2012/130 presented an overview of the operation pattern, fish size, trends in total catch and effort and nominal CPUE of the Japanese longline fishery in the Atlantic with respect to bluefin tuna up to December 2011. In the both west and east Atlantic, the recent fishing grounds for bluefin changed and/or substantially shrank, due to the introduction of IQ system for the Japanese longline vessels. In the east Atlantic, the Japanese longline vessels operated almost solely in the Northeast Atlantic (north of 40N). The total catch in the west Atlantic has been relatively stable between 280 and 420 tons in the past five years, whereas the caches in the east Atlantic substantially decreased from 2200 to 1100 tons; following the reductions in the national quota. The nominal CPUEs in the west Atlantic fluctuated significantly since 2007 fishing year, showing considerably high values for 2007, 2009, and 2011 fishing years, while a steep increasing trend since 2009 fishing year was observed in Northeast Atlantic.

Estimation of fish number and weight in purse seine catches

A comparison between 2012 purse seine caught BFT in the Adriatic Sea and those caught in the period 1999 to 2001 was presented in document SCRS/2012/135. The study confirmed that the predominant fish caught in both periods were 2 year old fish, with smaller percentages of 3 and 4 year old fish.

Various documents presented results of the pilot studies required in paragraph 87 of Rec 10-04. The results from the studies conducted in Turkey were reported in document SCRS/2012/052. The trials involved the use of stereoscopic cameras to measure the length of a number of fish in the cage and during the transfer to another cage through a gate followed by the subsequent harvest of the population to compare the lengths and weights estimated from the stereoscopic camera length measurements with the lengths and weights of the harvested fish. The authors confirmed the utility of the stereoscopic camera system to count and measure BFT and provided a number recommendations to further improve the efficiency and accuracy of the stereoscopic camera system. The Group noted some differences in the mean lengths determined by the stereoscopic camera but the authors were not available during the meeting to provide the necessary clarifications.

Similar work was carried out in Croatia as described in document SCRS/2012/136. The stereoscopic camera was applied at the point of first transfer into the farm cage (caging). A number of fish were killed so that the length and weight of these fish, together with a number of fish which had died during the transfer were taken and compared to the lengths and weights determined from the stereoscopic camera. From the analysis of errors of measurement, the authors concluded that further work is required to further improve the accuracy of measurement with the stereoscopic camera and better define the mathematical models used to convert measured length into weight.

An alternative approach to measure BFT was presented in document SCRS/2012/133 where a combined use of a single video camera and different acoustical systems were employed during the transfer of BFT from one cage to another. The authors described the various different equipment options available for the application of this technique and the practical considerations which were taken into consideration and have to be further investigated to improve the accuracy of the system.

The Group noted the progress that is taking place in the practical application of alternative techniques, in particular that of the stereoscopic camera, to count and measure the length of caged BFT. It was pointed out that a number of factors may affect the accuracy of the stereoscopic camera measurements, including lighting conditions, general weather conditions, distance of fish being measured to the angle of measurement in relation to the position of the fish. It was commented that fish may suffer a drop in condition from the time of capture to the actual caging. The importance of utilizing the correct L-W relationships to convert the lengths measured by the stereoscopic camera to weight was emphasized with a suggestion to carry out field trials to determine the appropriate equations. It was the view of the Group that, even if there are small errors in the determinations of length, the technology should move forward from the pilot study phase to full operational implementation. The organization of a working group was proposed to establish procedures for CPC to use the stereoscopic camera was proposed for 2013. However, the Group also stressed that current measurements from stereoscopic cameras are very encouraging and may lead to higher precision of the CAS from the PS fleets. As real size samples at time of the catch are still required, the Group stresses the importance of making the stereoscopic camera systems or any alternative technique that would provide equivalent precision to recover size information from farms operational for the coming year.

Document SCRS/2012/125 presents an analysis of the VMS data conducted by the Secretariat. The Group inquired if all ICCAT vessels operating in the Mediterranean Sea were equipped with VMS because VMS data and vessel catch rates could be used to estimate total catches. The Secretariat indicated that currently it is not possible to link VMS data with individual vessels catches. The Group emphasized the potential utility of linking VMS and catch data. The Secretariat also informed the Group that ICCAT vessels in the Mediterranean are expected to provide a ‘declaration of activity’ and that in some cases such information was not available making the estimation of total fishing effort more difficult. Overall, there was wide consensus within the Group of the great utility of VMS data and the high quality of the analysis conducted by the Secretariat, and recommended that this type of analysis be continued in the future.

Document SCRS/2012/148 presents an updated CPUE series from Balfego and it investigated correlations in the catch rates among fisheries of the Western and Eastern Atlantic and Mediterranean stocks. The Group agreed that the correlation found in the CPUE series between the Gulf of Saint Lawrence (GSL) fishery and some of the eastern BFT fisheries was an unexpected result, particularly considering that the catch of the GSL fishery has been described as being composed entirely of fish of Gulf of Mexico origin. In general, the Group cautioned with regard to the interpretation of correlation results. For example, the correlation found between some of the eastern and some of the western fisheries could be the result of simultaneous recruitment responses to environmental signals. The Group discussed the result that showed a negatively correlation between the GSL fishery and the U.S. Northeast fisheries. The Group discussed if this was an unexpected result given that these 2 CPUE series are considered to be indexing ages 8-9 of the Western stock. However, this particular result could be explained by of changes in the spatial distribution of adult fish, or certain age classes, throughout the time series considered. . The Group also discussed the issue of autocorrelation and multiple testing, but the author indicated that autocorrelation was only found for the trap fisheries. In general, it was agreed that giving the observed extent of mixing between the Western and Eastern stocks it is not surprising that some CPUE series showed positive correlations.

4.2.2 Western Atlantic

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 United States 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), total catch in the West Atlantic declined steadily to a level of 1,638 t in 2007 (**Figures 4** and **5**), the lowest level since 1982, before rising to 1,986 t in 2011, which is 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.

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 2007-2011 (including reported dead discards) totaled 491, 576, 533, 530, and 510 t, respectively. The 2006 catch was the highest recorded since 1977. The 2011 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, 925, and 884 t, respectively. The 2011 catches, including dead discards, by gear were: 70 t by harpoon, 231 t by longline, and 583 t by rod and reel and handline gear combined.

The U.S. bluefin fishery continues to be regulated by quotas, seasons, gear restrictions, limits on catches per trip, and size limits designed, to conform to ICCAT and domestic recommendations. The Group discussed the potential for these regulatory measures to influence perceptions of abundance, especially when there are changes or trends in the measures. A summary of how these measures have changed over time is therefore presented here.

The U.S. bluefin tuna allocation is subdivided among commercial and recreational user groups generally by gear type. Vessel owners must select a specific permit category that governs their allowed fishing practices throughout the calendar year. In addition to quota allocations, particular effort controls are also instituted for recreational and commercial (including charter) vessels. Through 2011, the daily retention limit for vessels using commercial hand gear could be adjusted between 0 and 3 bluefin tuna measuring greater than 185 cm Curve Fork Length (CFL), and was generally been set at 3 since 2006 due to the limited availability of fish in this size class. For recreational fishermen, daily and annual limits may be adjusted to allow retention of certain size classes of fish by season, area, and type of vessel (private vs. charter). Prior to 2006, recreational retention limits varied considerably among seasons as well as among private versus charter vessels (i.e., limits in 2003 included 6 recreational sized bluefin [69-185 cm CFL] for both private and charter vessels whereas in 2004 it was reduced to 2 for private and 3 for charter vessels during portions of the fishing season). In 2006, retention limits were reduced substantially for all vessels fishing recreationally on bluefin tuna measuring 69-119 cm CFL in order to avoid exceeding the ICCAT tolerance of bluefin measuring less than 115 cm CFL. Since 2006, more stringent management measures and recreational limits have remained in place for the recreational fishery with recent efforts focused on limited landings of medium sized bluefin (119-185 cm) for domestic management purposes. Of particular note were management measures for 2010-2011 prohibiting recreational landings of fish 144-175 cm FL during the main fishing season, which affected the 2003 cohort during those years.

These management measures may have impacts on the CAA which are somewhat independent of availability. For the abundance indices which are used to tune the models applied to the CAA (and are therefore intended, in part, to compensate for such impacts), potential changes in fishing behavior and preferences for pursuing specific size classes of bluefin tuna are accounted for in several ways. These include restricting observations to trips actively targeting each specific size class, recording catches specific to size classes and including released fish, and including management measures as factors in the standardization.

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 2010 and 2011 were 353, and 578 t, respectively.

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

As noted previously, the CAS and CAA for the western Atlantic were generated as described in documents SCRS/2010/119 (revised) and SCRS/2010/120, with the results shown in the **Appendix 6** on VPA inputs. The output from the R-Script AgeIT was also used to generate partial CAA corresponding to some indices with restrictions on sizes and month, a process which was facilitated by the new software.

Document SCRS/2012/119 responds to Rec 10-03 by providing yield and spawner per recruit analyses to evaluate the effectiveness of current size limits in the fishery for conserving and rebuilding spawning stock biomass and comment on alternative approaches. The Group enquired about the assumption of post-released mortality (which amounted to 20% of the landed fish) used by the authors with respect to the U.S. rod and reed fishery of 'small fish' (BFT < 145 cm FL, coded as RRFS in the ICCAT database). It was noted that the minimum assumption corresponded to a 16% post-release mortality, which is higher than the 5% mortality estimated for the Canadian recreational fisheries. The authors clarified that the 5% estimate relates to larger bluefin tuna (400kg) caught in the colder waters of the Gulf of St. Lawrence recreational fishery. The range of values explored did not take into account the proportion of fish released in the fishery nor is there empirical evidence supporting the assumed values. However, given that the observed proportion of US released fish for the period 2002-2011 varied between 1/4 of the landed fish to 3 times the landed fish, there appears to be potential for impacts associated with this fishery. The authors acknowledged that some of the assumptions made in their analysis were somewhat arbitrary, in particular assumptions of post-release mortality relative to landed mortality. The Group also noted that the results were likely sensitive to assumptions of underlying natural mortality. Therefore, the authors made further calculations using the M assumption (higher) for the East Atlantic and Mediterranean. As expected Y/R and SSB/R were lower by about half, but the relative differences between the different selectivities were broadly similar. The group recognized that Y/R and SSB/R could be improved under different selectivity patterns, but also recognized that the allocation changes that this would imply might not be easy to resolve. The Group recommended that more post-release mortality studies should be conducted, particularly for other size groups and in other areas.

Document SCRS/2012/163 presents an analysis of the incidental catch of bluefinm tuna *(Thunnus thynnus)* by the Mexican longline fleet operating in the Gulf of Mexico targeting yellowfin tuna during the period 1994-2011. The Group noted that the size frequency distribution of BFT incidentally caught by the Mexican longline fleet operating in the Gulf of Mexico contained fish as small as 115 cm FL. Fish of that small size have not been observed in the catches of the U.S. pelagic longline fleet which operates in the Northern Gulf of Mexico. The U.S. BFT catches are almost entirely composed of fish > 170 cm FL. An examination of the size frequency of the Mexican catches by area showed that the catches of the Mexican vessels operating in the central area of the Gulf of Mexico have a similar size composition to the catches of U.S. vessels; while catches from the southern Gulf of Mexico and closer to shore showed the presence of smaller BFT. Albeit the relatively small sample size in the Mexican data (757 fish caught over 18 yr), the Group agreed that the data highlighted 2 important facts: 1) the presence of BFT of 115 cm, and 2) that BFT of different sizes seem to occupy different areas of the Gulf of Mexico (something that has already been observed in the Mediterranean Sea). The author pointed out that the proportion of the BFT < 170 cm FL in the catches was 4%. The Group also indicated that the small fish observed in the Mexican catches corresponded to fish of age 4. In addition, it was noted that the Mexican data could be used to develop a CPUE series for use in future stock assessments. The Group agreed on the importance of these findings and recommended to collect more BFT data from the Mexican longline fishery as well as to expand maturity studies and electronic tagging to include fish caught in the southern Gulf of Mexico.

4.3 Relative abundance estimates

4.3.1 Relative abundance Indices and fishery indicators – East

Six documents dealing with CPUEs were submitted to the Group:

SCRS/2012/100 reported both indices of the Bay of Biscay baitboat fishery, 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, 2000-2011, 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.

SCRS/2012/103 presented updated standardized catch rates of bluefin tuna caught by the Moroccan and Spanish traps in the Atlantic area close to the Strait of Gibraltar for the period 1981-2011. Standardized catch rates were estimated through a General Linear Modeling (GLM) approach under a negative binomial error distribution assumption.

SCRS/2012/111 reported updated bluefin tuna standardized catch rates for the four Spanish traps operating in the area close to the Strait of Gibraltar for the period 1981- 2011. Catch rates standardization was accomplished by General Linear Modeling (GLM) techniques under a negative binomial error distribution assumption

SCRS/2012/124 presented an update of the aerial surveys carried out by Ifremer in the Western Mediterranean Sea since 2000. Since the Gulf of Lyons is considered a nursery ground for young individuals, these data would enable monitoring the juvenile population of bluefin tuna, The aerial surveys for juvenile bluefin tuna were carried out along the same transects between 2000-2003 and then 2009-2011. Detections are used to calculate a fishery-independent index of bluefin tuna abundance. The most striking result of these aerial surveys is the sharp increase in ABFT density since 2009 that were about 4-fold those of the 2000-2003 period.

SCRS/2012/131 reported updated abundance indices of bluefin tuna from the Japanese longline fishery in the West and Northeast Atlantic up to the 2011 fishing year, standardized using a delta-lognormal model with random effects. The index corresponding to the East Area (Eastern Atlantic, south of 40N, and the Mediterranean Sea) was not updated due to a reduction in the number of records for the most two recent years. The index in the Northeast Atlantic showed a steep increasing trend since 2009 fishing year, and the size of bluefin caught showed the contribution of the strong 2003 year class. The age structure of the catches in this area suggested that the age at full recruitment for the northern fishing ground (north of 50N) would involve older mature fish, and that the Japanese longline gradually exploited the 2003 year class since the 2009 fishing year. In the CPUE series, several unexpected high points were observed in the recent years, which could partly reflect an increase in abundance due to the strong year class of 2003 as well as the consequences of the implementation of the IQ system for the Japanese longliners.

SCRS/2012/164 presented fishery independent indices of bluefin tuna larvae in the western Mediterranean Sea utilizing ichthyoplankton survey data collected from 2001 through 2005 by the Spanish Institute of Oceanography. Indices were developed using larval catch rates collected using two different types of bongo gear by employing a delta-lognormal modeling approach, which included the covariates: water temperature at 25 m, salinity at 25 m, water depth, time of day, geostrophic water velocities, year, and a gear variable for the combined model.

A discussion mainly focusing on the effects of current management measures on the reported CPUEs followed these presentations. As regards the Bay of Biscay bait boat index (SCRS/2012/100), the authors reported that in addition to technological and environmental factors, the effects of regulation had also been considered in the analysis. The group agreed on the importance of this series since it is the only index for juvenile bluefin in the East Atlantic.

As for the Moroccan and Spanish trap index (SCRS/2012/103; SCRS/2012/111), the authors stressed that these indices took into account the number of fish released in both countries as the quotas were reached. It was pointed out that the currently implemented quota-by-gear system as well as annual variability in abundance or availability of bluefin tuna to the traps are either already affecting or will affect in the near future the length of the trap season. Since this is the effort unit implicitly used when modeling catch rates, the Group agreed that forthcoming updates of the indices should explicitly include this effort metric.

In addition, the Group acknowledged that both the fishery-independent index for juvenile bluefin based on aerial surveys in the Mediterranean (SCRS/2012/124), and the fishery-independent index based on larvae surveys in the Mediterranean Sea (SCRS/2012/164) involved a potentially valuable contribution for future stock assessment. The Group also discussed the possibility of taking account of variations in environmental conditions for the aerial surveys as it is done for Southern bluefin tuna in the Great Australian Bight.

The CPUE Series used for the tuning of the Eastern VPA were (**Tables 5** and **6** and **Figure 6**): Norwegian purse seine for ages 10+, Spain-Morocco trap combined for ages 6+, Japanese longline North East Atlantic for ages 6+, Japanese longline East Atlantic & Mediterranean for ages 6+, and the Spanish bait boat 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 bait boat_1 (1952-1962, ages 5-6), Spanish bait boat_2 (1963-2006, ages 2-3) and Spanish bait boat_3 (2007-2011, ages 3-6).

4.3.2 Relative Abundance Indices and fishery indicators – West

Document SCRS/2012/131 provides updated standardized bluefin CPUE from the Japanese Longline Fishery in the Atlantic to 2011 Fishing Year using delta-lognormal model with random effects. The West Atlantic index fluctuated significantly since the 2007 fishing year, showing considerably higher values for 2007, 2009, and 2011 fishing years. These high indices might be related to the abundance of relatively small-sized bluefin (135-150cm, 50-60kg) in the catch. The size data in the West Atlantic suggested a possibility of the mixing of fish from the east stock in the west catch. However, the possibility of appearance of strong year class of 2003 in the west stock as in the east stock cannot be rejected. It was suggested that careful considerations would be needed for the use of these CPUE series in the stock assessment of both west and east stocks.

Document SCRS/2012/118 provided indices of stock status from the Canadian bluefin tuna fishery. The standardized catch series from the Canadian rod and reel, tended line and harpoon fisheries was provided for two geographically distinct areas: south west Nova Scotia (SWNS) and the southern Gulf of St. Lawrence (sGSL). Both series show an increasing trend in abundance that has been sustained since 2000. Management changes are shown to have an impact on the estimates. In SWNS the series was affected by the non-mandatory submission of logbooks and the implementation of individual transferable quotas whereas in the sGSL, fishing restrictions imposed by the regional fishing associations affected the period of the year that was fished. Trends in the abundance of prey species within the domain of the indexed areas show a decline for herring and mackerel.

There was considerable discussion concerning the high value and large variance of the index in 2010. It was noted that the annual index values receive equal weighting in the stock assessment and therefore that the 2010 value might have undue influence on the stock assessment results (because the model would not account for the correspondingly high variance). It was also pointed out that this value reflected an unusual circumstance where the fishery was open only for a few days and that fishermen likely changed the way they fished. The Group agreed to drop the 2010 index value for sGSL in the base case model, but to include it in a sensitivity run. There was also some discussion about whether or not to use the revised index for SWNS (which uses effort as a factor in the model) or a strict update of the series used in the 2010 assessment (which uses effort as an offset). The Group agreed that there was insufficient time to properly evaluate the rationale and implications of the new approach at this time. However, the group agreed that the proposed approach should be explored further for future assessments.

Document SCRS/2012/160 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 1987-2011. The index was constructed using a “repeated measures” procedure to account for the variance in catch rates between vessels, and standardized using Generalized Linear Mixed Models and a delta-lognormal approach. The updated index was developed to be a strict update of the U.S. Pelagic Longline Index used in the 2010 assessment of Western Atlantic bluefin tuna. An alternative index was constructed to explore the introduction of additional explanatory variables. Both indices were very similar in trend. Due to changes in the fishery in 2011 which resulted in very low fishing effort in the Gulf of Mexico during January-May, the authors do not recommend the use of that estimate.

The Group further discussed on the validity of the estimated CPUE value for 2011. It was noted by the authors that in 2011 the U.S. longline fleet operated very differently from previous years; only 18 of the trips that met the filtering criteria caught bluefin tuna and these were limited vessels targeting swordfish in the Southeastern part of the Gulf of Mexico (which historically have low BFT CPUE). Given these factors, the Group agreed that the CPUE values estimated for 2011 were not consistent with the rest of the time series and did not reflect the relative abundance of Bluefin tuna in the Gulf of Mexico. Accordingly, the 2011 data point was not included in the stock assessment.

Document SCRS/2012/158 provided updated standardized catch rates of bluefin tuna from the Rod and Reel/Handline Fishery off the Northeast United States during 1980-2011. Individual trip rod and reel/handline catch per unit effort data, collected through interviews with fishermen, were used to estimate standardized catch rates considering factors such as time of year, area fished, boat type, fishing method, fishery open/closed status, bag limits and targeted species. Models were developed for three size categories of bluefin tuna, implementing a delta-Poisson approach in which catch rates are considered as a product of binomially distributed probabilities of a positive catch and Poisson distributed positive catch rates. The indices for the early period include a series for small bluefin (< 145 cm SFL) for 1980-1992 and for large bluefin (>195 cm SFL) for 1983-1992; these are presented unchanged from previous analyses. Also presented unchanged are the indices for 145-177 cm SFL bluefin and large bluefin (>195 cm SFL, 1983-2001), which were not used for the last Western Atlantic stock assessment. For the period 1993-2011, indices were calculated with current available data, developing new models following the same model standardization procedures as those of previous studies, for 66-114 cm, 115-144 cm, and >177 cm SFL bluefin. The distinct periods were defined because changes in survey data collection implemented in 1993 permitted separation of the catches into the smaller size intervals and because regulatory and management changes imposed different daily limits and fishery closures for those size categories.

The Group discussed impacts of management measures on the interpretation and possible bias of the index values developed for these series. One concern was that vessel limits resulted in bias in CPUE; however, discarded fish are reported in the database, with a large number of observations of catch greater than the vessel limit, indicating that there is no bias from limits, as long as fisherman report discarded BFT after the limit has been reached. The other concern is that vessel limits result in fisherman shifting effort to target other species in the middle of the trip. A preliminary analysis of the proportion of BFT in the RR catch over time did not show a large change in proportion catch of BFT, indicating that the indices are not biased as a result of shifting effort to target other species. Additionally, targeted species is recorded in the database, and several records demonstrated different efforts being partitioned by targeted species, indicating that effort shifting bias was not present. It certainly deserves further evaluation.

Document SCRS/2012/159 presented fishery independent indices of bluefin tuna spawning biomass in the Gulf of Mexico were estimated from bluefin tuna larval survey data collected from 1977 through 2011. Indices were developed using standardized data from which previous indices were developed (i.e. abundance of larvae with a first daily otolith increment formed under 100 m2 sea surface sampled with bongo gear). Due to the large frequency of zero bluefin larva catches during ichthyoplankton surveys, indices of larval abundance were developed using a zero-inflated delta-lognormal models, including following covariates: time of day, time of month, area sampled and year. The estimate index showed large values for years 1977-78. The rest of the series showed low and relatively stable values. An increasing trend was observed for 2007-2011 save for a slight decrease in 2010.

Concern was raised that this index might not cover entire spatial distribution of all the larvae and in turn the SSB of bluefin in the western Atlantic, based on recent findings of larvae in other areas of the western Atlantic (e.g., SCRS/2012/157).

The updated indices used in the assessment are included in **Table 7** and **Figure 7**.

Following the recommendation of the Working Group on Stock Assessment Methods (WGSAM), the Group prepared a table to evaluate the sufficiency of bluefin tuna CPUE series with regard to its use in the assessment. However, considering that the current assessment was an update of the assessment conducted in 2010 and that the indices used were those defined in 2010, the Group decided not to establish any score of the elements of the table. Therefore **Table 8** only describes the information provided with each of the different indices regarding the elements defined by the WGSAM as reference for future bench mark assessment.

4.4 Tagging

The Group reviewed 6 working papers describing tagging studies. A complete compilation of summaries of the working papers is provided in **Appendix 4**. Due to time considerations, the Group discussed only some of the presented papers. A summary of the Group's considerations are presented in this section.

SCRS 2012/112, 122 and 143 provided some arguments about the influence of area and season for the migrations occurring after release and the possible influence of the tagging method (tagging underwater or on board) for tagging experiences. The Group considered if fish tagged in and out of water showed different behaviour patterns, but it was suggested that these differences could be related to the month of tagging. A question was raised concerning the effects in releasing tagged fish that have been kept in cages. In response, it was noted that there are few experiments related to the subject and that here is no current analysis concerning this issue.

SCRS 2012/123 showed that fish tagged in the Adriatic Sea went as far as the Gulf of Lion and Balearics Islands. This connection between central and western Mediterranean has rarely been described before by electronic tagging but is only based on 2 specimens. These movements seemed to connect different nursery areas as the Gulf of Lion and Adriatic Sea. A young spawner also showed movements between the Adriatic Sea and Gulf of Sidra.

Problems for data transmission within the Mediterranean were also discussed. It was noted that SCRS 2012/123 reflected this limitation reporting days at liberty with information, reaching values around 50%.

Preliminary results from presentation 2012/143 showed that some adult bluefin tuna, tagged in the Atlantic coast from Moroccan traps, entered into the Mediterranean Sea and moved to the Central Mediterranean spawning areas. about the Group noted that these fish wnet directly to the central Mediterranean meanwhile other specimens tagged off Spanish southern Atlantic coast moved to spawning ground in the western Mediterranean (waters around Balearic Islands). The Group cautioned against drawing any conclusion based on very few deployments.

Paper SCRS 2012/157 showed that most of the individuals 150-185 cm curved fork length did not enter the Gulf of Mexico, which is the presumed spawning ground for Western bluefin tuna. The authors suggested that given that there are no known physiological or biological obstacles to the fish spawning in the time and area studied, these smaller/younger fish could reproduce in areas closer to foraging grounds outside the Gulf because gonad data indicated they were mature. It was argued that skipped spawning might explain why larger fish did not enter the Gulf of Mexico, but for smaller fish the findings from the paper can be biased because of the tag duration is not long enough to observe a return to the Mediterranean. One of the authors responded that tag duration is long enough to determine if fish will return to spawn within the year, and in relation to skipped spawning, they considered it more likely that fish might spawn in alternative locations because of a large body of supporting evidence, including historic studies reviewed in Mather (1995), age and maturity information presented in SCRS 2012/161, life history modeling (Chapman et al. 2011) and the lack of residence of tagged fish in the Gulf of Mexico.

4.5. Other Data

BCDs, Trade Statistics and Catch Estimates

A number of documents were presented during the meeting looking at the use of eBFT trade statistics and ICCAT documentation to back-calculate catches and relate these estimations to the Task I reported catches. The Group agreed to set up a parallel 'Trade Group' to discuss these working documents in order to better analyse the methodology and the reliability of the analysis and conclusions obtained. The discussions and conclusions of the group are reported in **Appendix 5**.

Document SCRS/2012/134 analysed the utilization of BCDs as a means of analysing quota management of each flag country and the validity of the SCRS growth factors for farmed fish. The authors concluded that on the basis of their analyses that only took into account BCDs accompanying imports to the Japan market there was no catch over the adopted TAC. The analysis seemed to indicate that the SCRS growth factors should be reviewed. The Group discussed the growth table and recalled the detailed analysis that had been carried out at the 2009 SCRS BFT Species Group meeting in which available data from research carried out in various countries were review to produce a growth table which indicated the maximum gain in weight of farmed BFT (taking into consideration that many factors can affect growth of fish during the farming period).

In document SCRS/2012/145 the authors utilised publicly available wild caught and farmed EBFT trade data to estimate total catches. Using a number of assumptions related to the reliability of the trade data used and to what extent it represents the whole BFT trade, in conjunction with various conversion factors to convert product weights to whole round weight and catch weight, the authors inferred that there were significant differences between the declared catches and the traded products between 2005 and 2011. The Group discussed this document and a number of questions were raised as to the applicability of the original trade data used in the analysis for the purpose intended by the author, pointing out that other more reliable sources of trade information are available, albeit not to the public. The Group also raised questions about the methods used to convert product weight to catch weight, although the author presented a range of sensitivity analyses that provided similar results regardless of the assumptions made. The Group concluded that more research is needed, particularly to verify the validity of the assumptions made.

Documents SCRS/2012/126 and SCRS/2012/127 analysed individual EBFT trade statistics to estimate catches of EBFT between the years 2001 and 2012. In the first document, Japanese fresh market (wild and farmed) auction data between the years 2002 and 2012 was utilised to provide an alternative approach to investigate changes in the annual mean weight variations of age 8+ fish. In order to back-calculate from product weight to catch weight, the author applied a number of assumptions related to product conversion factors, duration of farming depending on origin and size. From the analysis carried out, the author determined that there was a significant drop in the fraction of age 8+ EBFT in the catches during the period studied. In the second document (SCRS/2012/127), the author analysed trade statistics (fresh and frozen) between the years 1998 and 2012 to determine the catch of EBFT made during these years. The author made similar assumptions to those utilised in document SCRS/2012/126 to back-calculate the catches made in the years covered in the analysis. The authors concluded that, notwithstanding the significant controls put into place by ICCAT, in his opinion there had been substantial under-reporting of EBFT during the years studied. The group again discussed the methodology used in these papers and whether they truly represented the total market situation and a number of questions were raised about the accuracy of some data.

The small 'Trade Group' met and reviewed the four documents presented during the assessment sessions which discussed trade-related research for verifying reported catches and changes in size of EBFT. The Group found that all of the studies used trade data or BCDs to get product weight of imported tuna in the Japanese market, convert them to round weight and back-calculate to the weight at capture. All the data sources, except BCDs, contain double counting of fish, time lags between capture and final import, and a number of hypothesis on representativeness of Japanese market; the Group recognized data coverage, sample representation (bias), and fattening factors for farmed fish used for back calculations are the major sources of errors and uncertainties. The Group agreed that those problems could be solved with the use of BCD data. The Group considered that future studies should be aimed in that direction. Eventually the trade-related data should be all cross-checked against BCDs, with the Commission probably needing a team of experts to do so.

Also, fattening rates of farmed fish as demonstrated in the BCD analysis seemed quite variable, probably reflecting the conditions of farming Therefore, caution should be applied when back-calculating to determine the initial catch. The best is to avoid back calculations but have accurate records of weight of fish at the start and harvest of faming. Therefore, the group continues to stress the necessity of using ad-hoc technologies to provide accurate estimates of the weight of fish being caged and further survey the validity of ICCAT growth rates and modify if necessary.

Effect of delaying purse seine fishing season

Document SCRS/2012/110 considered the effect on future stock recovery, economic return and the environment of delaying the BFT purse seine fishing season in the Mediterranean by 2 weeks. The Group agreed that given the lack of a stock recruitment function for the Eastern stock, it is not possible to quantify how increases in egg/larval survival will result in a faster recovery of the stock. However, the Group noted the possible economic benefits of delaying the bluefin tuna fishing season in the Western Mediterranean as it was described by the author. The study was conducted on the Western Mediterranean and, therefore, the presented results cannot be applied to the Central and Eastern Mediterranean because of difference in the timing of the spawning seasons.

5. Methods and other data relevant to the assessment

The work plan for 2012 stipulated that the stock assessment should focus on updating the analyses conducted in 2010 that were used to provide management advice (SCRS 2011). Nevertheless, several methodological papers were presented in the spirit of improving future assessments.

Document SCRS/2012/137 presented a comparison of the 2010 SCRS assessment of the Eastern stock with a statistical catch-at-age (SCAA) assessment approach that also used the cohort-sliced catch-at-age inputs, and a statistical catch-at-length (SCAL) method which fits to catch-at-length distributions instead of cohort-sliced catch-at-age. Spawning biomass estimates for both the SCAA and -SCAL were appreciably larger than for the corresponding VPA assessment. This suggests that results are sensitive to modeling specifications and the source of differences between the three approaches should be investigated to determine the most appropriate assessment methods. The group agreed that the SCAL approach has merit in the sense that is able to fit to the length distribution data, without cohort-slicing. Thus, given the current problems in the data, the group agreed to attempt moving away from cohort slicing towards this type of statistical catch at age method. However, the group recognized that the SCAA and SCAL applications were still under development, and there will be critical assumptions to evaluate (e.g. the steepness value that can affect the productivity of the stock).

Document SCRS/2012/029 presented a catch curve analysis based on the catch at age matrix of the Eastern stock, with the aim of detecting recent changes in selection pattern following the implementation of the recovery Plan. Selection was estimated as the ratio of observed to predicted catch from the catch curve. The authors noted that two peaks appeared in the selectivity curve during 2001-2006, and that the peak at juvenile ages was not present in the more recent period.

Document SCRS/2012/030 explored the potential use of catch-at-size data for use as an indicator of exploitation level using the Powell-Wetherall method for Eastern stock. The calculation of such indicators was illustrated with task 2 size data as well as new trade data presented during the meeting. The aim of the paper, however, was to demonstrate the method (rather than interpreting results as mortality rates), because the estimates of Z derived from this methodology are sensitive to a range of assumptions and underlying dynamics (e.g. changes in catchability). Therefore, before the method could be used within a management framework, the method should be tested under simulation approaches, which could be done within the tuna RFMOs Management Strategy Evaluation initiative.

Two presentations investigated alternative recruitment scenarios for the western Atlantic bluefin stock. Document SCRS/2012/154 applied Bayesian methods to evaluate the credibility of stock-recruitment relationships. Bayes factors were used to evaluate the relative likelihood of alternative models. The treatment of prior distributions was revised from previous analyses so that they had less influence on results. The strong 2003 yearclass shifted results, from similar likelihoods of the 2-line and Beverton-Holt, to a greater likelihood of the Beverton-Holt model. Document SCRS/2012/162 provided an examination of alternative recruitment scenarios and presented a decision-table approach to evaluating the relative risks of a range of management decisions in the context of alternative recruitment scenarios. The group found the MINIMAX and MAXIMIN approaches to be somewhat difficult to comprehend and a challenge to communicate to managers. The group's preference was to communicate the issue through the recommended format of the Kobe matrix, but a description of the decision tables may be informative for management considerations with both SSB and yield utilities presented to inform the tradeoff in alternative management decisions.

Document SCRS/2012/138 described a simulation tool that is under development to evaluate effects of mixing between Atlantic bluefin tuna stocks. Results from a single movement-recruitment-management scenario were demonstrated to generate feedback from the group. The current practice of separate eastern and western assessments was contrasted with multi-stock assessment methods that include mixing (e.g., Taylor et al. 2011).

Both of the approaches involve simplification of the actual population and fishery dynamics. For example, the current assessments assume no mixing and the recent multi-stock models require other simplifications (e.g., constant selectivity, 'gravity' method of estimating movement). Therefore, the simulation framework can include more complexity and be used to evaluate performance of simpler assessment methods. The group discussed an intermediate approach to assessments in which stock composition is estimated and catches are allocated to separate eastern and western stock assessments. The simulation framework could also be used in such an intermediate approach by projecting forward with mixing from the results of separate-stock assessments that are based on stock composition sampling. There were some concerns in the group that most otolith collections are recent and archived samples are incomplete. Therefore the available otolith samples may not be adequate for determining stock composition of the entire time series.

Although the new approaches presented by participants would not be considered as a basis for stock status this year, the group discussed potential ways forward to incorporate these new approaches in future assessments. A suggestion was also made to consider results from exploratory modeling in the group's interpretations of current methods. The group agreed that, given the current uncertainties in the basic data, as well as new biological and tagging data becoming available, incorporating these new approaches would help deliver a more realistic report on stock status. In order to pursue this, the need for dedicated technical meetings in upcoming years was identified. Furthermore, the group recognized that while progress on the methods used are positive, there is a also need to improve the basic fishery data and fishery-independent information that support them. Therefore the suggested way forward is to plan data and model inter-sessional meetings to incorporate new approaches in future assessments.

5.1 Methods – Eastern Atlantic and Mediterranean stock

Development of Japanese longline Partial Catch-at-Age for the Eastern Atlantic Bluefin Analyses

The vulnerabilities of fishery-dependent abundance indices can be estimated within the VPA from the partial catches-at-age (PCAA) associated with those fisheries. These PCAA matrices were prepared by restricting the total CAA to include only data from the fleets, gears, and areas from which each specific index was developed.

- Japanese longline index in the East Atlantic (south of 40º North) and Mediterranean: The Japanese longline index for this area was not updated because there was almost no Japanese longline catch in 2010 and 2011 in this area. The partial catch at age (PCAA) for the East Atlantic and Mediterranean Japanese longline index was developed in the 2010 assessment by using the catch at age for the Japanese longline in this area for the months of April, May and June. PCAA was updated and used to confirm and replicate the 2010 calculations.

- Japanese longline index in the Northeast area (NEA, north of 40º North): This index is calculated for August to March and only for the NE Atlantic (Area BF53, BF54 and BF52E). However, the PCAA for the index was restricted to the months of Jan, Aug, Sept, Oct, Nov, Dec, StockID (ATE and MED) with all areas selected. The rationale for not using the months of Feb-March was that the spatial resolution on the CAA data prior to 2008 did not permit assigning it to area and some of the fishing during these months was from areas below of 40ºN latitude and was deemed not representative of the NEA index. Hence these months were removed when constructing the PCAA. This methodology compares favorably with the PCAA constructed for the 2010 stock assessment (**Figure 8**) and was used to construct the PCAA for years 2010 and 2011, that were added to the PCAA elaborated in the 2010 assessment for the years 1990-2009. The differences between the two methods are due to the change in the Japanese logbook system in 1994.

VPA Specifications applied to the East Atlantic and Mediterranean stock

Because the 2012 stock assessment was an update of the 2010 stock assessment, the Group ran the same model, i.e. ADAPT VPA (as implemented in VPA-2box) , with the most possible similar technical specifications. Runs 13 and 15 from the 2010 assessment, which were used as the basis for the 2010 scientific advice, were revised. The difference between runs 13 and 15 relied on the BB CPUE indices used. In run 13, age-specific indices were used, while run 15 was based on an age-aggregated baitboat (BB) index. The baitboat age specific indices (used in run 13) were no longer pertinent and were not updated since 2007 because of changes in the fisheries due to new management regulations. The age-aggregated BB index could be updated (see SCRS/2012/100), therefore the group based the 2012 analyses on updating Run 15. Run 1 (see **Table 9**) is similar to the 2010 Run 15, and includes the following cpue indices: Spanish-Morocan trap, Japanese longline in the East Atlantic and Mediterranean, Norwegian purse seine, Japanese longline in the North East Atlantic and Spanish baitboat. The historical index was used to calibrate the 1952-1999 period, and the newest index for 2000 onwards. Results of this Run 1 matched those obtained in 2010 with Run 15. Subsequently, this scenario was used to update the data up until 2011 and consider different sensitivity scenarios.

The agreed set of runs is specified in **Table 9**. All runs considered catch-at-age data for the 1950-2011 years. An inspection of the partial catch at age for the Spanish baitboat suggested 3 different vulnerability periods for this fleet. Thus, Run 2 considers 3 different periods (1952-1962, 1963-2006 and 2007-2011). The vulnerabilities of the three different periods were set to ages 5-6, 2-3 and 3-6, respectively. The rest of the specifications remained the same as in 2010. 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, i.e. equal to 0.7 over 1950-1969, equal to 1 over 1970-1984, equal to 0.6 over 1985-1994 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, 0.120, 0.100 for ages 1 to 10, respectively).

A suite of different specifications were investigated to test the sensitivity of the VPA to different technical assumptions and the choice of the CPUE series. Run 3 was similar to Run 1 but the vulnerability for the latest baitboat period was relaxed and included ages 3 to 6. Run 4 was similar to Run 2 but it excluded the Japanese longline index in the North East Atlantic, and Run 5 explores the sensitivity of Run 2 to removing the Spanish baitboat indices. In Run 6, the F-ratios were fixed to 1 instead of the 2008 F-ratio vector. Run 7 was similar to Run 2 but the F-ratios were estimated annually (sd=0.2, for details see VPA2-box Manual at the ICCAT software catalog). Run 8 was similar to Run 2 but incorporated the aerial survey index. Run 9 was similar to Run 2 but the Fratio for the last 4 years is set to 0.7. Finally, Run10 was similar to Run2 but excluding the Norwegian PS index.

All the scenarios were used with both the reported and inflated catch scenario. The inflated catch scenario uses an inflated CAA in the same way as done in the 2008 and 2010 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 2011).

5.2 Methods – Western Atlantic stock

5.2.1 ADAPT-VPA applied to the West Atlantic

Tuned virtual population analyses (VPA) were conducted using the VPA-2BOX software featured in the ICCAT Software Catalog. Except as otherwise noted, the parameter specifications used in the 2012 VPA assessments were identical to those used in the 2010 base-case assessment. The same data series were used (updated through 2011) although in a few cases the indices of abundance were computed somewhat differently than in 2010 (see the discussion in Section 4.3.2). The indices of abundance used in the assessment are included in **Tables 7** and **10** gives specifications for computing the corresponding partial catch at age and **Table 11** summarizes the parameter specifications for the various model runs.

General specifications

The oldest age class represents a plus group (ages 16 and older) and the fishing mortality rate on that age is specified as the product of the fishing mortality rate on the next younger age (F_{15}) and an estimated 'F-ratio' parameter that represents the ratio of F_{16+} to F_{15}. As for the 2010 base model, the F-ratio was fixed at 1.0 for the entire period as arguably the vulnerability would differ little amongst 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 (selectivity) 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 variance 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 was assumed age-independent (=0.14 yr-1) as in previous assessments.

The maturity vector used in assessments prior to 2010 assumed ages 1-7 were immature and ages 8 and older were fully mature. In 2010 it was observed that the original specification of age 8 and older was based on the 1994 growth curve and that fish of the same size would be classified at age 9 with the 2009 growth curve. However, as noted in Section 3.1, there remains considerable uncertainty about the maturation of western bluefin tuna. For this reason the group decided to examine the sensitivity of the perception of stock status in the base case run to two alternative maturity schedules, one with the early maturation schedule used for the Eastern Atlantic and Mediterranean (50% maturity at age 4 and 100% maturity for age 5 and older) and one with later maturation (0% at age 8, increasing to 100% at age 16 as described in SCRS/2010/018).

Detailed specifications for the 2012 base case and alternative runs

This section details all the model settings examined during the assessment. Note that the continuity run (below) was selected as the base case because it most closely repeated the specifications of the base model from the 2010 assessment (as stipulated in the SCRS workplan for 2012).

- Continuity run 0: This run most strictly adhered to the specifications of the 2010 base assessment. There were two changes that had little discernible effect on the result: 1) the partial catch at age for the U.S. RR <145 index was modified to include all age 1 fish in the ICCAT database (previously fish under 66 cm had been excluded) and 2) the partial catch at age for the Canadian Gulf of St. Lawrence index was created from the ICCAT database including catches from RR and tended line gears for August-October (previous versions could not be recreated exactly by the national scientists or the secretariat).

- Run 1: Like run 0, but the Canada SW Nova Scotia CPUE index developed using the methods in 2010 was replaced by one standardized using new methodology (hurdle negative binomial with effort and effort-squared as factors instead of a delta-lognormal model with effort offset, see discussion in section 4.2)

- Run 2: Like run 0, but removed the penalty restricting changes in vulnerability over the last three years

- Run 3: Like run 0, but softened the penalty restricting changes in vulnerability over the last three years by increasing the standard deviation from 0.5 to 1.0.

- Runs 4: Like run 0, but with the 2010 data point for the Gulf of St. Lawrence. The 2010 point was excluded in the continuity run as it was not considered to be representative of the normal operation of the fishery (see discussion in section 4.3.2)

- Runs 5-16. Jack-knife sensitivity analyses. The influence of the various indices of abundance on the base case model results was examined by removing one index at a time, running the VPA with the same model specifications, and comparing various reference statistics.

6. Stock status results

6.1 Stock status – East

6.1.1 VPA results

The continuity run of the 2010 base case runs 13 and 15 was carried out using the data updated up to 2011 and the parameter specifications described in **Table 9**. This run is referred as Run2 hereinafter. Run 2 can be considered the continuity run because the technical specifications and CPUE data used are very close to those used in the base run in the 2010 assessment. The Group also examined the results of a sensitivity analysis to the data and parameters used (i.e. assumptions about the choice of the CPUE series, inflated and reported catch, F-ratios, terminal ages, recruitment and vulnerability penalties and standard deviation of these penalties). In general, the different runs led to a similar perception of the stock status, except when changing the F-ratios (a result which has been also reported in the 2010 stock assessment).

Run 2 was further investigated using an inflated CAA in the same way as it was done in the 2010 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). In Run 2, as in all the sensitivity runs, F for the youngest ages (i.e. 2 to 5) displayed a continuous increase until recent years. Since 2008, those Fs have sharply decreased for both catch scenarios, i.e.

reported and inflated catch (**Figure 9**). This result was not surprising as the reported catch at ages 2 to 3 have declined dramatically (i.e. being about 10% or less of what they were prior to 2007) in the most recent years in response to the new minimum size regulations implemented in 2007. The rate of decrease was however sensitive to model specifications, namely the constraint of vulnerability. All the other runs displayed similar results for F at ages 2-5.

The fishing mortality for large bluefin tuna (F10+) in run 2 showed an initial decline corresponding to the decline of the Norwegian purse seine fishery 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+ iccurred in the mid-1990s to mid-2000s to reach high values (about 3 times M for these ages) as noted in previous assessments. Since 2008, run 2 estimated a rapid decrease in F10+ and confirmed previous results from the 2010 stock assessment (**Figure 9**). This decrease seems to result from the strong decrease in the reported catch for older fish since 2008 (that even accelerated over the last two years). This strong decline was confirmed by all sensitivity runs (**Figures 13** and **14**) and the retrospective analyses (**Figures 10** and **12**) and is in agreement with the catch class curve analysis (SCRS/2012/029).

The results of the runs with the inflated catch were similar to those of the reported catch, except for the SSB trajectories (**Figures 13** and **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 plateau between 1985 and 2005 and an increase since then. Note, however, that the spawning biomass was approximately the same in 2011 in the reported and inflated catch scenarios. These results that have already been seen in 2010, may seem surprising, but is the result of the higher recruitment estimated for the inflated catch scenarios (**Figure 9**). The retrospective patterns of the run performed on inflated catches confirmed the uncertainties on terminal F at ages 2-5 and a high uncertainty on the recruitment (**Figure 12**). Confidence intervals of the terminal F for ages 2 to 5 and of the SSB were estimated from the bootstraps of the run on confirmed the variability of these two values.

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 exhibited a substantial increase in all runs (**Figures 9** and **10**). The speed and the magnitude of this increase remain however highly uncertain and depend on technical specifications as well as the choice of the CPUE series and the used of reported or inflated catch data. For run 2, SSB2011 is 0.96 of the maximum SSB in the late 1950s. SSB in all sensitivity runs for 1950 to the late 1990s were very similar except run 6 (i.e. same as run 2, but with F-ratios = 1) where the SSB peaks at 237 000 t in the mid 1970s instead of above 300 000t in all other runs (**Figure 11)**. For the sensitivity runs, SSB in 2011 varies from 0.85 (run 9 -i.e. same as run 2, but with F-ratios = 0.7 over the last four years) to 1.52 (run 8 - same as run 2 but including the aerial survey index for tuning the juvenile ages) of the maximum SSB in the late 1950s. The extent of the speed of the recovery needs to be validated by future data and analyses.

Recruitment 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 estimate recent recruitment from the catch-at-age analysis and data for the last three year classes are not shown (**Figures 9, 10** and **13**). However, the local index of recruitment in the Gulf of Lions estimated by aerial surveys indicates higher recruitment over the recent period (Fromentin et al. 2012).

In general, the fits to the available CPUE indices are poor. This was also the case in 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 15**). Such a poor fit is not surprising given the poor quality of the catch-at-age matrix (see previous section) and uncertainties about catch-at-age and CPUE indices. Nonetheless, the fits of the CPUE indices over the most recent years do not display any special patterns (**Figure 16)**. The observed and expected values are plotted against each other in **Figure 17**; 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.

A retrospective analysis was conducted back to 2006. Retrospective patterns were generally satisfactory without consistent bias for the runs (**Figures 10** and **12**) and rather similar to those obtained in 2010. The highest uncertainties were observed on terminal estimates of fishing mortality at ages 2-5 and on the recruitment while estimates of F 10+ and SSB are 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.

Model uncertainty was estimated as in 2010, by bootstraping of the VPA Run 2 with two assumed historical catch levels (reported and inflated scenarios). Projection analyses were investigated with the VPA Run 2 using two assumed historical catch levels (reported and inflated scenarios), three recruitment levels (high, medium, low), and two scenarios of selectivity patterns of the fisheries (the one used in the 2010 stock assessment and the one estimated from the VPA Run 2). The Kobe plot shows the current stock status according to two reference points, the spawning biomass if the fishing mortality was equal to $F_{0.1}$ ($B_{F0.1}$) and fishing mortality ($F_{0.1}$) (**Figure 18**). The lines are the medians of $F/F_{0.1}$ and $SSB/SSB_{F0.1}$ 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 the low recruitment hypothesis, the stock recovers over the projection period, since the trajectories move from the red towards the green quadrant, but the end points are not always in the green zones. Regarding the high recruitment hypothesis, the fishing mortality was below $F_{0.1}$ but the spawning biomass was below $B_{F0.1}$ and the trajectories are mainly in the lower-left yellow quadrant (indicating that the stock was overfished, but not undergoing overfishing).

Estimates of the current stock status relative to MSY benchmarks led to the conclusion that F_{2011} was below the reference target $F_{0.1}$, as F_{2011} /$F_{0.1}$ is about 0.70 for the reported catch scenario and 0.36 for the inflated catch scenario (**Table 12**). 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 (**Table 12**). SSB was about 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 (**Table 12**). The recent decline in Fs leads to a substantially improved perception of the stock status relative to the benchmarks in comparison to previous assessment. However, current spawning biomass is, in most scenarios, below the spawning biomass that is expected at $F_{0.1}$ (**Table 13**)

6.2 Stock status – West

This Section summarizes the results from the VPA analyses described in Section 5.2. The inputs and output files of the VPA-2BOX software for the model are included as Appendix 6. The output reports contain a complete description of the 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-age in the terminal year.

Diagnostics

Fits to the indices of abundance for the 2012 VPA base model (continuity run 0) are compared to those of the 2010 base model in **Figure 19**. The fits to the relative abundance indices were similar between the 2010 base and 2012 continuity model.

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 continuity model, even when the most influential indices (Canadian GSL or US RR > 177 cm) were removed (**Figure 20**). Fits to the indices for large fish generally indicated an increase in abundance during recent years, and this trend was more apparent when the US RR > 177 cm was dropped as the observed indices for that fishery indicated a decline in the abundance of older fish over the last decade. Changes in the fits to the indices for large fish were less obvious when the Canada GSL index was dropped. The differences in model fits were almost imperceptible for the other jack-knife sensitivity runs and those results are therefore not shown.

Histograms of the bootstrap estimates of 2011 stock status from the continuity model were constructed to examine the bias and normality of the distribution. Stock status was determined using both F_{msy} and $F_{0.1}$ reference points. In each case, there was no evidence of a strong bias in the results (**Figure 21**).

A retrospective analysis was conducted for the continuity model by sequentially removing inputs of catch and abundance indices in annual increments, back to 2006. **Figure 22** shows the trends of spawning stock biomass (SSB) and age 1 recruitment for the retrospective analysis. The long-term trend in estimated SSB was not highly sensitive to the retrospective removal of data; however, an increase in SSB was estimated when the most recent data were included that was not apparent in the retrospective runs. Estimates of recruitment were sensitive to the retrospective removal of data, but this variability in recruitment demonstrated no consistent pattern and therefore likely represented model imprecision rather than a consistent bias. Inclusion of the most recent data decreased the signal of the 2003 recruitment compared to the retrospective model runs. The retrospective results indicated some variability in fishing mortality estimates for ages 5 to 8 (**Figure 23**) and abundance estimates for ages 1 to 8 (**Figure 24**), but again with no consistent trends that indicated a large bias in estimates.

Comparison of 2010 base model and 2012 VPA continuity model results

The 2012 continuity assessment produced consistent results in comparison with previous analyses in that SSB was estimated to decline sharply between 1970 and 1985 (**Figure 25**). The estimates of SSB for subsequent years fluctuated between approximately 25% and 36% of the 1970 level, with the lowest SSB estimated during 1992. Estimates of SSB generally increased during the course of the last decade (since 2000). The estimated fishing mortality rate was highest during the 1970s, but decreased substantially during the following decade. Estimated fishing mortality fluctuated around 0.2 for the period from 1984 to 2005, and declined between 2007 and 2011. The fishing mortality rate on spawners (ages 9 and older) declined markedly since 2003, with the exception of 2006 when fishing mortality was estimated to be greater than 0.2. Estimates of recruitment[1] (age 1) were greatest during the early 1970's, fell sharply after 1975, and fluctuated with little trend since that period. Relatively strong year-classes were estimated during 1988 and 2003, similar to results from previous assessments (Anon. 2011). The results from the 2012 VPA continuity model are compared to the 2010 base model (Anon. 2011) in **Figure 26**. The trends in estimated spawning stock biomass (SSB) and recruitment (Age 1) were nearly identical, except that the 2012 continuity model estimated a lower recruitment in 2004 (2003 year-class) and higher recruitment in 2003 (2002 year-class) than was observed during the 2010 assessment. It was surmised that the apparent redistribution of the 2003 year-class into 2002 was largely a result of cohort slicing. For individuals of age 6 and greater (when growth rate decreases greatly) the cohort slicing algorithm tends to smear adjacent age classes and the 2003 year-class was observed as 7 years old in 2010 and 8 years old in 2011. Management measures which reduced the U.S. catch of the 2003 year-class during 2010 to 2011 may also have contributed to this perception of the strength of the cohort; there are no abundance indices for this size range and the model may have interpreted the reduced catches as evidence of smaller initial numbers in the 2003 year-class.

Sensitivity Runs

The results of the jack-knife sensitivity analyses, in which indices were removed from the continuity model iteratively one at a time, are summarized in **Figure 27**. The Canadian GSL and US RR > 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 continuity model. However, exclusion of the Canadian GSL indices resulted in a lower estimated SSB than the continuity model and exclusion of the US RR >177 cm resulted in a higher estimated SSB than the continuity model.

Comparisons between the 2012 continuity model and the various sensitivity runs (discussed in detail in Section 5.2.1) are summarized in **Figure 28**. The SSB, apical fishing mortality and recruitment estimates are nearly identical for all selectivity sensitivity model runs, with the exception that recruitment in recent years deviated such that the 2003 year-class signal was lower than the estimates from the continuity model. Results from sensitivity run 2, in which no constraint was applied to the vulnerability schedule, are highly uncertain with the fishing mortality rate on one age class hitting the upper bound.

The estimated SSB and apical fishing mortality estimates were sensitive to the assumption of maturity (**Figures 28** and **29**). The assumption of early maturity (i.e. eastern Atlantic oogive 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 at age 8 to 1 at age 16) resulted in decreased estimates of SSB compared to the continuity model (fully mature at age 9). The overall 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 model runs (**Figures 28** and **29**).

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 can be measured. These benchmarks depend to a large extent on the relationship between spawning biomass and recruitment. This year, the Group maintained the two alternative spawner-recruit

[1] Common convention has been to define recruitment in terms of age 1 fish and year class in terms of age 0 fish. The recruitment for year y is from the same cohort as the year class for year y-1.

hypotheses explored in several prior assessments: the two-line (low recruitment potential hypothesis) and the Beverton and Holt spawner-recruit formulation (high recruitment potential hypothesis). The two-line model assumed recruitment increases linearly with SSB from zero to a maximum value (R_{MAX}) when SSB reaches capacity certain threshold. Here the SSB threshold (hinge) was set at the average SSB between 1990 to1995 (the period with the lowest estimated SSB), and R_{MAX} was calculated as the geometric mean recruitment during 1976 to 2008 (recruitment estimates for the last three years were deemed unreliable and were excluded from the analyses). The Beverton and Holt function was fit to the SSB and recruitment estimates corresponding to the period 1971 to 2008. The two stock-recruitment curves are shown in **Figure 30**. 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} which is consistent with the 2010 assessment ($F_{0.1}$ is calculated on the basis or yield per recruit).

Stock status was determined using the two-line (low recruitment hypothesis) and Beverton-Holt (high recruitment hypothesis) scenarios for the continuity model from 1970 to 2011 (**Figures 31** and **32**). The results under the two-line assumption indicated that the stock biomass has been above Convention objectives since 1970 and that fishing mortality rates have been below Convention objectives since 1983. In contrast, the results under the Beverton-Holt recruitment assumption suggest that the stock biomass has been below Convention objectives (overfished) since 1970 and the fishing mortality was above Convention objectives (overfishing) for most of the period of record. The estimated status of the stock in recent years was similar for all maturity schedules (**Figure 29**).

Stock status estimates from the continuity model and the jack-knife analyses that excluded the Canadian GSL and US RR > 177 cm indices are compared in **Figure 32** for both the low recruitment and high recruitment assumptions. The two jack-knife runs were included because their divergence from the continuity model helps to bracket the uncertainty in SSB and fishing mortality estimates.The perception of stock status is more sensitive to the level of future recruitment than it is to the removal of indices. For the continuity model under the two-line recruitment hypothesis, the recent F (geometric mean from 2009 to 2011) was estimated to be 0.61 F_{MSY} (0.49 to 0.74 at the 80% confidence level). Spawning stock biomass under the two-line recruitment hypothesis was estimated to be 1.4 B_{MSY} (1.14 to 1.72 at the 80% confidence level) and 0.92 $B_{0.1}$ (0.76 to 1.08 at the 80% confidence level). Under the Beverton and Holt recruitment hypothesis, recent F was estimated to be 1.57 F_{MSY} (1.24 to 1.95 at the 80% confidence level) and 0.92 $F_{0.1}$ (0.77 to 1.12 confidence interval). Spawning stock biomass under the Beverton and Holt recruitment hypothesis was estimated to be 0.19 B_{MSY} (0.13 to 0.29) and 0.45 $B_{0.1}$ (0.34 to 0.62 at the 80% confidence level).

The results of this assessment do not capture the full degree of uncertainty in the assessments and stock projections. An important factor contributing to uncertainty is mixing between fish of eastern and western origin. Previous analyses have indicated that stock mixing occurs (tag return information and microconstituents analyses) and that stock assessment results are sensitive to the stock mixing assumptions (e.g., Anon. 2009, Taylor et al. 2011). 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 assumptions. Mixing models will be further investigated prior to the next assessment. Another important source of uncertainty was recruitment, both in terms of recent levels (which were 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-at-age can affect the perception of changes in stock size. Finally, the lack of representative samples of otoliths required for determining the catch at age from length samples may result in imprecise age estimates for larger bluefin tuna.

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 assessment (Run 2), with reported and inflated catches (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 since 2008) and the current estimated selectivity pattern as well as the one used in the 2010 assessment. When projecting it is necessary to specify, biological parameters, selectivity pattern (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. Since for the most recent year-classes in VPA numbers-at-age are poorly estimated, especially for the younger ages (see previous section), the first three ages in the initial population vector (i.e. for 2009, 2010, and 2011) 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 2012 (i.e. the first projection year) and the fishing mortality-at-age for the replaced three year-classes.

Two hypotheses about the selectivity pattern in the projection period were evaluated, i.e. the current estimated selectivity for reported and inflated catch and, for comparison purposes, the 'perfect implementation´ selectivity pattern used in the 2010 projections. The current selectivity pattern was obtained from the geometric mean of the fishing mortality at age for years 2009-2011 and was calculated independently for each bootstrap within Pro2Box. For the calculation of benchmarks and projections based on the 2010 selectivity pattern, the 2009-2011 selectivity pattern was modified by applying a vector (i.e. the ratio of the median selectivities at age from the 2010 and 2012 assessments) to obtain the same selectivities as used in 2010 (**Figure 33**). This shows the selectivity patterns used for calculation of benchmarks and projections, these show the medians (lines) and +- 1 sd (bars). Selectivity is assumed in the 2010 and 2012 projections for the three recruitment and two catch scenarios.

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).

Three scenarios were evaluated for future recruitment, based on low, medium and high geometric mean levels, corresponding to the periods 1970-1980, 1955-2006 and 1990-2000 years, respectively (a decision that remained unchanged from the 2010 assessment). Updated geometric mean and log-scale standard errors in recruitment were calculated from the median recruitment estimates for VPA run 2 with inflated and reported catch levels. Since the sigma values (standard deviation of log-recruitment deviations) were very low for the high and low recruitment stanzas, the highest sigma across the three scenarios was used for all the projections. Absolute recruitment levels differed very little between Run 2 in the 2012 update and the most similarly configured run (run 15) in the 2010 assessment (**Table 14**).

The 12 projection scenarios therefore comprised: (i) the VPA Run 2 using two assumed historical catch levels (reported and inflated scenarios); (ii) three recruitment levels; and (iii) two anticipated selectivity patterns of the fisheries, These were run for the current quota (12,900 t) and for the 2010 quota (13,500 t) for comparison purposes. Subsequently projections with quotas ranging from 0-30000 t were conducted to create the Kobe matrix.

7.1.2 Results

From the bootstraps analysis and the projections of Run 2, the Group estimated the probability of the stock being in each of the Kobe phase plot quadrants from 2010 to 2022 (three scenarios of recruitment and the two historical catch scenarios combined). 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.. Using the selection patterns calculated as in 2010, $B_{F0.1}$ is greater and the stock has to recover to higher absolute levels of biomass to reach the green quadrant. A Kobe pie chart constructed from the proportion of bootstraps that lay in the colored quadrant of the phase plotshowed that for 2011 most bootstraps resulted in the yellow quadrant (overfished or overfishing) while a low fraction of the bootstraps are within the red quadrant (overfished and overfishing) or in the green quadrant (neither overfished nor overfishing) (**Figure 34**). The number of occurrence of bootstraps in the green quadrant is higher using the inflated catch scenario while the number of occurrence in the red quadrant is higher using the reported scenario. These results as well as the Kobe phase plot (**Figure 18**) indicate a higher probability to be in a an overfished but not-overfishing situation. When these results are projected the proportion of bootstraps in the green quadrant gradually increase while the number of bootstraps in the red quadrant is null after 2012 (**Figure 35**). For the two TACs investigated (12,900t and 13,500t) results were very similar with an obvious increase in the time for recovery under a higher TAC.

7.2 Projections WBFT

7.2.1 Methods

Medium projections for the western stock covering the time of the rebuilding plan (to 2019) were made using the PRO-2BOX software contained in the ICCAT Software Catalog. As in 2010, the Group considered the two recruitment scenarios discussed in Section 6.2: 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 (see **Figure 30**). The Group agreed that there was still no strong evidence to favor one scenario over the other and that they provide reasonable (but not extreme) lower and upper bounds on rebuilding potential.
The projections for the western stock were based on the bootstrap replicates of the fishing mortality-at-age and numbers-at-age matrices for the continuity run (produced by the VPA-2BOX software). The Beverton-Holt stock-recruitment relationship was fitted to each of the bootstrap replicates of spawning stock size and recruitment for the 1970-2007 year-classes by means of maximum likelihood (lognormal error). As in 2010, future recruitment was allowed to deviate from its expectation as a first-order multiplicative (lognormal) autocorrelated process with the standard deviation (σ_R) and autocorrelation (ρ) parameters set equal to the maximum likelihood estimates for each bootstrap replicate (0.34 and 0.27, respectively).

The 2-line stock-recruitment relationship assumes a linear increase in recruitment from the origin to a “pivot” level of spawning stock size above which recruitment is independent of spawning stock size. The “pivot” spawning stock size was computed for each bootstrap replicate as the mean spawning stock size over 1990-95 (the period that includes the lowest estimates of spawning biomass). The constant level of recruitment was computed for each bootstrap replicate as the geometric mean recruitment over the years 1976-2008, a period over which recruitment was relatively constant. For the 2-line stock recruitment relationship the group agreed to use an autocorrelated process with the standard deviation (σ_R) set equal to the mle of 0.27 and the autocorrelation parameter (ρ) set equal to the mle of 0.31.

The recruitment estimates from the VPA for 2009-2011 were replaced with values generated from the fitted stock-recruitment relationship underlying the projection (for both low and high recruitment scenarios). Numbers and fishing mortality-at-age for ages 1-3 at the start of 2009 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 2008-2010 (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 2010). 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 2012 was assumed to be equal 1,750 t [Rec. 10-03]. For years beyond 2012, projections were continued using various levels of constant catch with the restriction that the fully-selected *F* was constrained not to exceed 2 yr^{-1}.

Projected spawning stock size was expressed relative to the spawning stock size associated with *MSY* and $F_{0.1}$ (i.e., B_{MSY}, $B_{0.1}$) for the appropriate recruitment scenario. The B_{MSY} was used as a reference level for rebuilding because it is the target of the current rebuilding program. The group noted that $F_{0.1}$ 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}.

7.2.2 Results

The recruitment expected at B_{MSY} was much lower with the two-line scenario (87,000) than with the Beverton-Holt scenario (278,000), with correspondingly lower estimates of MSY and B_{MSY}. However, the two-line and Beverton-Holt scenarios predict nearly identical levels of recruitment when spawning stock sizes are low (i.e., between 5,000 and 13,000 t).

Projections of SSB from the base VPA were made through 2019 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. 10-03]. The associated benchmarks for the base case are given in **Table 15**. The results assuming low recruitment potential (**Figures 36-38**) indicate there is better than a 60% chance that the stock is currently at or above the convention objective (B_{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 (Figures 7.2.3, 7.2.4) is less optimistic, indicating a stock that is currently overfished and experiencing overfishing.

The median estimates of projected SSB, SSB/SSB_{MSY}, F, F/F_{MSY}, F, F/F_{01} and recruitment for the high and low recruitment scenarios are shown in **Figures 36** and **37**. Under the low recruitment potential scenario (**Figure 36**) the current TAC will lead to the 2019 SSB being higher than the estimated SSB for 2012. Constant catches at 2000 t would lead to no increase in the SSB in 2019 compared with 2012, while catches above 2000 will result in the 2019 SSB being smaller than the 2012 SSB. The high recruitment potential scenario (**Figure 37**) suggests that the western stock will not rebuild by 2019 even with no catch (0 t), although catches of 1,300 t or less are expected to end overfishing in 2013 and initiate rebuilding. At the current TAC of 1,750 t, the high recruitment scenario indicates that the stock is not expected to be rebuilt to SSB_{MSY} before 2050. The Group also noted that the 2012 estimated stock biomass trajectory under the low and high recruitment scenarios is very similar to the results of the 2010 assessment (**Figure 39**). The 2012 assessment indicates a slightly lower level of SSB and SSB relative to MSY between 2014 and 2019. The 60^{th} percentile of projected SSB/SSB_{MSY} and F/F_{MSY} were also computed, and are illustrated in **Figure 38**. The projected stock status under the two recruitment scenarios are more similar when $F_{0.1}$ is used as the management reference (**Figures 36** and **37**), with both indicating that the stock is overfished ($B < B_{F0.1}$) and at or near the overfishing threshold ($F>F_{0.1}$).

The Kobe 2 Strategy Matrices are summarized in **Tables 16-18**. **Table 16** summarizes the chance that various constant catch policies will allow rebuilding under the high and maintain SSB above SSB_{MSY} under the low recruitment scenarios. **Table 17** similarly summarizes the chance that various constant catch policies will end overfishing whereas **Table 18** summarizes the joint distribution ($SSB>SSB_{MSY}$ and $F<F_{MSY}$). The results are consistent with those discussed above (**Figures 36** and **37**).

One important factor in the recent decline of fishing mortality on large bluefin is that the TAC had not been taken during this time period until 2009, due primarily to a shortfall by the United States fisheries (until 2009). Two plausible explanations for the shortfall were put forward previously by the Committee: (1) that availability of fish to the United States fishery has been abnormally low, and/or (2) the overall size of the population in the Western Atlantic declined substantially from the level of recent years. While there is no overwhelming evidence to favor either explanation over the other, the base case assessment implicitly favors the first hypothesis (regional changes in availability) by virtue of the estimated increase in SSB. The decrease indicated by the U.S. catch rate of large fish is matched by an increase in several other large fish indices (see Executive Summary). Nevertheless, the Group notes that there remains substantial uncertainty on this issue and more research needs to be done.

8. Recommendations

8.1 Research recommendations

- The Group reiterated the importance of getting fishery independent information, through a large-scale tagging program, and developing fishery independent indices of abundance, through aerial surveys, to better track trends in biomass and better estimate fishing mortality rates. Fishery-independent information is furthermore crucial to avoid biases due to management regulations in the models based on catch and CPUE.

- The Group recommended that the new biological information presented in the 2012 assessment meeting and previous meetings, new information coming from GBYP (growth, ageing, maturity, reproduction) and information coming from other ongoing research projects, should be carefully evaluated during a special intersessional meeting proposed for 2013, in order to analyse these new findings that could influence and be used in future Atlantic bluefin tuna stock assessment. This meeting should also the reliability of existing information inputs to stock assessment to advice for the suitability for input to new stock assessment apporoaches.

- The Group also recommended two modeling meetings, in 2013 and in 2014 to advance assessment methods' refinement for BFT stocks.

- It was also recommended by the Group that future update of the CPUE indices from the Spanish and Moroccan traps in the Atlantic area of the Strait of Gibraltar explicitly include environmental factors and the length of the fishing season as a variable in the model used for standardization in order to account for the effect of current regulation.

- The Group recommended continuing the analysis of VMS data to get a better estimates of the spatial and temporal variations in the fishing effort of the main fleets and to obtain an index of abundance of the Mediterranean PS fleet through state-space modeling.

- The Group also agreed that research about the BFT population structure is also needed to solve key uncertainties in stock assessment. Sampling effort and preliminary analyses that have been performed under the GBYP umbrella should continue.

- The Group reiterated that it is essential to obtain representative samples of otoliths and other tissues from all major fisheries in all areas. Otoliths, spines and vertebrae can be used to provide direct estimates of the age composition of the catch, thus avoiding the biases associated with determining age from size. Moreover, otolith microconstituent data can be very useful to determine stock origin with relatively high accuracy, and thus could be a key factor to improve our ability to conduct mixing analyses.

- The Group recognized the great value of the historical data that has been collected through the GBYP over the last 3 years. These data should be analysed and validated in the coming year before being integrated in the ICCAT database.

- It was also recommended that the historical catch and effort for the West Atlantic data from the Japanese longline fleet be analyzed by main areas and groups of years that show a consistent effort distribution, rather than considering only catches of bluefin reports. The main areas of interest are the Gulf of Mexico, the waters off Brazil and the Florida-Bahamas areas from 1960 through the 1980s. Special attention should also be given to the South Atlantic, both from an historical and recent perspective.

8.2 Management Recommendations

BFTE

In [Rec. 09-06] the Commission established a total allowable catch for eastern Atlantic and Mediterranean bluefin tuna at 13,500 t in 2010. Additionally, in [Rec. 09-06] the Commission required that the SCRS provide the scientific basis for the Commission to establish a three-year recovery plan for 2011-2013 with the goal of achieving BMSY through 2022 with at least 60% of probability.

A Kobe II strategy matrix reflecting recovery scenarios of eastern Atlantic and Mediterranean bluefin tuna in accordance with the multiannual recovery plan has been computed for the current quota (12,900 t) and the 2010 quota (13,500 t, **Figure 35**).
The implementation of recent regulations through [Rec. 09-06, and previous recommendations] has clearly resulted in reductions in catch and fishing mortality rates. The Committee notes that maintaining catches at the current TAC (12,900 t) or at the 2010 TAC (13,500 t) under the current management scheme will likely allow the stock to increase during that period and is consistent with the goal of achieving FMSY and BMSY through 2022 with at least 60% of probability, given the quantified uncertainties. A period of stabilization in the main management regulations of the rebuilding plan would allow the SCRS to better estimate the magnitude and speed of recent trends in F and SSB in the coming years.

BFTW

In 1998, the Commission initiated a 20-year rebuilding plan designed to achieve BMSY 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 [Rec. 10-03].

The current (2012) assessment indicates similar historical trends in abundance as in previous assessments. The strong 2003 year class has contributed to stock productivity such that total biomass has been increasing 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 1970’s and a “low recruitment potential” scenario in which future recruitment is expected to remain near present levels. The results of this assessment have shown that long term implications of future biomass are different between the two hypotheses and the issue of distinguishing between them remains unresolved.

Probabilities of achieving BMSY within the Commission rebuilding period were projected for alternative catch levels (**Table 17** and **Figures 36** and **37**). The "low recruitment potential " scenario suggests that biomass is currently sufficient to produce MSY, whereas the "high recruitment potential" scenario suggests that BMSY 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 current catches (1,750 t) should allow the biomass to continue to increase. Larger catches in excess of 2,000 t will prevent the possibility of the 2003 year class elevating the productivity potential of the stock in the future. The Commission may wish to protect the 2003 year class to enhance its contribution to the spawning biomass. Maintaining catch at current levels (1,750 t) is expected to allow the spawning biomass to increase, which may help resolve the issue of low and high recruitment potential. For example, should the high recruitment hypothesis be correct, allowing substantial increases in spawning biomass should lead to higher recruitment.

As noted previously by the Committee, both the productivity of western Atlantic bluefin and western Atlantic bluefin fisheries are linked to the eastern Atlantic and Mediterranean stock. Therefore, management actions taken in the eastern Atlantic and Mediterranean are likely to influence the recovery in the western Atlantic, because even small rates of mixing from East to West can have considerable effects on the West due to the fact that Eastern plus Mediterranean resource is much larger than that of the West.

9. Other matters

Not other matters were discussed.

10. Adoption of the report and closure

The report was adopted.

The Chairman thanked the participants for their hard work.

The meeting was adjourned.

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Table 1 Task I catch data (t) of Atlantic northern bluefin tuna (Thunnus thynnus) by major area, gear and flag.

			1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TOTAL			26716	24695	21570	20723	27016	23819	26027	29350	34131	36636	48853	49714	53320	49489	42375	35228	36541	37390	37089	33469	33505	37602	32501	36154	25849	21730	13186	11765
BFT-E			24427	22010	19247	18220	24118	21061	23247	26429	31849	34268	46740	47291	50807	47155	39718	32456	33766	34605	33770	31163	31381	35845	30689	34516	23849	19751	11328	9779
	ATE		7395	4807	4687	4456	6951	5433	6040	6556	7619	9367	6930	9650	12663	13539	11376	9628	10528	10086	10347	7362	7410	9036	7535	8037	7645	6684	4379	3989
	MED		17032	17203	14560	13764	17167	15628	17207	19872	24230	24901	39810	37640	38144	33616	28342	22828	23238	24519	23424	23801	23971	26810	23154	26479	16205	13066	6949	5790
BFT-W			2289	2685	2322	2503	2898	2759	2780	2921	2282	2368	2113	2423	2514	2334	2657	2772	2775	2784	3319	2306	2125	1756	1811	1638	2000	1980	1857	1986
Landings	ATE	Bait boat	2262	2004	1414	1821	1936	1971	1693	1445	1141	3447	1980	2601	4985	3521	2550	1492	1822	2275	2567	1371	1790	2018	1116	2032	1794	1260	725	567
		Longline	1541	551	967	924	1169	962	1496	3197	3817	2717	2176	4392	4788	4534	4300	4020	3736	3303	2896	2750	2074	2713	2448	1706	2491	1960	1194	1157
		Other surf.	948	536	972	668	1221	1020	562	347	834	1548	932	1047	646	511	621	498	703	712	701	560	402	1014	1047	502	187	298	143	36
		Purse seine	373	86	276	0	0	0	54	46	462	24	213	458	323	828	692	726	1147	150	884	490	1078	871	332	0	0	0	1	
		Sport (HL+RR)	0	1	1	3	1	2	1	0	0	0	0	0	0	162	28	33	126	61	63	109	87	11	4	10	6	2	25	92
		Traps	2271	1630	1057	1040	2624	1478	2234	1522	1365	1631	1630	1152	1921	3982	3185	2859	2996	3585	3235	2082	1978	2408	2588	3788	3166	3164	2292	2137
	MED	Bait boat	1699	278	0	0	0	0	25	148	158	48	0	206	5	4	11	4	0	0	1	9	17	5	0	0	0	0	0	
		Longline	1196	1228	678	799	1227	1121	1026	2869	2599	2342	7048	8475	8171	5672	2749	2463	3317	3750	2614	2476	2564	3101	2202	2656	2254	1213	1058	869
		Other surf.	1738	3211	3544	2762	2870	3289	1212	1401	1894	1607	3218	1043	1197	1037	1880	2976	1067	1096	990	2536	1106	480	301	699	1022	169	275	223
		Purse seine	9888	11219	9333	8857	11198	9450	11250	13245	17807	19297	26083	23588	26021	24178	21291	14910	16195	17174	17656	17167	18785	22475	20020	22952	12641	11395	4984	4293
		Sport (HL+RR)	275	507	322	433	838	457	1552	738	951	1237	2257	3556	2149	2340	1336	1622	1921	1321	1647	1392	1340	634	503	78	137	146	351	226
		Traps	2236	760	683	913	1034	1311	2142	1471	821	370	1204	772	601	385	1074	852	739	1177	515	221	159	115	129	95	152	144	281	165
	ATW	Longline	832	1245	764	1138	1373	698	739	895	674	696	539	466	547	382	764	914	858	610	730	186	644	425	565	420	606	366	529	743
		Other surf.	377	293	166	156	425	755	536	578	509	406	307	384	432	293	342	281	284	202	108	140	97	89	85	63	82	121	107	148
		Purse seine	401	377	360	367	383	385	384	237	300	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28	0	11	0	
		Sport (HL+RR)	676	750	518	726	601	786	1004	1083	586	854	804	1114	1029	1181	1108	1124	1120	1649	2035	1398	1139	924	1005	1023	1130	1251	1009	887
		Traps	3	20	0	17	14	1	2	0	1	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26
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	0	0	0	0	0	13
	ATW	Longline	0	0	514	99	102	119	115	128	211	88	83	138	167	155	123	160	222	105	211	232	181	131	149	100	159	207	174	181
		Other surf.	0	0	0	0	0	14	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sport (HL+RR)	0	0	0	0	0	0	0	0	0	0	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	
Landings	ATE	Cape Verde	1	0	0	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 P.R.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	103	80	68	39	19	41	24	42	72	119	42	38	36
		Chinese Taipei	3	16	197	20	0	109	0	0	0	6	20	8	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	**0**
		EU.Denmark	0	37	0	0	1	0	0	0	0	37	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.España	4804	3628	2876	2479	4567	3565	3557	2272	2319	5078	3137	3819	6174	6201	3800	3360	3474	3633	4089	2138	2801	3102	2033	3276	2938	2409	1550	1488
		EU.France	602	490	348	533	724	460	510	565	894	1099	336	725	563	269	613	588	542	629	755	648	561	818	1218	629	253	366	228	135
		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	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	0	0	0	
		EU.Ireland	0	0	0	0	0	0	0	0	0	0	0	0	0	14	21	52	22	8	15	3	1	1	2	1	1	1	2	4
		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	0	0	0	
		EU.Portugal	34	29	193	163	48	3	27	117	38	25	240	35	199	712	323	411	441	404	186	61	27	79	97	29	36	53	58	180
		EU.Sweden	0	0	0	0	0	0	0	1	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	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	
		Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	104	118	0	0	0	0	0	0	0	0	0	0	
		Guinée Conakry	0	0	0	0	0	0	0	0	0	0	330	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	2	27	0	0	1	0	0	0	0	0	0	0	0	2
		Japan	1514	420	739	900	1169	838	1464	2981	3350	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089
		Korea Rep.	0	77	0	0	0	0	0	0	0	0	4	205	92	203	0	0	6	1	0	0	3	0	1	0	0	0	0	
		Libya	0	0	0	0	0	0	0	0	312	0	0	0	576	477	511	450	487	0	0	0	0	0	47	0	0	0	0	
		Maroc	171	86	288	356	437	451	408	531	562	415	720	678	1035	2068	2341	1591	2228	2497	2565	1797	1961	2405	2196	2418	1947	1909	1348	1055
		NEI (ETRO)	6	3	4	0	5	6	74	4	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	85	144	223	68	189	71	208	66	0	0	0	0	0	0	0	0	0	0	0	0	
		Norway	243	0	31	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	
		Panama	17	22	11	4	0	0	0	0	0	0	1	19	550	255	0	13	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	0	0	0	0	0	2	0	0	0	0	0	0	0	0	
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	93	118	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	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	0	0	0	0	0	50	0	
		Algerie	254	260	566	420	677	820	782	800	1104	1097	1560	156	156	157	1947	2142	2330	2012	1710	1586	1208	1530	1038	1511	1311	0	0	
		China P.R.	0	0	0	0	0	0	0	0	0	0	97	137	93	49	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Chinese Taipei	0	0	0	0	0	0	0	0	0	328	709	494	411	278	106	27	169	329	508	445	51	267	5	0	0	0	0	**0**
		Croatia	0	0	0	0	0	0	0	1418	1076	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371

		EU.Cyprus	10	10	10	10	10	10	10	10	10	14	10	10	10	10	21	31	61	85	91	79	105	149	110	1	132	2	3	10
		EU.España	2743	1460	701	1178	1428	1645	1822	1392	2165	2018	2741	4607	2588	2209	2000	2003	2772	2234	2215	2512	2353	2758	2689	2414	2465	1769	1056	942
		EU.France	3600	5430	3490	4330	5780	4434	4713	4620	7376	6995	11843	9604	9171	8235	7122	6156	6794	6167	5832	5859	6471	8638	7663	10157	2670	3087	1754	805
		EU.Greece	0	11	131	156	159	182	201	175	447	439	886	1004	874	1217	286	248	622	361	438	422	389	318	255	285	350	373	224	172
		EU.Italy	7140	7199	7576	4607	4201	4317	4110	3783	5005	5328	6882	7062	10006	9548	4059	3279	3845	4377	4628	4973	4686	4841	4695	4621	2234	2735	1053	1783
		EU.Malta	21	21	41	36	24	29	81	105	80	251	572	587	399	393	407	447	376	219	240	255	264	346	263	334	296	263	136	142
		EU.Portugal	0	0	0	0	0	0	0	278	320	183	428	446	274	37	54	76	61	64	0	2	0	0	11	0	0	0	0	
		Iceland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	
		Israel	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	1036	1006	341	280	258	127	172	85	123	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	684	458	591	410	66	0	0	0	0	0	700	1145	26	276	335	102	0	
		Libya	274	300	300	300	300	84	328	370	425	635	1422	1540	812	552	820	745	1063	1941	638	752	1300	1091	1280	1358	1318	1082	645	**0**
		Maroc	4	12	56	116	140	295	1149	925	205	79	1092	1035	586	535	687	636	695	511	421	760	819	92	190	641	531	369	205	182
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	427	639	171	1066	825	140	17	0	0	0	0	0	0	0	0	0	0	
		NEI (MED)	19	0	168	183	633	757	360	1799	1398	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	0	0	0	0	0	773	211	0	101	1030	1995	109	571	508	610	709	0	0	0	0	0	0	
		Panama	0	0	0	72	67	0	74	287	484	467	1499	1498	2850	236	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Serbia & Montenegro	0	0	0	0	0	0	0	0	0	0	0	2	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	
		Syria Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	0	34	
		Tunisie	307	369	315	456	624	661	406	1366	1195	2132	2773	1897	2393	2200	1745	2352	2184	2493	2528	791	2376	3249	2545	2622	2679	1932	1042	852
		Turkey	869	41	69	972	1343	1707	2059	2459	2817	3084	3466	4220	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519
		Yugoslavia Fed.	755	1084	796	648	1523	560	940	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	ATW	Argentina	0	6	0	2	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Brasil	0	1	0	2	0	2	1	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	0	0	0	
		Canada	264	142	73	83	393	619	438	485	443	459	392	576	597	503	595	576	549	524	604	557	537	600	733	491	575	530	505	474
		Chinese Taipei	0	3	3	4	0	20	0	0	0	0	0	0	0	2	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	0	0	0	0	0	74	11	19	27	19	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	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	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	0	0	0	
		FR.St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	1	10	5	0	4	3	2	8	0
		Japan	696	1092	584	960	1109	468	550	688	512	581	427	387	436	322	691	365	492	506	575	57	470	265	376	277	492	162	353	578
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	52	0	0	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	0	4	0	19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14
		NEI (ETRO)	0	0	0	0	0	30	24	23	17	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	0	0	0	0	0	2	0	0	429	270	49	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	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	0	0	0	
		Sta. Lucia	0	0	0	1	3	2	14	14	14	2	43	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Trinidad and Tobago	0	1	0	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.	1320	1424	1142	1352	1289	1483	1636	1582	1085	1237	1163	1311	1285	1334	1235	1213	1212	1583	1840	1426	899	717	468	758	764	1068	803	738
		UK.Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0
		Uruguay	9	16	6	0	2	0	0	1	0	1	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
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	0	0	0	0
		Croatia	0	0	0	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
		Turkey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
	ATW	Canada	0	0	0	0	0	14	0	0	0	0	0	0	0	6	16	11	46	13	37	14	15	0	2	0	1	3	25	36
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	8	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	0	0	0	0	0
		U.S.A.	0	0	514	99	102	119	115	128	211	88	83	138	171	155	110	149	176	98	174	218	167	131	147	100	158	204	150	145

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.

Task 1 Yr	t1FlagN	tlFleetC	t1GearG	t1Gear	L or D	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2010	Canada	CAN	LL	LL	D	25	2010	Canada	CAN	LL	LL	ATW	87.00	453	143-294	208.70	192.3	1	sub-raise
2010	Canada	CAN	LL	LL	L	65	2010	Canada	CAN	LL	LL	ATW	87.00	453	143-294	208.70	192.3	1	re-raise
2010	Canada	CAN	RR	RR	L	324	2010	Canada	CAN	RR	RR	ATW	349.67	1205	156-288	236.67	290.3	1	re-raise
2010	Canada	CAN	TL	TL	L	40	2010	Canada	CAN	TL	TL	ATW	43.58	156	171-280	235.49	279.6	1	re-raise
2010	Canada	CAN	TP	TRAP	L	39	2010	Canada	CAN	TP	TRAP	ATW	39.38	140	157-291	243.05	281.7	1	re-raise
2010	Canada	CAN	HP	HP-E	L	37	2010	Canada	CAN	HP	HP-E	ATW	40.37	141	175-280	237.52	286.3	1	re-raise
2010	FR.St Pierre e	FR.SPM-CAN	LL	LL	L	8	2010	FR.St Pierre e	FR.SPM-CAN	LL	LL	ATW	7.65	46	173-272	201.74	166.4	0	raise
2010	Japan	JPN	LL	LLHB	L	353	2010	Japan	JPN	LL	LLHB	ATW	353.65	2091	129-284	200.21	169.1	1	none
2010	Mexico	MEX	LL	LL	L	14	2010	Mexico	MEX	LL	LL	ATW	18.59	58.0	137-371	249.16	320	0	raise
2010	U.S.A.	USA	RR	RRFB	L	570.8	2010	U.S.A.	USA-Com	RR	RRFB	ATW	574.26	3584	143-279	194.94	160.2	1	none
2010	U.S.A.	USA-Com	HL	HAND	L	2.7	2010	U.S.A.	USA-Com	HL	HAND	ATW	3.33	22	180-233	196.73	152.8	1	none
2010	U.S.A.	USA-Com	HP	HARP	L	29.0	2010	U.S.A.	USA-Com	HP	HARP	ATW	34.31	245	177-306	192.61	140.2	1	none
2010	U.S.A.	USA-Com	LL	LL	D	149.6	2010	U.S.A.	USA-Com	LL	LLD	ATW	150.75	1328	67-278	168.09	113.5	1	none
2010	U.S.A.	USA-Com	LL	LL	L	89.2	2010	U.S.A.	USA-Com	LL	LL	ATW	86.66	410	170-307	219.98	211.6	1	none
2010	U.S.A.	USA-Rec	RR	RRFS	L	111.4	2010	U.S.A.	USA-Rec	RR	RRFS	ATW	112.02	3985	58-142	109.22	28.1	1	none
2011	Canada	CAN	HP	HP-E	L	30	2011	Canada	CAN	HP	HP-E	ATW	31.77	106	164-288	237.70	298.6	1	re-raise
2011	Canada	CAN	LL	LL	D	36	2011	Canada	CAN	LL	LL	ATW	76.52	498	137-281	193.20	153.6	1	sub-raise
2011	Canada	CAN	LL	LL	L	76	2011	Canada	CAN	LL	LL	ATW	76.52	498	137-281	193.20	153.6	1	none
2011	Canada	CAN	RR	RR	L	294	2011	Canada	CAN	RR	RR	ATW	302.85	1150	145-290	229.74	263.4	1	re-raise
2011	Canada	CAN	TL	TL	L	30	2011	Canada	CAN	TL	TL	ATW	31.07	141	168-275	217.01	220.1	1	re-raise
2011	Canada	CAN	TP	TRAP	L	26	2011	Canada	CAN	TP	TRAP	ATW	25.93	91	138-285	244.94	285.3	1	re-raise
2011	Canada	CAN	TR	TROL	L	16	2011	Canada	CAN	TR	TROL	ATW	16.33	47	217-287	256.46	347.0	1	none
2011	Japan	JPN	LL	LLHB	L	578	2011	Japan	JPN	LL	LLHB	ATW	579.90	4890	117-278	174.63	118.6	1	none
2011	Mexico	MEX	LL	LL	L	14	2011	Mexico	MEX	LL	LL	ATW	18.85	55.0	171-350	253.30	343	0	raise
2011	U.S.A.	USA-Com	HL	HAND	L	1	2011	U.S.A.	USA-Com	HL	HAND	ATW	0.96	5	179-245	212.70	191.0	1	none
2011	U.S.A.	USA-Com	HP	HARP	L	70	2011	U.S.A.	USA-Com	HP	HARP	ATW	80.45	566	159-286	194.29	142.1	1	none
2011	U.S.A.	USA-Com	LL	LL	D	145	2011	U.S.A.	USA-Com	LL	LLD	ATW	146.38	1511	120-270	164.88	96.9	1	none
2011	U.S.A.	USA-Com	LL	LL	L	75	2011	U.S.A.	USA-Com	LL	LL	ATW	71.25	360	162-277	215.57	197.9	1	none
2011	U.S.A.	USA-Com	RR	RR	L	419	2011	U.S.A.	USA-Com	RR	RR	ATW	465.74	2457	150-294	207.51	189.6	1	none
2011	U.S.A.	USA-Com	TW	TRAW	L	0.4	2011	U.S.A.	USA-Com	TW	TRAW	ATW	0.45	1	269-269	269.50	447.2	1	none
2011	U.S.A.	USA-Rec	RR	RR	L	173	2011	U.S.A.	USA-Rec	RR	RR	ATW	175.80	4873	75-270	118.32	36.1	1	none

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	tlFleetC	t1GearG	t1Gear	t1Stock	t1Yt	szYr	szFlagN	szFleetC	szGearG	szGear	szStock	szYt0	szNt	Lrng	Lmed	Wmed	szInfo	Actions
2010	China P.R.	CHN	LL	LL	ATE	38	2010	Japan	JPN	LL	LLHB	ATE	1137.6126	9594	145-272	188.79928	118.6	1	sub-raise
2010	EU.España	EU.ESP	BB	BB	ATE	97	2010	EU.España	EU.ESP	BB	BB	ATE	95.356186	2087	85-269	126.47221	45.7	1	re-raise
2010	EU.España	EU.ESP	HL	HAND	ATE	21	2010	EU.España	EU.ESP	HL	HAND	ATE	21.391115	125	160-249	213.9	171.1	1	re-raise
2010	EU.España	EU.ESP	TP	TRAP	ATE	887	2010	EU.España	EU.ESP	TP	TRAP	ATE	735.91852	5217	100-284	198.99511	141.1	1	re-raise
2010	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	14	2010	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	14.251246	71	180-266	225.97874	201.7	0	none
2010	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	530	2010	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	518.06573	25531	61-206	99.420234	20.3	1	re-raise
2010	EU.France	EU.FRA	BB	BB	ATE	83	2010	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	518.06573	25531	61-206	99.420234	20.3	1	sub-raise
2010	EU.France	EU.FRA	HL	SPHL	ATE	4	2010	EU.España	EU.ESP	HL	HAND	ATE	21.391115	125	160-249	213.9	171.1	1	sub-raise
2010	EU.France	EU.FRA	TW	TRAW	ATE	122	2010	EU.France	EU.FRA	TW	TRAW	ATE	10.368869	140.0	86-232	155	74	0	raise
2010	EU.France	EU.FRA	UN	UNCL	ATE	19	2010	EU.France	EU.FRA	TW	TRAW	ATE	10.368869	140	86-232	155.07857	74.1	0	sub-raise
2010	EU.Ireland	EU.IRL	TW	MWTD	ATE	2	2010	EU.Ireland	EU.IRL	TW	MWTD	ATE	0.7246969	5	70-247	172.7	144.9	1	re-raise
2010	EU.Portugal	EU.PRT-PT-MA	PS	PS	ATE	1	2010	EU.Portugal	EU.PRT-PT-MA	TP	TRAP	ATE	92.256487	565	118-293	208.80531	163.3	0	sub-raise
2010	EU.Portugal	EU.PRT-PT-MA	TP	TRAP	ATE	57	2010	EU.Portugal	EU.PRT-PT-MA	TP	TRAP	ATE	92.256487	565	118-293	208.80531	163.3	0	raise
2010	Japan	JPN	LL	LLHB	ATE	1155	2010	Japan	JPN	LL	LLHB	ATE	1137.6126	9594	145-272	188.79928	118.6	1	none
2010	Maroc	MAR	TP	TRAP	ATE	1348	2010	Maroc	MAR	TP	TRAP	ATE	1205.6643	6821	150-284	215.30384	176.8	1	re-raise
2011	China P.R.	CHN	LL	LL	ATE	36	2011	China P.R.	CHN	LL	LL	ATE	34.63415	244.0	142-251	201	142	0	raise
2011	EU.España	EU.ESP	BB	BB	ATE	40	2011	EU.España	EU.ESP	BB	BB	ATE	39.051262	1156.0	85-254	117	34	0	raise
2011	EU.España	EU.ESP	HL	HAND	ATE	19	2011	EU.España	EU.ESP	HL	HAND	ATE	19.3825	107.0	155-269	218	181	0	raise
2011	EU.España	EU.ESP	TP	TRAP	ATE	902	2011	EU.España	EU.ESP	TP	TRAP	ATE	400.32417	2214.0	110-284	217	181	0	raise
2011	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	57	2011	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	56.993418	325.8	176-271	216	175	1	none
2011	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	470	2011	EU.España	EU.ESP-ES-CAI	BB	BB	ATE	66.284671	1588.0	74-210	126	42	0	raise
2011	EU.France	EU.FRA	HL	HAND	ATE	74	2011	EU.España	EU.ESP	HL	HAND	ATE	19.3825	107.0	155-269	218	181	0	sub-raise
2011	EU.France	EU.FRA	LL	LL	ATE	32	2011	EU.España	EU.ESP	HL	HAND	ATE	19.3825	107.0	155-269	218	181	0	sub-raise
2011	EU.France	EU.FRA	TW	TRAW	ATE	28	2011	EU.France	EU.FRA-FR	TW	MWT	ATE	2.981457	36	81-244	161.63889	82.8	1	re-raise
2011	EU.Ireland	EU.IRL	TW	MWTD	ATE	4	2011	EU.Ireland	EU.IRL	TW	MWTD	ATE	0.4320361	3	198-205	202.83333	144.0	0	raise
2011	EU.Portugal	EU.PRT-PT-MA	TP	TRAP	ATE	180	2011	EU.Portugal	EU.PRT-PT-MA	TP	TRAP	ATE	151.82256	1192	114-259	192.6745	127.4	0	raise
2011	Iceland	ISL	TW	MWT	ATE	2	2011	Iceland	ISL	TW	MWT	ATE	1.9038619	12	192-227	209.08333	158.7	0	raise
2011	Japan	JPN	LL	LLHB	ATE	1089	2011	Japan	JPN	LL	LLHB	ATE	1072.9666	7679	149-277	200.35259	139.7	1	none
2011	Maroc	MAR	TP	TRAP	ATE	1055	2011	Maroc	MAR	TP	TRAP	ATE	889.07006	4331	145-294	227.87174	205.3	1	re-raise

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
2010	Croatia	HRV	HL	HAND	MED	16	2010	Croatia	HRV	HL	HAND	MED	15.919704	332	112-208	129.90964	48.0	0	none
2010	Croatia	HRV	HL	SPHL	MED	3	2010	Croatia	HRV	HL	HAND	MED	15.919704	332	112-208	129.90964	48.0	0	sub-raise
2010	Croatia	HRV	PS	PS	MED	370	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3	2010	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.5850182	27	120-300	171.7963	132.8	1	re-raise
2010	EU.España	EU.ESP	LL	LLALB	MED	46	2010	EU.España	EU.ESP	LL	LLALB	MED	58.62196	2807	48-210	99.05896	20.9	1	re-raise
2010	EU.España	EU.ESP	LL	LLJAP	MED	177	2010	EU.España	EU.ESP	LL	LLJAP	MED	228.54699	1379	90-279	196.80384	165.7	1	re-raise
2010	EU.España	EU.ESP-ES-ME	PS	PS	MED	804	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	EU.España	EU.ESP-ES-ME	SP	SPOR	MED	13	2010	EU.España	EU.ESP	LL	LLALB	MED	58.62196	2807	48-210	99.05896	20.9	1	sub-raise
2010	EU.España	EU.ESP-ES-ME	LL	LLHB	MED	17	2010	EU.España	EU.ESP-ES-ME	LL	LLHB	MED	8.0503536	189	65-239	121.7328	42.6	0	raise
2010	EU.France	EU.FRA-MED	HL	SPHL	MED	23	2010	EU.España	EU.ESP	LL	LLALB	MED	58.62196	2807	48-210	99.05896	20.9	1	sub-raise
2010	EU.France	EU.FRA-MED	PS	PS	MED	1546	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	raise
2010	EU.France	EU.FRA-MED	TW	TRAW	MED	1	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	EU.France	EU.FRA-MED	UN	UNCL	MED	184	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	EU.Greece	EU.GRC	HL	HAND	MED	135	2010	Croatia	HRV	HL	HAND	MED	15.919704	332	112-208	129.90964	48.0	0	sub-raise
2010	EU.Greece	EU.GRC	LL	LL-deri	MED	52	2010	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.5850182	27	120-300	171.7963	132.8	1	sub-raise
2010	EU.Greece	EU.GRC	PS	PS	MED	37	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	EU.Italy	EU.ITA	UN	UNCL	MED	61	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-ADR	LL	LLBFT	MED	356	2010	EU.Italy	EU.ITA-IT-ADR	LL	LLBFT	MED	252.1378	5616	110-224	128.36906	44.9	1	re-raise
2010	EU.Italy	EU.ITA-IT-ADR	SP	SPOR	MED	109	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	raise
2010	EU.Italy	EU.ITA-IT-ADR	UN	UNCL	MED	4	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-ION	LL	LLBFT	MED	2	2010	EU.Italy	EU.ITA-IT-ION	LL	LLBFT	MED	1.8674837	33	110-199	136.83333	56.9	1	re-raise
2010	EU.Italy	EU.ITA-IT-ION	SP	SPOR	MED	18	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-ION	UN	UNCL	MED	11	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-LIG	LL	LLBFT	MED	1	2010	EU.Italy	EU.ITA-IT-LIG	LL	LLBFT	MED	0.9629886	18	120-149	138.125	55.0	1	re-raise
2010	EU.Italy	EU.ITA-IT-LIG	SP	SPOR	MED	2	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-LIG	UN	UNCL	MED	4	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-SAR	SP	SPOR	MED	16	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-SAR	TP	TRAP	MED	281	2010	EU.Italy	EU.ITA-IT-TYRI	LL	LLBFT	MED	0.7746326	9	120-194	158.75	88.5	1	sub-raise
2010	EU.Italy	EU.ITA-IT-SAR	UN	UNCL	MED	1	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-SIC.	LL	LLBFT	MED	161	2010	EU.Italy	EU.ITA-IT-SIC.	LL	LLBFT	MED	308.61691	2545	110-284	174.32717	121.3	1	re-raise
2010	EU.Italy	EU.ITA-IT-SIC.	UN	UNCL	MED	2	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-TYRI	LL	LLBFT	MED	1	2010	EU.Italy	EU.ITA-IT-TYRI	LL	LLBFT	MED	0.7746326	9	120-194	158.75	88.5	1	re-raise
2010	EU.Italy	EU.ITA-IT-TYRI	SP	SPOR	MED	16	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Italy	EU.ITA-IT-TYRI	UN	UNCL	MED	6	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2010	EU.Malta	EU.MLT	LL	LL-surf	MED	136	2010	EU.Malta	EU.MLT	LL	LL-deri	MED	178	1240	91-289	180.2	143.3	0	raise
2010	Libya	LBY	PS	PS	MED	645	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	Maroc	MAR	LL	LL	MED	107	2010	EU.España	EU.ESP-ES-ME	LL	LLHB	MED	8.0503536	189	65-239	121.7328	42.6	0	sub-raise
2010	Maroc	MAR	PS	PS	MED	98	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	Syria Rep.	SYR	PS	PS	MED	34	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise

2010	Tunisie	TUN	PS	PS	MED	1042	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2010	Turkey	TUR	PS	PS	MED	409	2010	EU.France	EU.FRA-MED	PS	PS	MED	850.43093	11663.0	77-204	149	73	0	sub-raise
2011	Albania	ALB	PS	PS	MED	0.2	2011	Albania	ALB	PS	PS	MED	0.0793908	4	98-99	99	19.8	0	raise
2011	Croatia	HRV	HL	HAND	MED	6	2011	Croatia	HRV	HL	HAND	MED	5.4910504	133.0	112-197	125	41	0	raise
2011	Croatia	HRV	HL	SPHL	MED	3	2011	Croatia	HRV	HL	HAND	MED	5.4910504	133.0	112-197	125	41	0	sub-raise
2011	Croatia	HRV	PS	PS	MED	4	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	Croatia	HRV	PS	PS	MED	362	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	EU.Cyprus	EU.CYP	LL	LLBFT	MED	7	2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.3672166	33	115-249	160.68182	102.0	1	sub-raise
2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	2	2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.3672166	33	115-249	160.68182	102.0	1	re-raise
2011	EU.España	EU.ESP	LL	LLALB	MED	31	2011	EU.España	EU.ESP	LL	LLALB	MED	61.325181	2129.0	52-206	111	29	0	raise
2011	EU.España	EU.ESP	LL	LLJAP	MED	22	2011	EU.España	EU.ESP	LL	LLJAP	MED	9.424479	134.0	100-224	146	70	0	raise
2011	EU.España	EU.ESP-ES-ME	PS	PS	MED	877	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	EU.España	EU.ESP-ES-ME	SP	SPOR	MED	7	2011	EU.España	EU.ESP	LL	LLALB	MED	61.325181	2129.0	52-206	111	29	0	sub-raise
2011	EU.España	EU.ESP-ES-ME	LL	LLHB	MED	4	2011	EU.España	EU.ESP-ES-ME	LL	LLHB	MED	2.7747241	71.0	75-199	121	39	0	raise
2011	EU.France	EU.FRA-MED	HL	SPHL	MED	14	2011	EU.France	EU.FRA-MED	HL	SPHL	MED	17.459213	337	112-271	132.07864	51.8	0	raise
2011	EU.France	EU.FRA-MED	LL	LL	MED	20	2010	EU.España	EU.ESP	LL	LLALB	MED	58.62196	2807	48-210	99.05896	20.9	1	sub-raise
2011	EU.France	EU.FRA-MED	PS	PS	MED	678	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	re-raise
2011	EU.France	EU.FRA-MED	TW	TRAW	MED	1	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	EU.France	EU.FRA-MED	UN	OTH	MED	93	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	EU.Greece	EU.GRC	HL	HAND	MED	52	2011	Croatia	HRV	HL	HAND	MED	5.4910504	133.0	112-197	125	41	0	sub-raise
2011	EU.Greece	EU.GRC	LL	LL-deri	MED	19	2011	EU.Cyprus	EU.CYP	LL	LLSWO	MED	3.3672166	33	115-249	160.68182	102.0	1	sub-raise
2011	EU.Greece	EU.GRC	PS	PS	MED	3	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	EU.Greece	EU.GRC	PS	PSFB	MED	98	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	EU.Italy	EU.ITA	SP	SPOR	MED	66	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2011	EU.Italy	EU.ITA	UN	UNCL	MED	130	2010	EU.Italy	EU.ITA	SP	SPOR	MED	163.06443	2962	114-226	137.40108	55.1	0	sub-raise
2011	EU.Italy	EU.ITA-IT-ADR	LL	LLBFT	MED	3	2011	EU.Italy	EU.ITA-IT-ADR	LL	LLBFT	MED	5.1291959	88	120-159	140.41667	58.0	1	re-raise
2011	EU.Italy	EU.ITA-IT-IONI	LL	LLBFT	MED	5	2011	EU.Italy	EU.ITA-IT-IONI	LL	LLBFT	MED	6.9859388	111	130-169	144.83333	63.2	1	re-raise
2011	EU.Italy	EU.ITA-IT-SARI	TP	TRAP	MED	165	2011	EU.Italy	EU.ITA-IT-SARI	TP	TRAP	MED	197.97729	2658	110-279	148.02453	74.5	1	re-raise
2011	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	582	2011	EU.Italy	EU.ITA-IT-SIC.:	LL	LLBFT	MED	721.02517	5151	115-279	179.42418	140.0	1	re-raise
2011	EU.Italy	EU.ITA-IT-TYRI	LL	LLBFT	MED	79	2011	EU.Italy	EU.ITA-IT-TYRI	LL	LLBFT	MED	100.46713	1216	115-249	152.92424	82.6	1	re-raise
2011	EU.Italy	EU.ITA-IT-TYRI	PS	PSFB	MED	752	2011	EU.Italy	EU.ITA-IT-TYRI	PS	PSFB	MED	737.04978	7204	110-279	159.16667	102.3	1	re-raise
2011	EU.Malta	EU.MLT	LL	LLBFT	MED	92	2011	EU.Malta	EU.MLT	LL	LL-deri	MED	114.83791	706.0	94-321	187	163	0	raise
2011	EU.Malta	EU.MLT	PS	PS	MED	50	2011	EU.Italy	EU.ITA-IT-TYRI	PS	PSFB	MED	737.04978	7204	110-279	159.16667	102.3	1	sub-raise
2011	Maroc	MAR	HL	HAND	MED	78	2011	Maroc	MAR	HL	HAND	ATE	86.543617	525	155-279	210.77619	164.8	1	re-raise
2011	Maroc	MAR	LL	LL	MED	1	2010	EU.España	EU.ESP-ES-ME	LL	LLHB	MED	8.0503536	189	65-239	121.7328	42.6	0	sub-raise
2011	Maroc	MAR	PS	PS	MED	103	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	Tunisie	TUN-TUN-MAI	PS	PS	MED	134	2011	Tunisie	TUN-TUN-MAI	PS	PS	MED	9.1678888	115	120-199	154.02174	79.7	0	raise
2011	Tunisie	TUN-TUN-SFA:	PS	PS	MED	718	2011	Tunisie	TUN-TUN-SOL	PS	PS	MED	5.512952	90	105-209	141.94444	61.3	0	raise
2011	Turkey	TUR	PS	PS	MED	8	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise
2011	Turkey	TUR	PS	PS	MED	519	2011	EU.France	EU.FRA-MED	PS	PS	MED	297.21493	4788.0	99-184	143	62	1	sub-raise

Table 5 CPUE series used in the eastern and Mediterranean bluefin stock assessment..

series	SP BB1	CV	SP BB2	CV	SP BB3	CV	SP TRAP all season	CV	MO SP TRAP All seas.	CV	JPN LL	CV	JPN LL	CV	Norway PS from Task II		
age	5-6		2-3		3-6		6+		6+		6 - 10		4 - 10		10 +		
indexing	Weight		Weight		Weight		Number		Number		Number		Number		Weight		
area	East Atlantic		East Atlantic		East Atlantic		East Atlantic		East Atlantic		East Atl and Med		NEast Atl		East Atlantic		
method	Delta lognormal RE		Delta lognormal RE		Delta lognormal RE		Neg. Binom. (log) no RE		Neg. Binom. (log) no RE		Delta Lognormal RE		Delta Lognormal RE		Nominal		
time of the year	Mid-year		Mid-year		Mid-year		Mid-year		Mid-year		Mid-year		Begin-year		Unknown		
source	SCRS/2012/100		SCRS/2012/100		SCRS/2012/100		SCRS/2012/111		SCRS/2012/106		SCRS/2012/131		SCRS/2012/131		Task I	Effort	CPUE
1952	179.22	0.43															
1953	184.74	0.53															
1954	226.46	0.41															
1955	187.01	0.42													13394	370	36
1956	470.53	0.43													5313	250	21
1957	315.05	0.41													6437	225	29
1958	252.25	0.41													3860	160	24
1959	506.79	0.41													3241	100	32
1960	485.16	0.43													4215	90	47
1961	327.29	0.41													8553	165	52
1962	180.12	0.46													8730	135	65
1963			312.09	0.49											167	100	2
1964			457.40	0.42											1461	43	34
1965			228.91	0.41											2506	36	70
1966			349.10	0.42											1000	28	36
1967			345.89	0.41											2015	33	61
1968			447.00	0.42											753	32	24
1969			610.62	0.40											842	30	28
1970			594.66	0.43											470	11	43
1971			744.71	0.40											653	15	44
1972			525.63	0.41											430	10	43
1973			535.63	0.40											421	10	42
1974			245.39	0.44											869	19	46
1975			484.22	0.41							1.90	0.15			988	26	38
1976			483.96	0.41							2.15	0.12			529	25	21
1977			547.56	0.41							3.53	0.14			764	18	42
1978			705.26	0.41							1.50	0.15			221	18	12
1979			623.01	0.41							2.70	0.14			60	16	4
1980			634.81	0.45							1.69	0.16			282	14	20
1981			510.66	0.42			2989.64	30.78	1541.00	55.55	1.63	0.17					
1982			503.78	0.42			4044.73	17.74	2061.62	33.11	3.32	0.13					
1983			625.14	0.43			4255.15	17.74	2174.30	33.11	2.12	0.13					
1984			331.71	0.45			4679.21	17.74	2391.52	33.11	1.62	0.12					
1985			1125.74	0.41			3176.36	17.75	1621.34	33.11	1.75	0.15					
1986			751.21	0.42			1137.38	15.68	781.72	26.52	1.32	0.14					
1987			1008.43	0.42			1519.70	15.66	860.82	26.52	2.16	0.13					
1988			1394.68	0.42			3450.21	15.62	2014.26	26.49	1.35	0.14					
1989			1285.60	0.40			1852.44	15.65	1071.04	24.58	1.05	0.16					
1990			986.51	0.41			3849.98	15.62	1228.66	21.95	1.41	0.14	0.36	0.33			
1991			901.20	0.42			2024.97	15.64	1454.41	21.94	1.21	0.13	0.46	0.28			
1992			695.16	0.43			1847.91	15.65	630.44	21.97	1.03	0.14	0.78	0.17			
1993			2093.55	0.40			1710.55	15.65	655.10	21.97	1.04	0.14	0.77	0.14			
1994			1007.03	0.42			1634.16	15.66	689.65	21.97	1.12	0.16	0.91	0.16			
1995			1235.91	0.41			1181.49	15.68	447.47	22.00	1.42	0.15	0.96	0.14			
1996			1739.29	0.40			1797.58	15.65	756.43	23.12	0.50	0.22	2.56	0.13			
1997			2246.41	0.40			4892.18	15.61	1996.46	23.09	0.53	0.21	1.63	0.13			
1998			879.51	0.41			3318.06	15.62	1849.79	23.09	0.71	0.17	0.85	0.16			
1999			339.77	0.44			5939.72	15.61	2279.69	23.09	0.64	0.22	1.21	0.15			
2000			960.44	0.40			2675.89	15.63	1497.16	21.94	0.74	0.20	1.23	0.12			
2001			704.49	0.45			2140.69	15.64	2579.38	21.93	0.96	0.17	1.46	0.12			
2002			687.42	0.42			2999.56	15.63	2257.33	21.93	2.05	0.15	1.12	0.13			
2003			444.91	0.48			1335.00	17.80	1318.13	23.14	1.70	0.13	1.15	0.14			
2004			1210.46	0.42			1325.32	15.67	665.17	21.97	0.82	0.18	1.03	0.12			
2005			2383.57	0.40			1567.50	15.66	1348.53	21.94	0.88	0.15	0.75	0.12			
2006			850.09	0.48			2149.31	15.64	1277.98	21.95	1.91	0.15	0.87	0.12			
2007			1177.62	0.42	2967.83	0.33	2616.56	15.63	2006.59	21.94	0.94	0.19	0.90	0.12			
2008					3063.81	0.32	2306.97	15.64	1277.25	21.95	1.22	0.17	1.05	0.12			
2009					1351.93	0.35	3695.14	15.62	1576.03	21.94	1.04	0.24	1.55	0.12			
2010					2393.02	0.33	5035.77	15.61	2023.26	23.12			2.53	0.13			
2011					4045.55	0.33	2953.05	15.63	1406.38	21.94			4.23	0.17			

Table 6 Scaled CPUE series used in the eastern and Mediterranean bluefin stock assessment..

series	SP BB1	CV	SP BB2	CV	SP BB3	CV	SP TRAP all season	CV	MO SP TRAP All seas.	CV	JPN LL	CV	JPN LL	CV	Norway PS from Task II		
age	5-6		2-3		3-6		6+		6+		6 - 10		4 - 10		10 +		
indexing	Weight		Weight		Weight		Number		Number		Number		Number		Weight		
area	East Atlantic		East Atlantic		East Atlantic		East Atlantic		East Atlantic		East Atl and Med		NEast Atl		East Atlantic		
method	Delta lognormal RE		Delta lognormal RE		Delta lognormal RE		Neg. Binom. (log) no RE		Neg. Binom. (log) no RE		Delta Lognormal RE		Delta Lognormal RE		Nominal		
time of the year	Mid-year		Mid-year		Mid-year		Mid-year		Mid-year		Mid-year		Begin-year		Unknown		
source	SCRS/2012/100		SCRS/2012/100		SCRS/2012/100		SCRS/2012/111		SCRS/2012/106		SCRS/2012/131		SCRS/2012/131		Task I	Effort	CPUE
1952	0.59	0.43															
1953	0.61	0.53															
1954	0.75	0.41															
1955	0.62	0.42													13394	370	1
1956	156	0.43													5313	250	1
1957	105	0.41													6437	225	1
1958	0.84	0.41													3860	160	1
1959	168	0.41													3241	100	1
1960	161	0.43													4215	90	1
1961	109	0.41													8553	165	1
1962	0.60	0.46													8730	135	2
1963			0.38	0.49											167	100	0
1964			0.56	0.42											1461	43	1
1965			0.28	0.41											2506	36	2
1966			0.43	0.42											1000	28	1
1967			0.42	0.41											2015	33	2
1968			0.54	0.42											753	32	1
1969			0.74	0.40											842	30	1
1970			0.72	0.43											470	11	1
1971			0.91	0.40											653	15	1
1972			0.64	0.41											430	10	1
1973			0.65	0.40											421	10	1
1974			0.30	0.44											869	19	1
1975			0.59	0.41							129	0.15			988	26	1
1976			0.59	0.41							146	0.12			529	25	1
1977			0.67	0.41							2.39	0.14			764	18	1
1978			0.86	0.41							102	0.15			221	18	0
1979			0.76	0.41							183	0.14			60	16	0
1980			0.77	0.45							1.14	0.16			282	14	1
1981			0.62	0.42			108	30.78	104	55.55	1.10	0.17					
1982			0.61	0.42			146	17.74	140	33.11	2.25	0.13					
1983			0.76	0.43			153	17.74	147	33.11	144	0.13					
1984			0.40	0.45			168	17.74	162	33.11	1.10	0.12					
1985			137	0.41			1.14	17.75	1.10	33.11	1.19	0.15					
1986			0.91	0.42			0.41	15.68	0.53	26.52	0.89	0.14					
1987			123	0.42			0.55	15.66	0.58	26.52	146	0.13					
1988			170	0.42			124	15.62	137	26.49	0.91	0.14					
1989			157	0.40			0.67	15.65	0.73	24.58	0.71	0.16					
1990			120	0.41			139	15.62	0.83	21.95	0.96	0.14	0.28	0.33			
1991			1.10	0.42			0.73	15.64	0.99	21.94	0.82	0.13	0.36	0.28			
1992			0.85	0.43			0.67	15.65	0.43	21.97	0.70	0.14	0.61	0.17			
1993			2.55	0.40			0.62	15.65	0.44	21.97	0.70	0.14	0.59	0.14			
1994			123	0.42			0.59	15.66	0.47	21.97	0.76	0.16	0.71	0.16			
1995			150	0.41			0.43	15.68	0.30	22.00	0.96	0.15	0.75	0.14			
1996			2.12	0.40			0.65	15.65	0.51	23.12	0.34	0.22	198	0.13			
1997			2.74	0.40			176	15.61	135	23.09	0.36	0.21	126	0.13			
1998			107	0.41			1.19	15.62	125	23.09	0.48	0.17	0.66	0.16			
1999			0.41	0.44			2.14	15.61	155	23.09	0.43	0.22	0.94	0.15			
2000			1.17	0.40			0.96	15.63	101	21.94	0.50	0.20	0.95	0.12			
2001			0.86	0.45			0.77	15.64	175	21.93	0.65	0.17	1.13	0.12			
2002			0.84	0.42			108	15.63	153	21.93	139	0.15	0.87	0.13			
2003			0.54	0.48			0.48	17.80	0.89	23.14	1.15	0.13	0.89	0.14			
2004			147	0.42			0.48	15.67	0.45	21.97	0.56	0.18	0.80	0.12			
2005			2.90	0.40			0.56	15.66	0.91	21.94	0.60	0.15	0.58	0.12			
2006			104	0.48			0.77	15.64	0.87	21.95	129	0.15	0.68	0.12			
2007			143	0.42	107	0.33	0.94	15.63	136	21.94	0.64	0.19	0.70	0.12			
2008					1.11	0.32	0.83	15.64	0.87	21.95	0.83	0.17	0.82	0.12			
2009					0.49	0.35	133	15.62	107	21.94	0.70	0.24	120	0.12			
2010					0.87	0.33	181	15.61	137	23.12			196	0.13			
2011					146	0.33	106	15.63	0.95	21.94			3.28	0.17			

Table 7 Description of available indices of abundance for the 2012 western bluefin tuna assessment.

	CAN GLS	CAN GLS W/O 2010	CAN SWNS NEW	CAN SWNS OLD
Age Min	13	13+	8	8
Age Max	16+	16+	14	14
Catch Unit	Numbers	Numbers	Numbers	Numbers
Effort Unit	48h	48h	24h	Hour
Method	Hurdle Model with Binomial on Zeros and Truncated Negative Binomial on Count	Hurdle Model with Binomial on Zeros and Truncated Negative Binomial on Count	Hurdle Model with Binomial on Zeros and Truncated Negative Binomial on Count	Delta-Lognormal
Months Covered	Aug 1 - Oct 31	Aug 1 - Oct 31	Aug 1 - Oct 31	Aug 1 - Oct 31
Area Covered	Canada - Gulf of St. Lawrence	Canada - Gulf of St. Lawrence	Canada - SW Nova Scotia	Canada - SW Nova Scotia
Updated Since Last Assessment	YES	YES	YES	YES
USED FOR RUN		BASE		BASE
	SENS 4		SENS	

	CAN GLS		CAN GLS W/O 2010		CAN SWNS		CAN SWNS OLD	
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	-	-	-	-	-	-	-	-
1981	1.414	0.171	1.556	0.157	-	-	-	-
1982	0.761	0.486	0.796	0.397	-	-	-	-
1983	1.490	0.108	2.472	0.115	-	-	-	-
1984	0.881	0.145	1.112	0.142	-	-	-	-
1985	0.272	0.316	0.214	0.283	-	-	-	-
1986	0.261	0.256	0.273	0.253	-	-	-	-
1987	0.304	0.317	0.366	0.372	-	-	-	-
1988	0.522	0.295	0.610	0.295	1.487	0.056	1.969	0.147
1989	0.544	0.273	0.704	0.319	1.528	0.054	2.639	0.122
1990	0.207	0.288	0.188	0.289	1.511	0.059	2.459	0.123
1991	0.729	0.222	0.935	0.210	0.908	0.093	1.337	0.124
1992	1.185	0.165	1.735	0.176	1.102	0.045	1.239	0.104
1993	0.870	0.108	1.229	0.119	0.589	0.061	0.619	0.097
1994	0.239	0.190	0.253	0.158	0.974	0.035	1.167	0.100
1995	0.707	0.094	0.909	0.098	0.984	0.039	0.963	0.094
1996	0.141	0.234	0.090	0.208	0.471	0.078	0.344	0.088
1997	0.163	0.192	0.139	0.178	0.319	0.104	0.240	0.103
1998	0.283	0.178	0.271	0.156	0.662	0.083	0.508	0.104
1999	0.435	0.193	0.527	0.159	0.967	0.076	0.909	0.116
2000	0.348	0.190	0.359	0.163	0.326	0.104	0.230	0.107
2001	0.272	0.242	0.340	0.206	0.801	0.080	0.633	0.106
2002	0.391	0.176	0.445	0.182	0.801	0.088	0.665	0.120
2003	0.587	0.178	0.881	0.179	1.684	0.067	1.440	0.104
2004	0.772	0.236	1.048	0.256	0.780	0.150	0.499	0.136
2005	1.218	0.104	1.686	0.104	0.887	0.128	0.592	0.143
2006	0.663	0.225	0.816	0.244	1.379	0.070	0.902	0.093
2007	0.859	0.264	1.520	0.263	1.106	0.074	0.725	0.115
2008	0.816	0.195	1.083	0.207	1.504	0.067	1.050	0.105
2009	2.642	0.268	2.574	0.324	1.178	0.092	1.026	0.156
2010	8.296	0.300	-	-	1.005	0.092	0.869	0.118
2011	2.729	0.083	4.870	0.088	1.047	0.100	0.973	0.113

Table 7 cont.

	US RR<145		US RR66-114		US RR115-144		US RR145-177	
Age Min	1		2		4		6	
Age Max	5		3		5		8	
Catch Unit	Numbers		Numbers		Numbers		Numbers	
Effort Unit	Offset = log(Hours Fished)		Offset = log(Hours Fished)		Offset = log(Hours Fished)		Offset = log(Hours Fished)	
Method	Delta-Poisson		Delta-Poisson		Delta-Poisson		Delta-Poisson	
Months Covered	June-Sept		June-Sept		June-Sept		June-Sept	
Area Covered	NE UNITED STATES		NE UNITED STATES		NE UNITED STATES		NE UNITED STATES	
Updated Since Last Assessment	NO		YES		YES		NO	
USED FOR RUN	BASE		BASE		BASE		NOT USED	
	US RR<145		US RR66-114		US RR115-144		US RR145-177	
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	-	-	-	-	-	-	-	-
1978	-	-	-	-	-	-	-	-
1979	-	-	-	-	-	-	-	-
1980	0.799	0.430	-	-	-	-	-	-
1981	0.399	0.520	-	-	-	-	-	-
1982	2.102	0.330	-	-	-	-	-	-
1983	1.114	0.260	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-
1985	0.630	0.640	-	-	-	-	-	-
1986	0.778	0.430	-	-	-	-	-	-
1987	1.219	0.400	-	-	-	-	-	-
1988	0.988	0.380	-	-	-	-	-	-
1989	0.988	0.430	-	-	-	-	-	-
1990	0.904	0.340	-	-	-	-	-	-
1991	1.261	0.350	-	-	-	-	-	-
1992	0.820	0.420	-	-	-	-	-	-
1993	-	-	1.304	0.315	1.291	0.345	0.311	3.743
1994	-	-	0.265	0.645	0.237	0.565	0.378	3.118
1995	-	-	1.008	0.296	0.263	0.402	1.334	1.779
1996	-	-	1.637	0.271	0.695	0.351	0.697	2.717
1997	-	-	2.541	0.235	0.267	0.530	0.461	3.046
1998	-	-	1.448	0.267	0.886	0.281	0.362	3.455
1999	-	-	1.188	0.353	1.049	0.384	1.071	2.060
2000	-	-	0.946	0.540	1.456	0.457	0.961	2.064
2001	-	-	0.471	0.365	1.678	0.301	3.424	2.573
2002	-	-	1.079	0.330	2.490	0.346	-	-
2003	-	-	0.474	0.288	0.534	0.289	-	-
2004	-	-	1.836	0.235	0.598	0.309	-	-
2005	-	-	1.638	0.240	0.784	0.309	-	-
2006	-	-	0.657	0.343	1.377	0.279	-	-
2007	-	-	0.584	0.266	1.410	0.249	-	-
2008	-	-	0.278	0.369	1.036	0.264	-	-
2009	-	-	0.320	0.349	0.521	0.356	-	-
2010	-	-	0.622	0.310	1.226	0.292	-	-
2011	-	-	0.704	0.330	1.203	0.328	-	-

Table 7 cont.

	US RR>195		US RR>177		JLL WEST		LARVAL ZERO INFLATED	
Age Min	10		8		2		9	
Age Max	16		16		16		16	
Catch Unit	Numbers		Numbers		Numbers		Index of Spawning Biomass	
Effort Unit	Offset = log(Hours Fished)		Offset = log(Hours Fished)				CPUE = Larvae/100m^2	
Method	Delta-Poisson		Delta-Poisson		Delta-lognormal		Delta-lognormal Zero inflated	
Months Covered	July-Oct		July-Oct				Apr 20 - May 31	
Area Covered	NE UNITED STATES		NE UNITED STATES				Gulf of Mexico	
Updated Since Last Assessment	NO		YES		YES		YES	
USED FOR RUN	BASE		BASE		BASE		BASE	
	US RR>195		US RR>177		JLL WEST		LARVAL ZERO INFLATED	
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	-	-	-	-	0.657	0.418	-	-
1977	-	-	-	-	2.424	0.208	2.724	0.520
1978	-	-	-	-	1.200	0.278	4.733	0.251
1979	-	-	-	-	0.822	0.244	-	-
1980	-	-	-	-	1.508	0.202	-	-
1981	-	-	-	-	1.912	0.151	0.770	0.469
1982	-	-	-	-	0.715	0.241	1.417	0.308
1983	2.805	0.100	-	-	0.313	0.334	1.073	0.369
1984	1.246	0.188	-	-	0.958	0.215	0.393	0.584
1985	0.857	0.300	-	-	1.089	0.209	-	-
1986	0.503	1.097	-	-	0.081	0.586	0.435	0.451
1987	0.529	0.476	-	-	0.717	0.264	0.386	0.484
1988	0.941	0.364	-	-	1.089	0.204	1.063	0.339
1989	0.763	0.364	-	-	0.910	0.214	0.762	0.388
1990	0.626	0.335	-	-	0.752	0.242	0.318	0.354
1991	0.820	0.284	-	-	0.752	0.259	0.387	0.637
1992	0.910	0.276	-	-	1.148	0.212	0.530	0.381
1993	-	-	0.668	0.180	1.138	0.226	0.486	0.709
1994	-	-	0.831	0.178	1.050	0.219	0.528	0.370
1995	-	-	1.250	0.129	0.788	0.286	0.327	0.556
1996	-	-	3.489	0.111	2.317	0.202	1.019	0.557
1997	-	-	1.324	0.254	1.453	0.250	0.416	0.433
1998	-	-	1.652	0.129	0.684	0.284	0.124	0.561
1999	-	-	1.932	0.159	0.744	0.302	0.528	0.563
2000	-	-	0.602	0.180	0.934	0.266	0.352	0.567
2001	-	-	1.388	0.209	0.597	0.391	0.413	0.402
2002	-	-	1.806	0.092	0.697	0.299	0.318	0.673
2003	-	-	0.387	0.186	0.679	0.387	0.784	0.430
2004	-	-	0.600	0.169	0.608	0.376	0.581	0.717
2005	-	-	0.501	0.195	0.732	0.222	0.236	0.340
2006	-	-	0.350	0.311	1.268	0.225	0.585	0.369
2007	-	-	0.270	0.324	1.950	0.225	0.265	0.519
2008			0.369	0.301	0.768	0.356	0.411	0.426
2009			0.244	0.414	1.864	0.332	0.650	0.350
2010			0.792	0.173	0.696	0.358	0.459	0.856
2011			0.544	0.213	2.967	0.238	0.844	0.430

Table 7 cont.

	US PLL GOM		JLL GOM		TAGGING	
Age Min	9		9		1	
Age Max	16		16		3	
Catch Unit	Numbers		Numbers		Numbers	
Effort Unit	1000 Hooks				-	
Method	Delta-Lgn with Repeated Measures				-	
Months Covered	Jan 1 - May 31				-	
Area Covered	Gulf of Mexico and US Florida East Coast					
Updated Since Last Assessment	YES		NO		NO	
USED FOR RUN	BASE		BASE		BASE	
	US PLL GOM 1 - 6		JLL GOM		TAGGING	
YEAR	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	-	-	0.666	0.207	253265	0.200
1977	-	-	0.913	0.216	257385	0.200
1978	-	-	0.876	0.225	121110	0.200
1979	-	-	1.287	0.283	98815	0.200
1980	-	-	1.158	0.265	192541	0.200
1981	-	-	0.553	0.239	337995	0.242
1982	-	-	-	-	-	-
1983	-	-	-	-	-	-
1984	-	-	-	-	-	-
1985	-	-	-	-	-	-
1986	-	-	-	-	-	-
1987	3.255	0.333	-	-	-	-
1988	1.533	0.361	-	-	-	-
1989	2.440	0.345	-	-	-	-
1990	1.889	0.362	-	-	-	-
1991	3.256	0.336	-	-	-	-
1992	0.797	0.386	-	-	-	-
1993	0.452	0.412	-	-	-	-
1994	0.335	0.439	-	-	-	-
1995	0.310	0.448	-	-	-	-
1996	0.183	0.452	-	-	-	-
1997	0.332	0.419	-	-	-	-
1998	0.357	0.425	-	-	-	-
1999	0.612	0.369	-	-	-	-
2000	0.884	0.369	-	-	-	-
2001	0.503	0.425	-	-	-	-
2002	0.471	0.434	-	-	-	-
2003	0.862	0.362	-	-	-	-
2004	0.783	0.364	-	-	-	-
2005	0.590	0.382	-	-	-	-
2006	0.414	0.444	-	-	-	-
2007	0.559	0.422	-	-	-	-
2008	1.283	0.377	-	-	-	-
2009	1.018	0.402	-	-	-	-
2010	0.881	0.387	-	-	-	-
2011	-	-	-	-	-	-

Table 8 Summary table to evaluate the available Atlantic bluefin abundance indices.

SCRS doc Index	SCRS/2012/100 Bay of Biscay Baitboat	SCRS-12-103 Morocco and Spanish traps	SCRS/2012/111 Spanish traps	Fishery Independent SCRS/2012/124 Juvenile western Med	SCRS/2012/131 Japanese LL	SCRS/2012/158 US rod and reel	SCRS/2012/160 US LL	Fishery Independent SCRS/2012/164 Larval survey	SCRS/2012/118 southern Gulf of St. Lawrence	SCRS/2012/118 Southwest Nova Scotia
Diagnostics	Most of the appropriate diagnostics appear to be included	Most of the appropriate diagnostics appear to be included	Most of the appropriate diagnostics appear to be included	No diagnotics presented	Yes diagnotics presented	Few diagnostics presented	Presented - Some Deviation for expectations	Most of the appropriate diagnostics appear to be included	all the appropriate diagnostics were included	all the appropriate diagnostics were included
Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	data exclusions/classifications are listed and justified, specific targeting factors included in standardisation	data exclusions not discussed, targetting not an issue	data exclusions not discussed, although data is classified	data described and method clearly explained with caveats and limitations	data exclusions are clearly identified and justified, alternate CPUE runs are attempted using additional exclusions. GLM includes factors that could be considered proxies for targetting	Data exclusions, if any are not mentioned. GLMM specifically includes a target factor	Data exclusions are described. Vessel exclusions applied to limit trips to those that caught BF in >= 2 years.	data collection method clearly explained, as is a survey, presumabely few data exclusions	data exclusions are indicated, classifications appropriate	data exclusions are indicated, classifications appropriate
Geographical Coverage	Geographical coverage is limited to bay of Biscay, maps are provided	Coverage limited to the straits of Gibraltar	Coverage limited to the straits of Gibraltar	coverage limited to Med. Maps of surveys provided	covers west and north-east Atlantic. Distribution maps are provided	Northeast US coast only, no distribution maps provided	U.S. GOM	coverage limited to Med. No maps of surveys provided	coverage limited to Nafo area 4T	coverage limited to Nafo area 4X
Catch Fraction	catch fraction is roughly 5%	? Not clear	appears to be small	NA	significant	?	Not discussed.	NA		
Length of Time Series relative to the history of exploitation.	longer series (starts in 1952) ; shorter series (starts in 2000)	time series starts at beginning of the 1980s	time series starts at beginning of the 1980s	Starts 2000	for the west ; for the northeast	time series starts at beginning of the 1980s	1987-2010	since 2001	since 1981, exploitation began in 1972-73	since 1988
Are other indices available for the same time period?	Yes (5)	Yes (3)	Yes (3)	Yes (2)	Yes (3)	Yes (3)	Yes (3)	Yes (1)	no	no
Does the index standardization account for known factors that influence catchability/selectivity?	analysis includes many factors that could affect fishing efficiency/selectivity. Multiple interactions included	factors included in the model, table 1, are not explained in the text and impossible to understand for those not immediately familiar with the fishery. It would appear only one factor was included that could influence catchability - trap	due to the nature of the fishery, only the trap factor could explain catchability but the factors were explained. GLM contains only factors	Methodology for standardisation of the series appears to be appropriate for a survey	gear type is included as is a selectivity proxy. No interactions included	Model includes multiple factors that could influence cathability and selectivity		Methodology for standardisation of the series appears to be appropriate for a survey	factors are month, fleet, gear and hours fished	factors are month, fleet, gear and hours fished
Are there conflicts between the catch history and the CPUE response?	No conflict noted	No conflict noted	No conflict noted	No conflict noted	No conflict noted	No conflict noted	Yes. Circle hooks, weak hooks and regulatory measures were discussed. The index was not adjusted for these factors.	No conflict noted	response sensitive to management measures and shrinking quotas	response sensitive to management measures and shrinking quotas
Is the interannual variability within plausible bounds (e.g. SCRS/2012/039)	variability increases over the latter years of the series		there is a high degree of variability, but no formal tests conducted to see whether this is biologically plausible	There is a high degree of variability between the beginning of the series and the final few years, but no formal tests conducted to see whether this is biologically plausible	annual variability higher for west atlantic base case cpues, but northeast cpue has extreme increase in most recent years		Unknown		variability does not impair interpretation of the trend. Increased variability in recent times.	variability does not impair interpretation of the trend. Increased variability in recent times.
Are biologically implausible interannual deviations severe? (e.g. SCRS/2012/039)	moderate			No tests condcuted	No tests condcuted		Unknown		deviations relate to known impacts	deviations relate to known impacts
Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	information does not include length frequencies of catches in recent years. Multiple factors and interactions included. Model design takes into account effort distribution. Discussions of data quality touched on	document states LF data was recorded, but it is not presented. Document states series applied to spawners 10+, model is extremely low on factors	data is discussed and method has been adjusted from prior studies accordingly. Paper provides size distribution of sampled catch	data is presented and limitations of the method discussed	information includes length frequencies of catches. Multiple factors included. Sample design and sensitivity runs investigate effort distribution as well as data assumptions/concerns and effort is presented	information includes length frequencies of catches. Multiple factors included. Sample design and sensitivity runs investigate alternative data assumptions/concerns	data is presented and methodolgy for standardisation explicitly presented. Factors appear to be appropriate	data is presented and methodolgy for standardisation explicitly presented. Factors appear to be appropriate for a survey	includes trends in forage fish and recent changes in environmental variables. Shows weight frequencies and trends in condition.	includes trends in forage fish and recent changes in environmental variables. Shows weight frequencies and trends in weight.
Is this CPUE time series continuous?	Yes	Yes	Yes	Yes	Yes	No missing points, although series have been split into time periods	Yes.		yes	yes

Table 9 Technical specifications of the ADAPT-VPA runs investigated for the East Atlantic and Mediterranean bluefin tuna stock (for acronyms of CPUE series, see Table 4.3.1.1).

Run	Period	CPUE series	SPBB selectivity	F-ratios
Run_1	1950-2009	MOSPTRAP, JPNLLEAM, NORPS, JPNLLNEA, SPBB1(1952-1999), SPBB2(2000-2009)	2-3	As in 2010
Run_2	1950-2011	As Run 1 but the SPBB are cut into 3: SPBB1 (1952-1963), SPBB2 (1964-2006), SPBB3(2007-2011)	SPBB1 (5-6), SPBB2 (2-3), SPBB3(3-6)	As Run 1
Run_3	1950-2011	As Run 1	SPBB1 (2-3), SPBB2(3-6)	As Run 1
Run_4	1950-2011	As Run_2 without JPNLLNEA	As Run 2	As Run 1
Run_5	1950-2011	As Run_2 without SPBB	-	As Run 1
Run_6	1950-2011	As Run 2	As Run 2	equal to 1 over the whole period
Run_7	1950-2011	As Run 2	As Run 2	estimated (sd=0.2)
Run_8	1950-2011	As Run 2 plus the aerial survey index	As Run 2	As Run 1
Run_9	1950-2011	As Run 2	As Run 2	As Run 1 but with Fratio=0.7 over the last 4 years.
Run_10	1950-2011	As Run_2 without NORPS	As Run 2	As Run 1

Table 10 Specifications for computing the partial catch at age associated with the indices of abundance used in the western Atlantic bluefin tuna VPA.

Index	
CAN GSL	SpeciesCode = BFT FlagName = Canada StockID = ATW GearCodes = RR + RRFB + TL Monthc = 8,9,10
CAN SWNS	SpeciesCode = BFT FlagName = Canada StockID = ATW GearCodes = RR + RRFB + TL + HARP Monthc = 8,9,10
US RR<145	SpeciesCode = BFT FlagName = U.S.A Stock = West GearGroupCode = RR Monthc = 6,7,8,9 Size = 0 - 144
US RR66-114	SpeciesCode = BFT FlagName = U.S.A Stock = West GearGroupCode = RR Monthc = 6,7,8,9 Size = 66 - 114
US RR115-144	SpeciesCode = BFT FlagName = U.S.A Stock = West GearGroupCode = RR Monthc = 6,7,8,9 Size = 115 - 144
US RR>195	SpeciesCode = BFT FlagName = U.S.A Stock = West GearGroupCode = RR Monthc = 7,8,9,10 Size = >195
US RR>177	SpeciesCode = BFT FlagName = U.S.A Stock = West GearGroupCode = RR Monthc = 7,8,9,10 Size = >177
JPN LL AREA 2	SpeciesCode = BFT FlagName = Japan StockID = ATW GearGroupCode = LL Monthc = 1-12
LARVAL ZERO INFLATED Years 1975-1981 Years 2004-11	 Used JLL GOM; Historic Series - As estimated for 2010 assessment SpeciesCode = BFT FlagName = U.S.A. StockID = ATW GearGroupCode = LL Monthc = 1-5
US PLL GOM'	SpeciesCode = BFT FlagName = U.S.A. StockID = ATW GearGroupCode = LL Monthc = 1-5
'JLL GOM'	Historical Series - As estimated for 2010 assessment
'TAGGING'	Assumed Fixed at 1.0 for ages 1-3, 0.0 for ages 4+

Table 11 Western Atlantic bluefin tuna. Parameter specifications for the VPA continuity run (0) and sensitivity analyses (runs 1-16). Differences from the continuity run (0) are highlighted in gray.

Run number	*0,1,4,5-16*	*2*	*3*
First Age	1	1	1
Plus Group Age	16+	16+	16+
First Year	1970	1970	1970
Last Year	2011	2011	2011
Natural Mortality	0.14 all ages	0.14 all ages	0.14 all ages
Maturity	Same as 2010: 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	none	3; 1.0; 1-9
F in last year	Estimated for ages 1-15		
F-ratio	Fixed at 1.0 for all years		
Index Weighting	Indices equally weighted (estimate a single variance parameter common to all indices)		
Bootstrap Specifications	If bootstapped, used Stine correction (see VPA-2Box manual, ICCAT Software Catalog)		

Table 12 Eastern Atlantic and Mediterranean bluefin tuna. Summary of the values of the reference points for the different scenarios for recruitment and historical catch levels

Recruitment scenario	Catch level	$SSB/SSB_{F0.1}$	$F/F_{0.1}$
High	Inflated	0.37	0.36
High	Reported	0.37	0.69
Low	Inflated	1.17	0.36
Low	Reported	0.89	0.70
Medium	Inflated	0.77	0.36
Medium	Reported	0.63	0.70

Table 13 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

Reference point	**Recruitment scenario**	**Catch level**	**Quantile10%**	**Median**	**Quantile 90%**
$F_{0.1}$	High	Inflated	0.08	0.08	0.09
$F_{0.1}$	High	Reported	0.09	0.10	0.13
$F_{0.1}$	Low	Inflated	0.08	0.08	0.09
$F_{0.1}$	Low	Reported	0.09	0.10	0.13
$F_{0.1}$	Medium	Inflated	0.08	0.08	0.09
$F_{0.1}$	Medium	Reported	0.09	0.10	0.13
$SSB_{F0.1}$	High	Inflated	1069000	1087000	1100000
$SSB_{F0.1}$	High	Reported	739000	774400	805900
$SSB_{F0.1}$	Low	Inflated	337100	342300	346500
$SSB_{F0.1}$	Low	Reported	303800	318500	331200
$SSB_{F0.1}$	Medium	Inflated	515600	523800	530000
$SSB_{F0.1}$	Medium	Reported	431100	452400	470000

Table 14 Eastern Atlantic and Mediterranean bluefin tuna. Change in recruitment levels between run 15 in 2010 and run 2 in 2012. Increase means that the recruitment for that time period is higher than the same time period in the 2010 assessment

	high (1990-2000)	med (1950-2006)	low (1970-1980)
Reported	-0.92%	1.12%	-0.04%
Inflated	4.19%	1.11%	-1.44%

Table 15. Western Atlantic bluefin tuna. Estimated benchmarks and reference points with 80% confidence intervals for Western Atlantic bluefin tuna. The labels “Deterministic” and “Run 0” refer to the maximum likelihood (point) estimates. The confidence limits (CL), median and standard deviation are calculated from the bootstrap replicates.

Low Recruitment					
MEASURE	LOWER CL	MEDIAN	UPPER CL	DETERMINISTIC	STD. DEV.
F at MSY	0.14	0.17	0.19	0.17	0.02
MSY	2451.7	2634.1	2834.3	2651.5	154.8
Y/R at MSY	29.4	30.5	31.3	30.6	0.8
S/R at MSY	142.9	150.1	157.1	149.5	5.6
SPR AT MSY	0.21	0.22	0.23	0.22	0.01
SSB AT MSY	12717.2	12943.5	13267.5	12962.5	218.2
F at max. Y/R	0.18	0.20	0.22	0.20	0.02
Y/R maximum	29.70	30.75	31.59	30.85	0.78
S/R at Fmax	107.17	115.83	122.37	114.85	6.10
SPR at Fmax	0.16	0.17	0.18	0.17	0.01
SSB at Fmax	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
F 0.1	0.10	0.11	0.12	0.11	0.01
Y/R at F0.1	27.48	28.27	28.96	28.37	0.60
S/R at F0.1	220.05	231.89	241.13	230.69	8.56
SPR at F0.1	0.33	0.35	0.36	0.34	0.01
SSB at F0.1	18475.5	19985.8	21708.3	20007.2	1240.1

High Recruitment					
MEASURE	LOWER CL	MEDIAN	UPPER CL	RUN 0	STD. DEV.
F at MSY	0.06	0.06	0.07	0.06	0.01
MSY	5735.6	6472.3	7500.1	6493.1	697.6
Y/R at MSY	22.0	23.3	24.5	23.3	1.0
S/R at MSY	324.4	338.3	351.7	338.7	10.8
SPR AT MSY	0.48	0.50	0.52	0.51	0.02
SSB AT MSY	77288.5	93621.1	116679.0	94264.4	15827.1
F at max. Y/R	0.18	0.20	0.22	0.20	0.02
Y/R maximum	29.72	30.76	31.59	30.85	0.78
S/R at Fmax	107.11	115.74	122.32	114.81	6.10
SPR at Fmax	0.16	0.17	0.18	0.17	0.01
SSB at Fmax	***0.0***	***0.0***	***0.0***	***0.0***	***384.8***
F 0.1	0.10	0.11	0.12	0.11	0.01
Y/R at F0.1	27.50	28.29	28.95	28.38	0.60
S/R at F0.1	219.96	232.11	241.33	230.59	8.56
SPR at F0.1	0.33	0.35	0.36	0.34	0.01
SSB at F0.1	33169.6	41027.8	46114.6	40220.2	5144.6

Table 16 WBFT: The annual probability that F < Fmsy 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	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
1600 mt	99.8%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1700 mt	99.8%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1750 mt	**99.8%**	**99.8%**	**100.0%**	**99.8%**	**99.8%**	**100.0%**	**99.8%**	**99.8%**
1800 mt	99.8%	99.6%	99.6%	99.6%	99.8%	99.8%	99.8%	99.8%
1900 mt	99.8%	99.4%	99.6%	99.6%	99.6%	99.6%	99.6%	99.8%
2000 mt	99.8%	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%	99.4%
2100 mt	99.8%	98.6%	98.8%	98.4%	98.2%	99.0%	99.2%	99.0%
2200 mt	99.8%	97.8%	97.6%	97.0%	97.0%	97.6%	97.8%	98.0%
2300 mt	99.8%	96.0%	96.4%	94.6%	94.4%	95.6%	95.0%	95.0%
2400 mt	99.8%	94.0%	93.4%	90.2%	90.0%	92.4%	90.8%	90.2%
2500 mt	99.8%	91.2%	90.0%	86.0%	85.2%	87.0%	86.2%	84.2%
2600 mt	99.8%	86.8%	85.4%	81.8%	81.0%	81.4%	80.6%	79.2%
2700 mt	99.8%	82.8%	81.2%	76.0%	74.0%	74.8%	72.4%	70.0%
2800 mt	99.8%	78.6%	76.0%	69.0%	67.0%	67.6%	64.6%	61.0%
2900 mt	99.8%	73.6%	69.6%	62.0%	58.0%	59.2%	55.8%	52.8%
3000 mt	99.8%	66.6%	62.8%	53.2%	50.8%	51.4%	48.0%	44.6%
3100 mt	99.8%	59.8%	54.6%	45.6%	42.8%	43.6%	40.2%	34.6%
3200 mt	99.8%	51.8%	48.2%	39.4%	36.0%	35.6%	31.2%	27.8%
3300 mt	99.8%	45.4%	42.2%	33.0%	29.0%	29.4%	26.4%	22.8%
3400 mt	99.8%	41.8%	36.6%	28.6%	25.4%	24.4%	21.2%	16.2%
3500 mt	99.8%	36.0%	30.8%	23.2%	20.0%	19.4%	14.6%	11.6%

B) High Recruitment

Probability that F < Fmsy (No Overfishing)								
TAC	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
400 mt	7.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
500 mt	7.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
600 mt	7.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
700 mt	7.6%	99.6%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
800 mt	7.6%	99.0%	99.4%	99.6%	99.6%	100.0%	100.0%	100.0%
900 mt	7.6%	95.4%	97.4%	98.4%	99.2%	99.6%	99.6%	99.8%
1000 mt	7.6%	89.4%	92.4%	94.2%	96.6%	98.4%	99.2%	99.6%
1100 mt	7.6%	79.8%	85.0%	86.8%	89.8%	95.0%	96.6%	98.0%
1200 mt	7.6%	66.6%	75.2%	77.8%	82.6%	88.4%	91.2%	93.2%
1300 mt	7.6%	52.0%	61.8%	66.2%	71.8%	80.6%	83.4%	85.6%
1400 mt	7.6%	39.2%	47.6%	51.8%	60.2%	69.8%	73.6%	79.0%
1500 mt	7.6%	30.4%	37.8%	41.4%	46.8%	57.4%	63.8%	67.6%
1600 mt	7.6%	18.6%	27.6%	30.4%	37.8%	46.0%	53.0%	56.6%
1700 mt	7.6%	13.0%	17.8%	20.8%	28.2%	37.2%	42.4%	45.8%
1750 mt	**7.6%**	**11.8%**	**14.6%**	**17.2%**	**23.0%**	**32.2%**	**37.6%**	**41.8%**
1800 mt	7.6%	8.8%	12.6%	13.4%	19.4%	28.0%	31.8%	35.8%
1900 mt	7.6%	5.8%	9.2%	10.2%	12.4%	20.4%	24.2%	27.8%
2000 mt	7.6%	3.0%	5.2%	6.6%	9.2%	12.4%	17.8%	20.2%
2100 mt	7.6%	2.2%	2.8%	3.6%	5.2%	9.4%	11.0%	13.0%
2200 mt	7.6%	1.8%	2.2%	2.6%	3.0%	5.6%	7.4%	8.8%
2300 mt	7.6%	1.2%	1.6%	2.0%	2.6%	3.4%	4.6%	6.4%

Table 17 WBFT: The annual probability that SSB > SSBmsy 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	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
1600 mt	98.0%	96.8%	95.6%	96.4%	95.6%	97.4%	98.8%	99.4%
1700 mt	98.0%	96.8%	95.0%	96.2%	95.2%	96.8%	98.0%	98.8%
1750 mt	**98.0%**	**96.6%**	**94.4%**	**95.8%**	**94.4%**	**96.6%**	**97.4%**	**98.2%**
1800 mt	98.0%	96.6%	94.4%	95.4%	93.6%	96.2%	96.8%	98.0%
1900 mt	98.0%	96.6%	94.4%	95.0%	93.2%	95.0%	95.8%	97.0%
2000 mt	98.0%	96.6%	94.0%	94.4%	92.4%	93.6%	94.0%	95.4%
2100 mt	98.0%	96.6%	93.8%	94.2%	90.8%	92.0%	93.4%	93.8%
2200 mt	98.0%	96.4%	93.4%	93.8%	89.0%	89.4%	91.2%	92.2%
2300 mt	98.0%	96.4%	92.8%	93.2%	87.4%	87.2%	89.8%	89.4%
2400 mt	98.0%	96.2%	92.4%	92.6%	85.2%	85.4%	87.4%	86.4%
2500 mt	98.0%	96.2%	92.2%	91.6%	83.8%	84.2%	84.2%	84.0%
2600 mt	98.0%	96.2%	91.4%	90.4%	81.6%	82.0%	80.2%	79.8%
2700 mt	98.0%	96.2%	91.0%	88.6%	80.4%	78.4%	77.4%	76.0%
2800 mt	98.0%	96.2%	90.4%	88.0%	78.4%	76.2%	74.6%	71.6%
2900 mt	98.0%	96.0%	89.6%	86.6%	77.0%	72.8%	69.8%	66.8%
3000 mt	98.0%	95.8%	89.0%	85.4%	74.2%	70.2%	66.6%	62.0%
3100 mt	98.0%	95.6%	87.4%	83.2%	70.2%	67.6%	61.0%	55.6%
3200 mt	98.0%	95.0%	86.8%	81.8%	67.2%	63.2%	56.6%	51.8%
3300 mt	98.0%	95.0%	86.4%	81.2%	65.8%	58.0%	52.8%	47.4%
3400 mt	98.0%	94.8%	84.6%	79.8%	63.2%	55.2%	48.4%	42.2%
3500 mt	98.0%	94.8%	83.8%	78.2%	60.0%	51.8%	44.0%	38.2%

B) High Recruitment

Probability that SSB > SSBmsy (Not Overfished)								
TAC	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
400 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
600 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
700 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
800 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
900 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1100 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1200 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1300 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1400 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1600 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1700 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1750 mt	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
1800 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1900 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2100 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2200 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2300 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

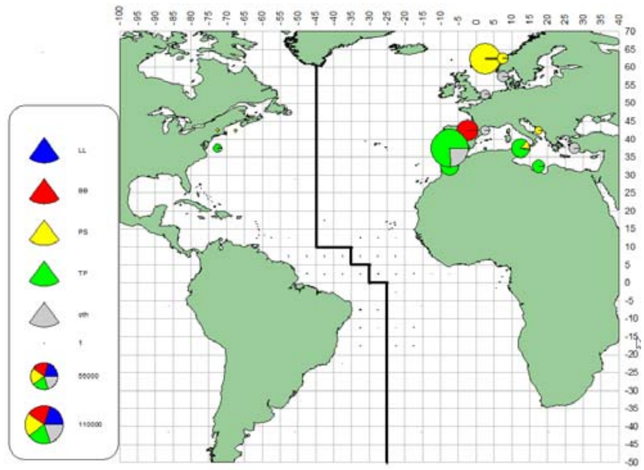
Table 18 WBFT: The annual joint probability that F<Fmsy and SSB > SSBmsy at various levels of total allowable catch. The current TAC of 1,750 mt is highlighted in bold.

A) Low Recruitment

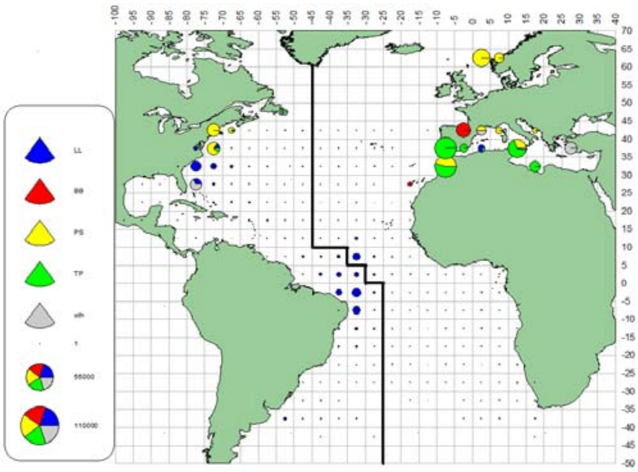
Probability that F < Fmsy and SSB > SSBmsy (No Overfishing and Not Overfished)								
TAC	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
1600 mt	98.0%	96.8%	95.6%	96.4%	95.6%	97.4%	98.8%	99.4%
1700 mt	98.0%	96.8%	95.0%	96.2%	95.2%	96.8%	98.0%	98.8%
1750 mt	**98.0%**	**96.6%**	**94.4%**	**95.8%**	**94.4%**	**96.6%**	**97.4%**	**98.2%**
1800 mt	98.0%	96.6%	94.4%	95.4%	93.6%	96.2%	96.8%	98.0%
1900 mt	98.0%	96.6%	94.4%	95.0%	93.2%	95.0%	95.8%	97.0%
2000 mt	98.0%	96.6%	94.0%	94.4%	92.4%	93.6%	94.0%	95.4%
2100 mt	98.0%	96.6%	93.8%	94.2%	90.8%	92.0%	93.4%	93.8%
2200 mt	98.0%	96.2%	93.4%	93.8%	89.0%	89.4%	91.2%	92.2%
2300 mt	98.0%	95.2%	92.8%	92.4%	87.0%	87.2%	89.6%	89.4%
2400 mt	98.0%	94.0%	91.4%	90.0%	84.2%	85.2%	86.8%	86.2%
2500 mt	98.0%	91.2%	88.8%	85.4%	82.6%	83.4%	83.6%	82.6%
2600 mt	98.0%	86.8%	85.2%	81.8%	79.2%	79.8%	78.6%	77.4%
2700 mt	98.0%	82.8%	81.0%	76.0%	73.8%	74.2%	71.8%	69.6%
2800 mt	98.0%	78.6%	76.0%	69.0%	67.0%	67.6%	64.6%	60.6%
2900 mt	98.0%	73.6%	69.6%	62.0%	58.0%	59.0%	55.6%	52.6%
3000 mt	98.0%	66.6%	62.8%	53.2%	50.8%	51.4%	48.0%	44.6%
3100 mt	98.0%	59.8%	54.6%	45.6%	42.8%	43.6%	40.2%	34.6%
3200 mt	98.0%	51.8%	48.2%	39.4%	36.0%	35.6%	31.2%	27.8%
3300 mt	98.0%	45.4%	42.2%	33.0%	29.0%	29.4%	26.4%	22.8%
3400 mt	98.0%	41.8%	36.6%	28.6%	25.4%	24.4%	21.2%	16.2%
3500 mt	98.0%	36.0%	30.8%	23.2%	20.0%	19.4%	14.6%	11.6%

B) High Recruitment

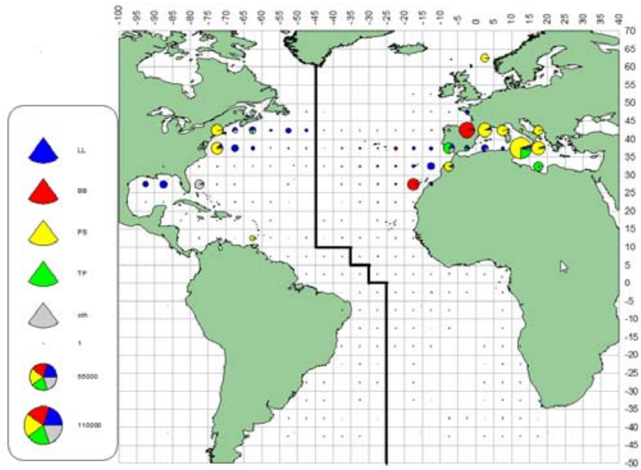
Probability that F < Fmsy and SSB > SSBmsy (No Overfishing and Not Overfished)								
TAC	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
400 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
600 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
700 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
800 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
900 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1100 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1200 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1300 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1400 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1500 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1600 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1700 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1750 mt	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
1800 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1900 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2000 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2100 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2200 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
2300 mt	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%



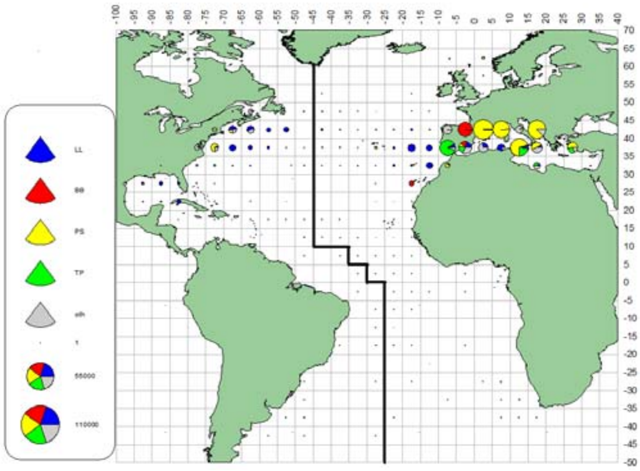
a. BFT(1950-59)



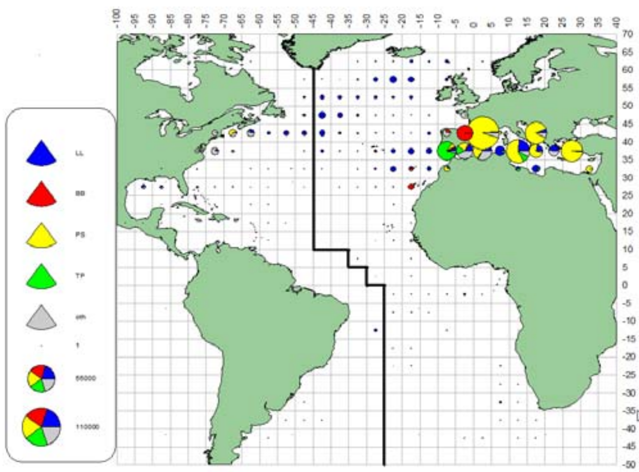
b. BFT(1960-69)



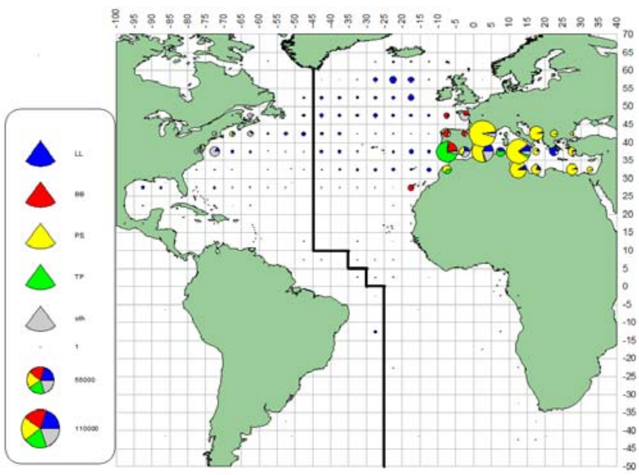
c. BFT(1970-79)



d. BFT(1980-89)

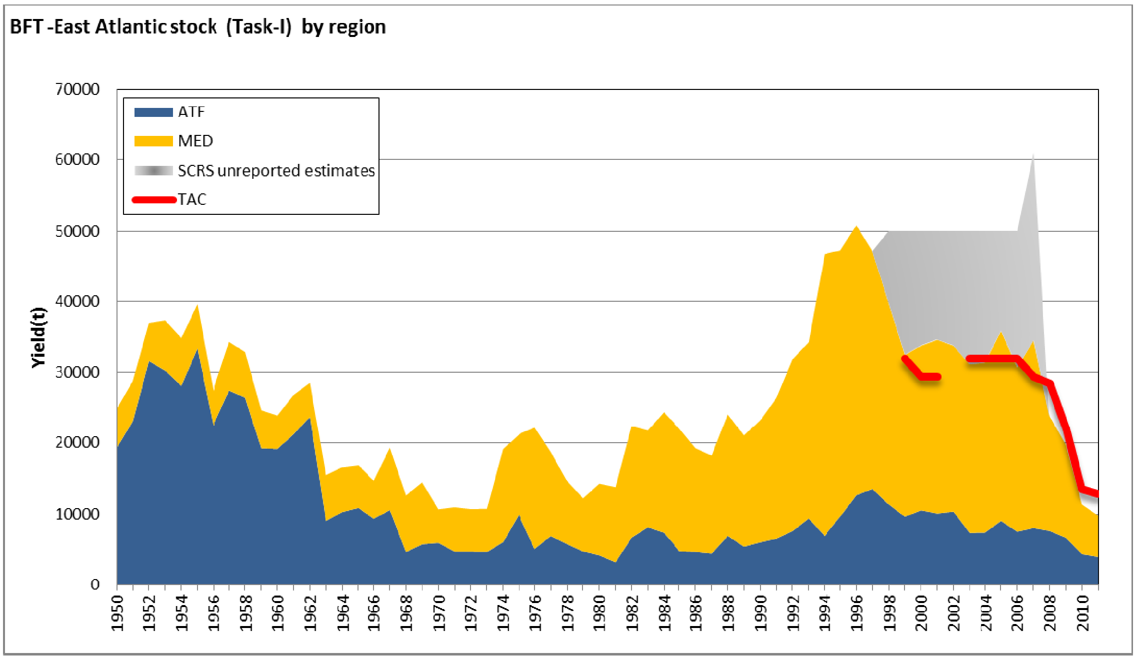


e. BFT (1990-99)



f. BFT (2000-09)

BFT-Figure 1 Estimated task I catch distribution (5x5 lat lon) of bluefin tuna by decade (1950-2009) and by major gear



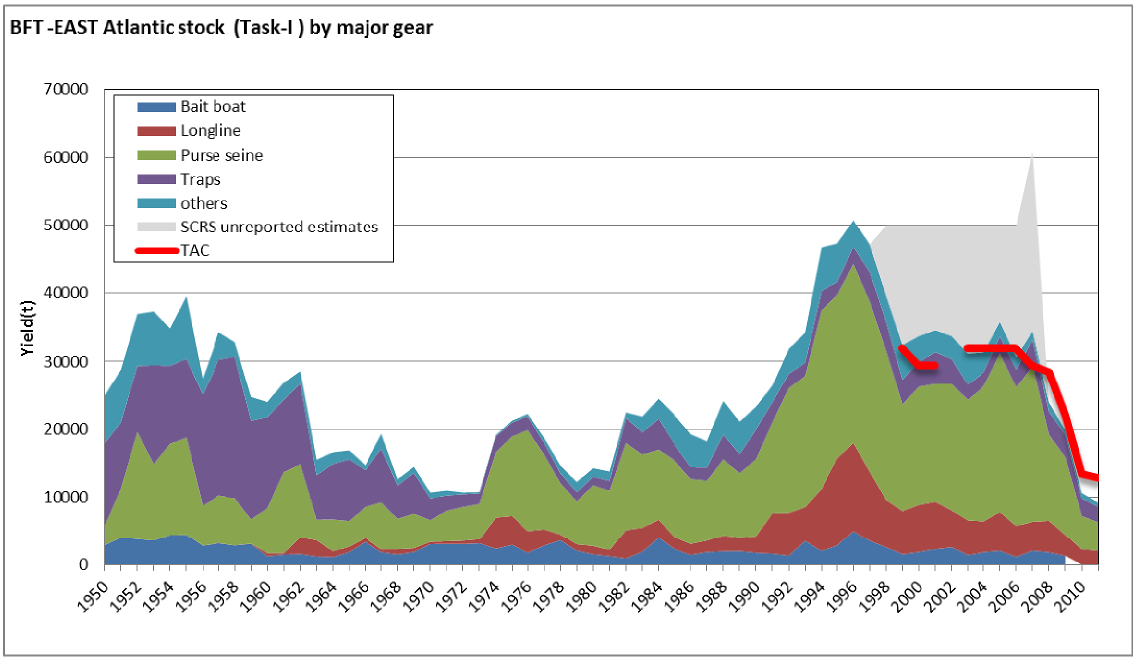


Figure 2 Eastern Atlantic and Mediterranean bluefin reported and estimated catches by area. The estimated catches are indicated by the gray area, and the TAC is indicated by the red line.

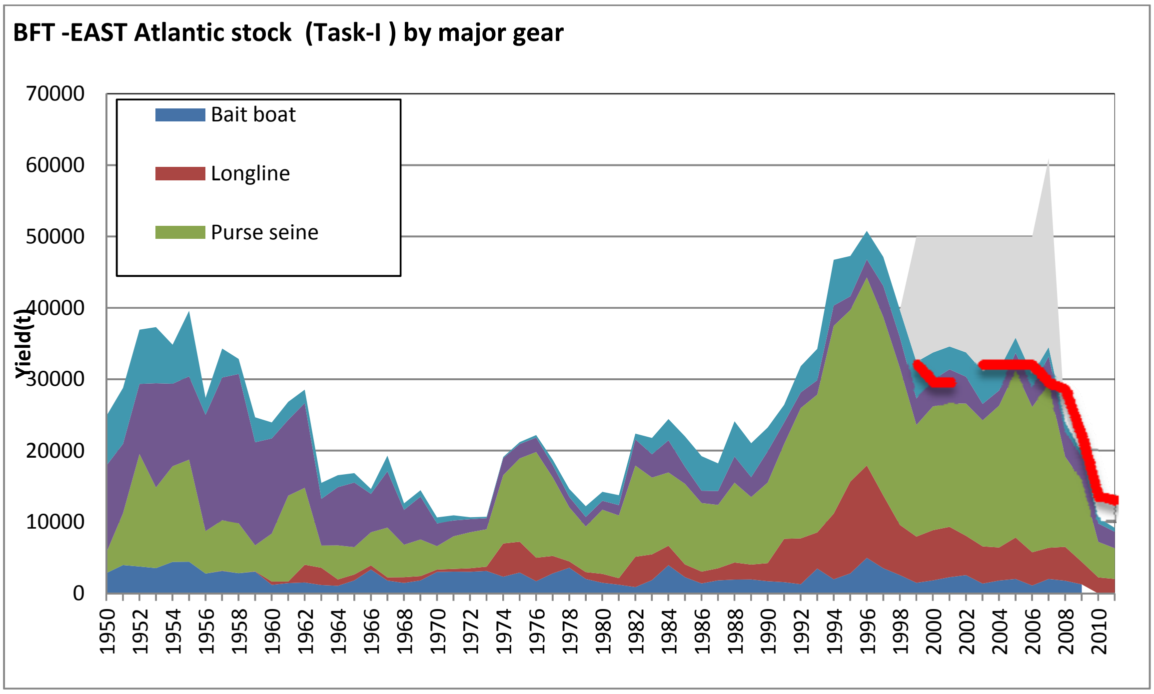


Figure 3 Eastern Atlantic and Mediterranean bluefin reported and estimated catches by main gears. The estimated catches are indicated by the gray area, and the TAC is indicated by the red line.

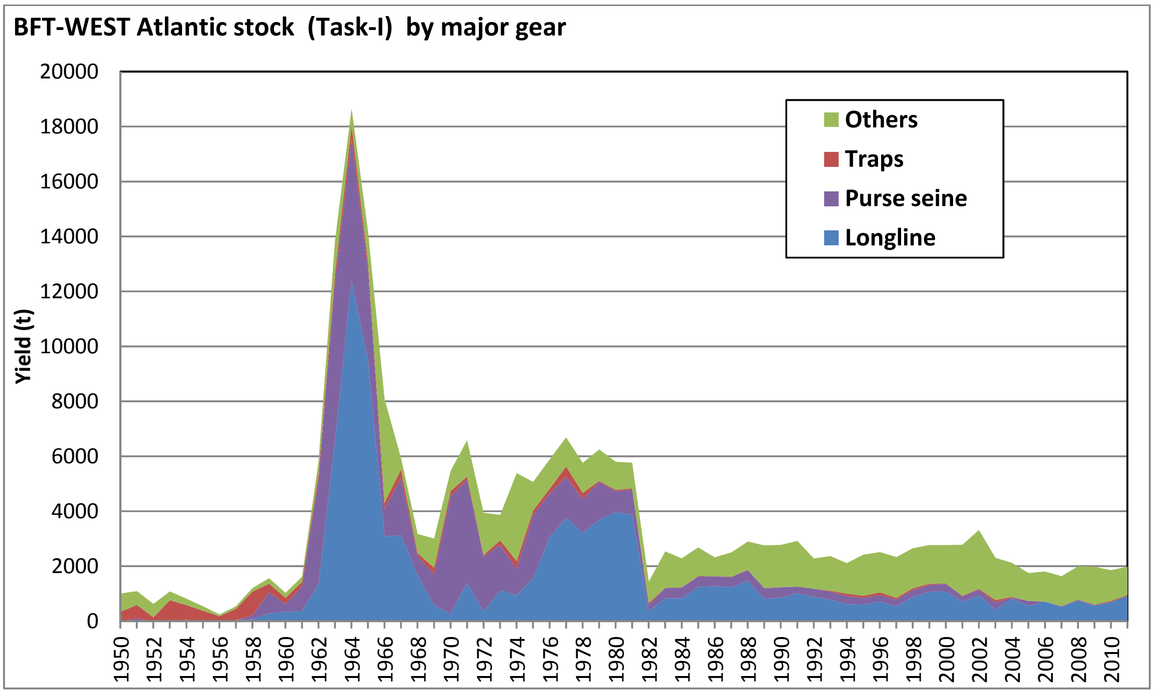


Figure 4 Western Atlantic bluefin tuna reported catch by year and main gears.

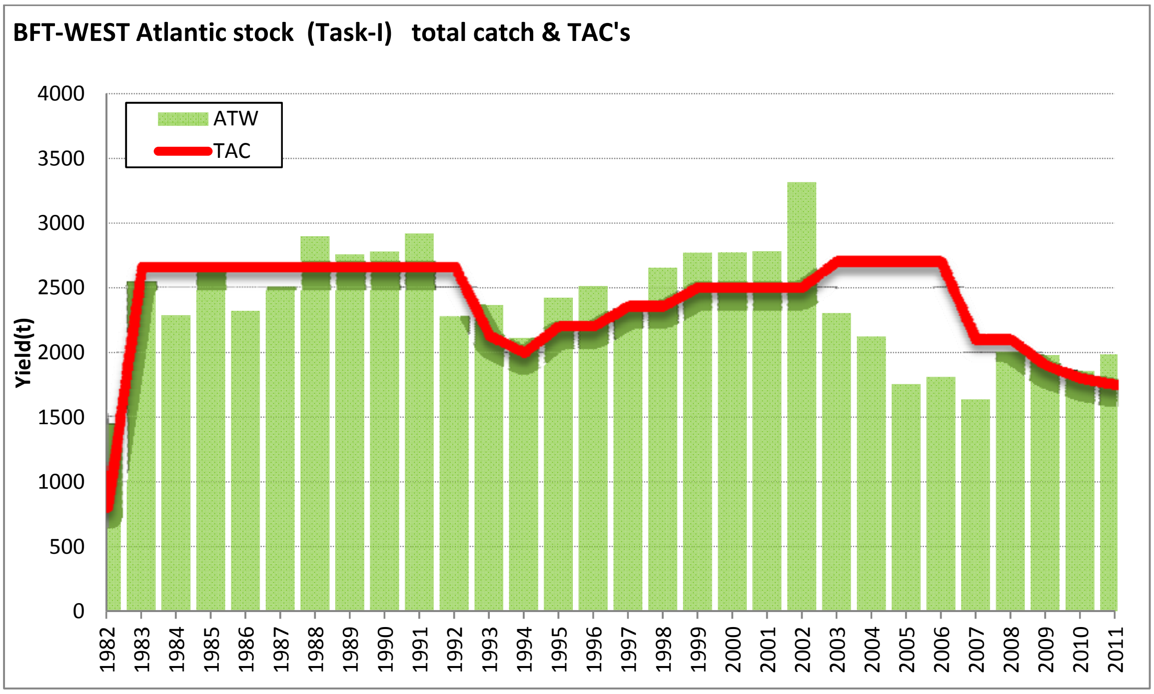


Figure 5 Western Atlantic bluefin tuna reported annual catch (bars) and the corresponding annual TAC (red line).

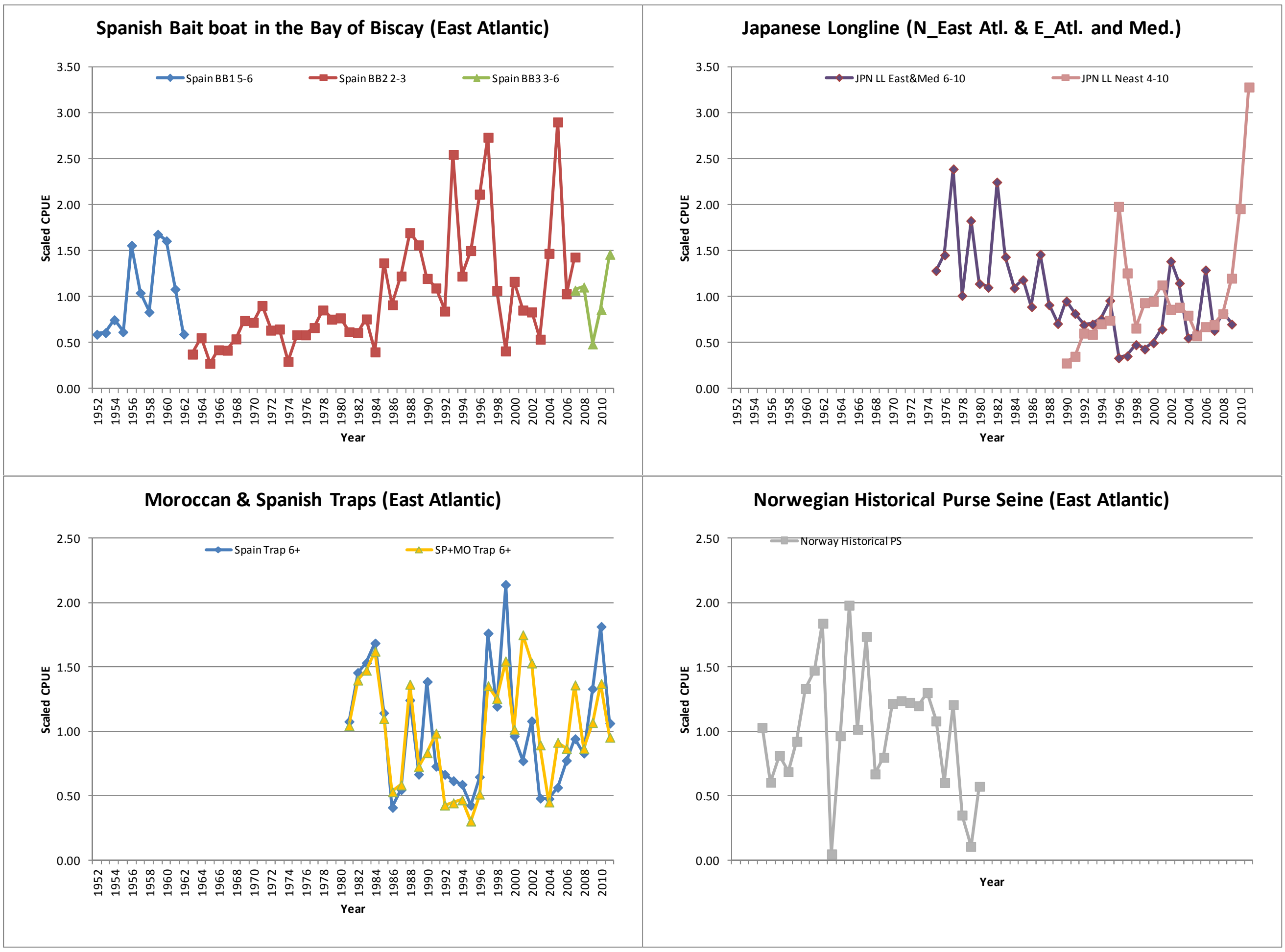


Figure 6 Plots of the CPUE time series fishery indicators for the East Atlantic and Mediterranean bluefin tuna stock used in the 2012 stock assessment. All CPUE series are standardized series except the nominal Norway PS index. The Spanish BB series (top left panel) was split in three series to account for changes in selectivity patterns.

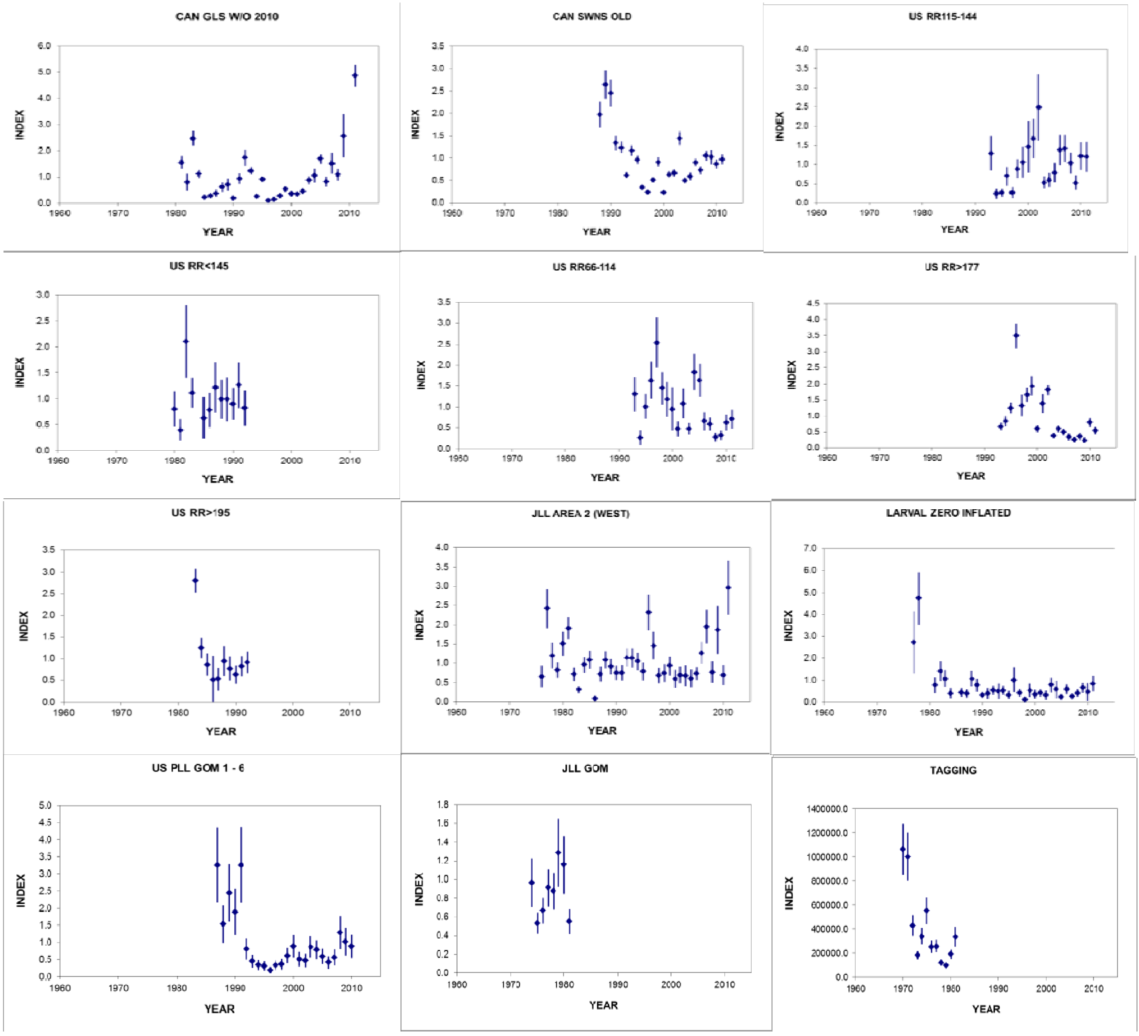


Figure 7 Indices of abundance used in the base VPA model of western bluefin tuna (with standard errors).

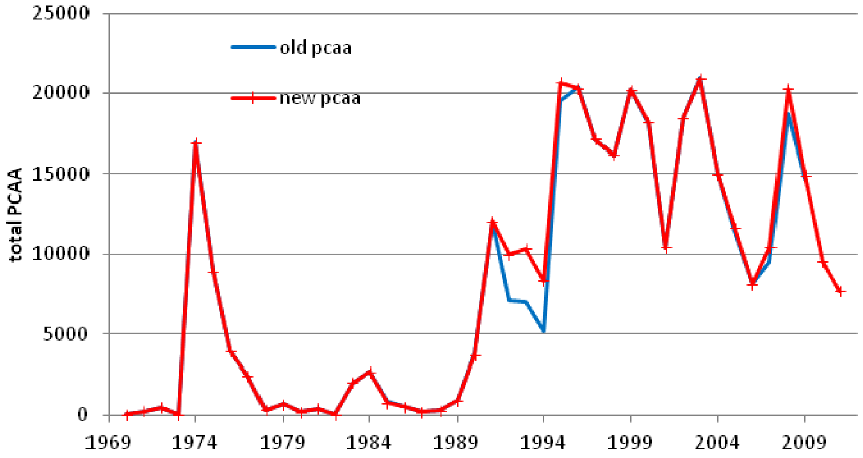


Figure 8 Total number of fish in the partial catch at age estimated in 2010 for the Japanese longline fishery in the NorthEast Atlantic (in blue) and the one estimated by the group (in red) without considering months February and March.

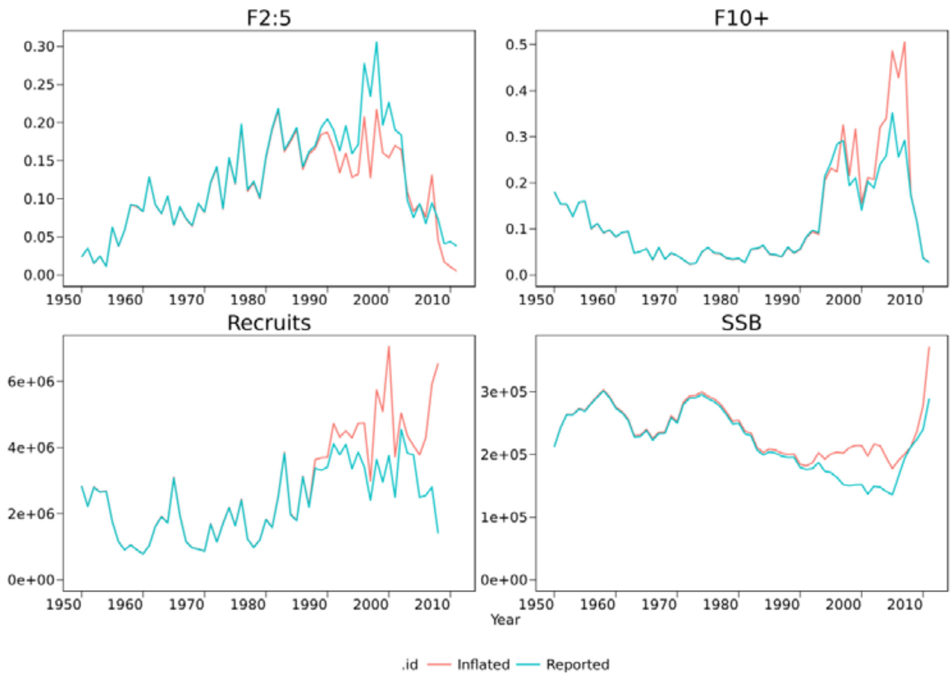


Figure 9 Eastern bluefin tuna. Results for the run 2 *(reported and inflated)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last removed because of it is not possible to estimate recent recruitment reliably from the catch-at-age analysis VPA issue (bottom left), and SSB (bottom right) keep the same xlimits.

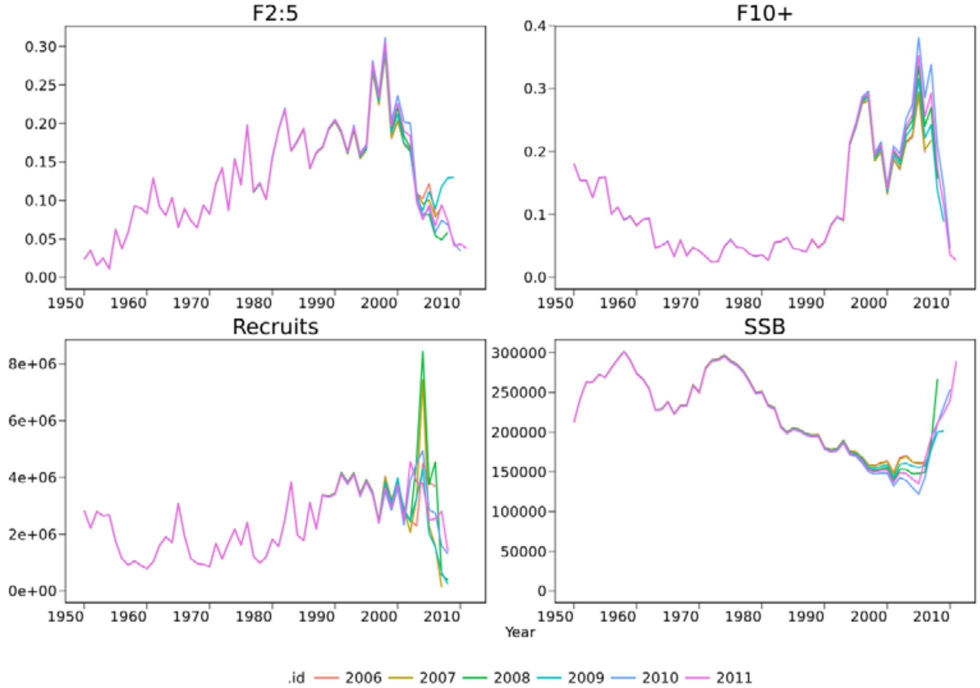


Figure 10 Eastern bluefin tuna. Retrospective runs for the Run 2 *(reported catch)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality at ages 10+ (top right), recruits with the three last removed because of it is not possible to estimate recent recruitment reliably from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

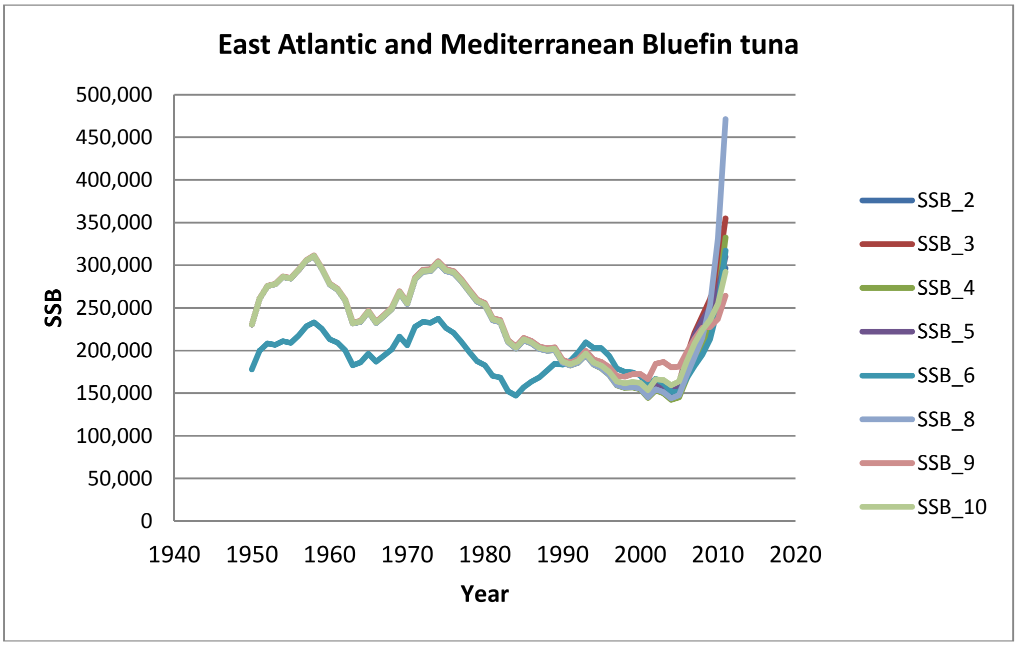
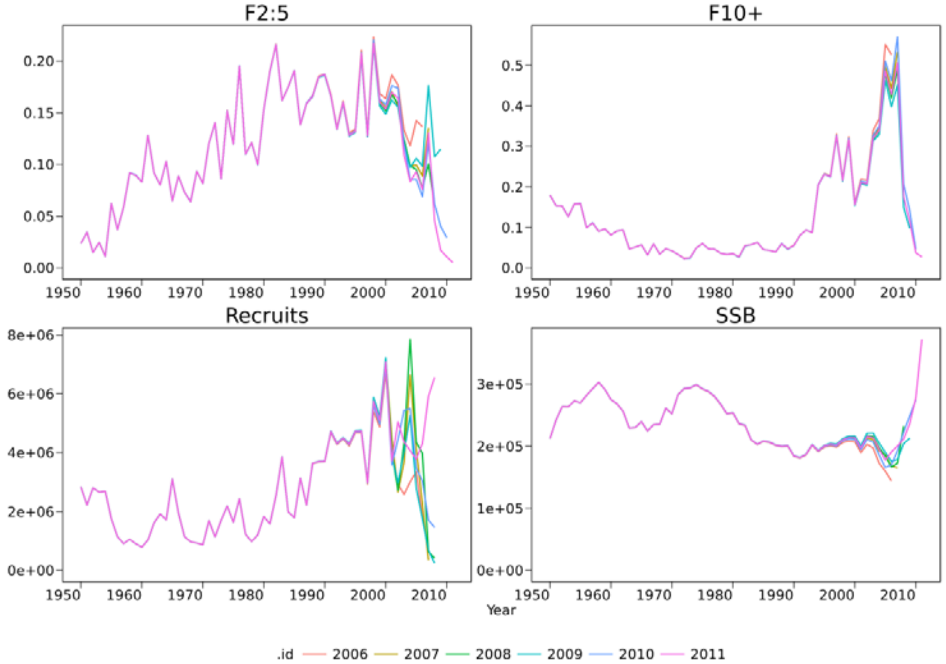


Figure 11 Eastern bluefin tuna SSB estimates by run 2 and sensitivity runs. For 1950 to the late 1990s SSB estimates are very similar except run 6 where the SSB peaks at 237 000 t in the mid 1970s instead of above 300 000t in all other runs.



F2:5
F10+
Recruits
SSB
Year
.id 2006 2007 2008 2009 2010 2011

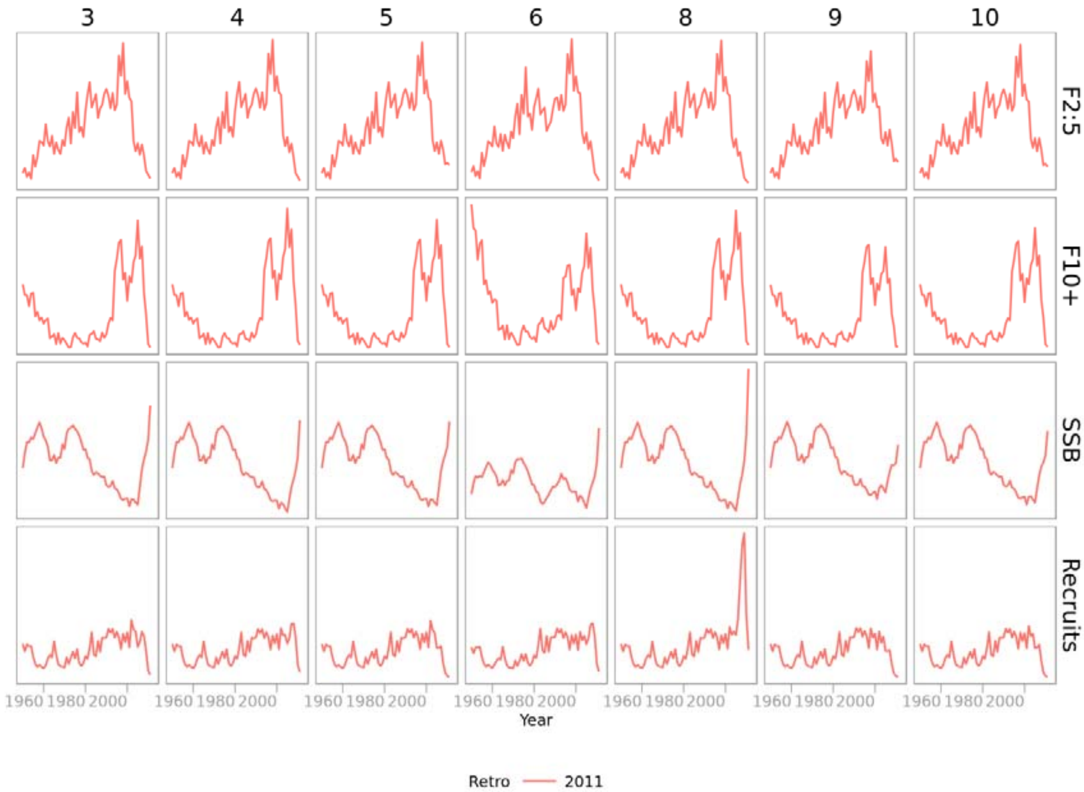


Figure 12 Eastern bluefin tuna. Retrospective runs for the Run 2 *(inflated catch, i.e., catch raised to 50,000 tonnes from 1998 to 2006 and to 61,000 tonnes in 2007, but no inflation of the reported catch since 2008)* showing time series of fishing mortality at ages 2-5 (top left), fishing mortality 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). Specify inflated = up to 2007 switch graphs.**Figure 13** Eastern bluefin tuna. Runs for the seven sensitivity runs (columns; Table 5.1.1) using the reported catch showing time series of fishing mortality at ages 2-5 (first row panels), fishing mortality at ages 10+ (second row panels), SSB (third row panels), and recruits (fourth row panels) ref to the table

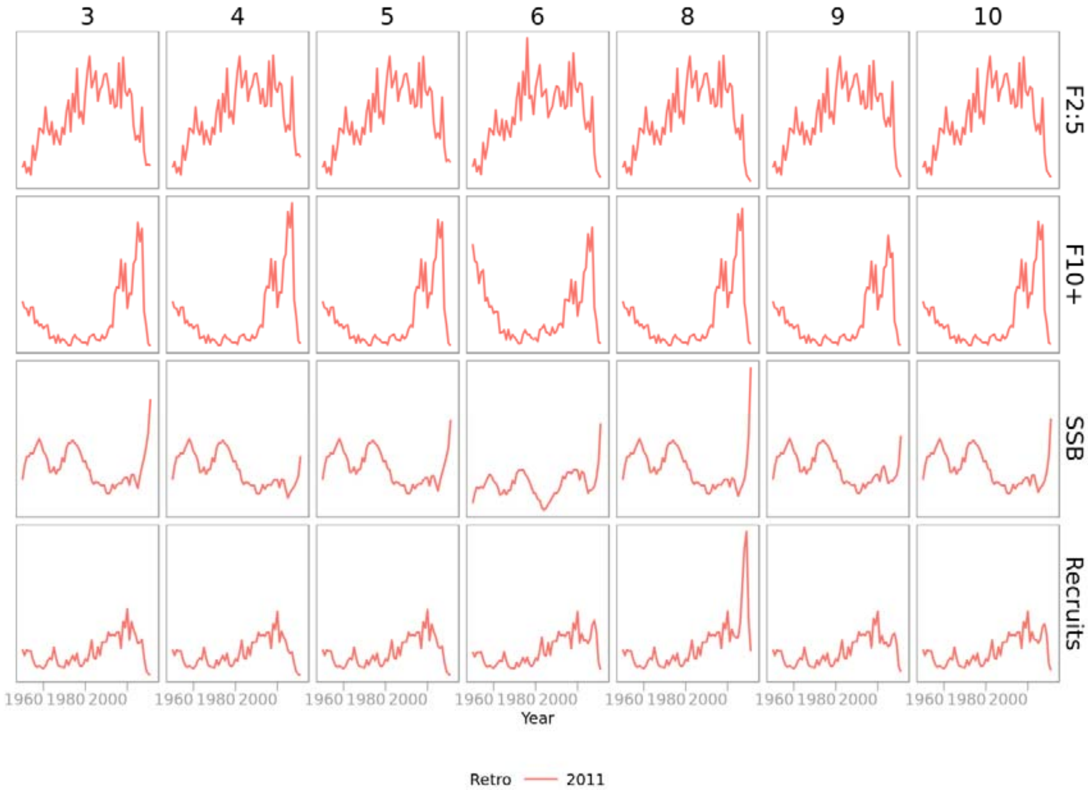


Figure 14 Eastern bluefin tuna. Runs for the seven sensitivity runs (columns; Table 5.1.1) using the inflated catch (i.e., catch raised to 50,000 tonnes from 1998 to 2006 and to 61,000 tonnes in 2007, but no inflation of the reported catch since 2008) showing time series of fishing mortality at ages 2-5 (first row panels), fishing mortality at ages 10+ (second row panels), SSB (third row panels), and recruits (fourth row panels) Remove the retrospective

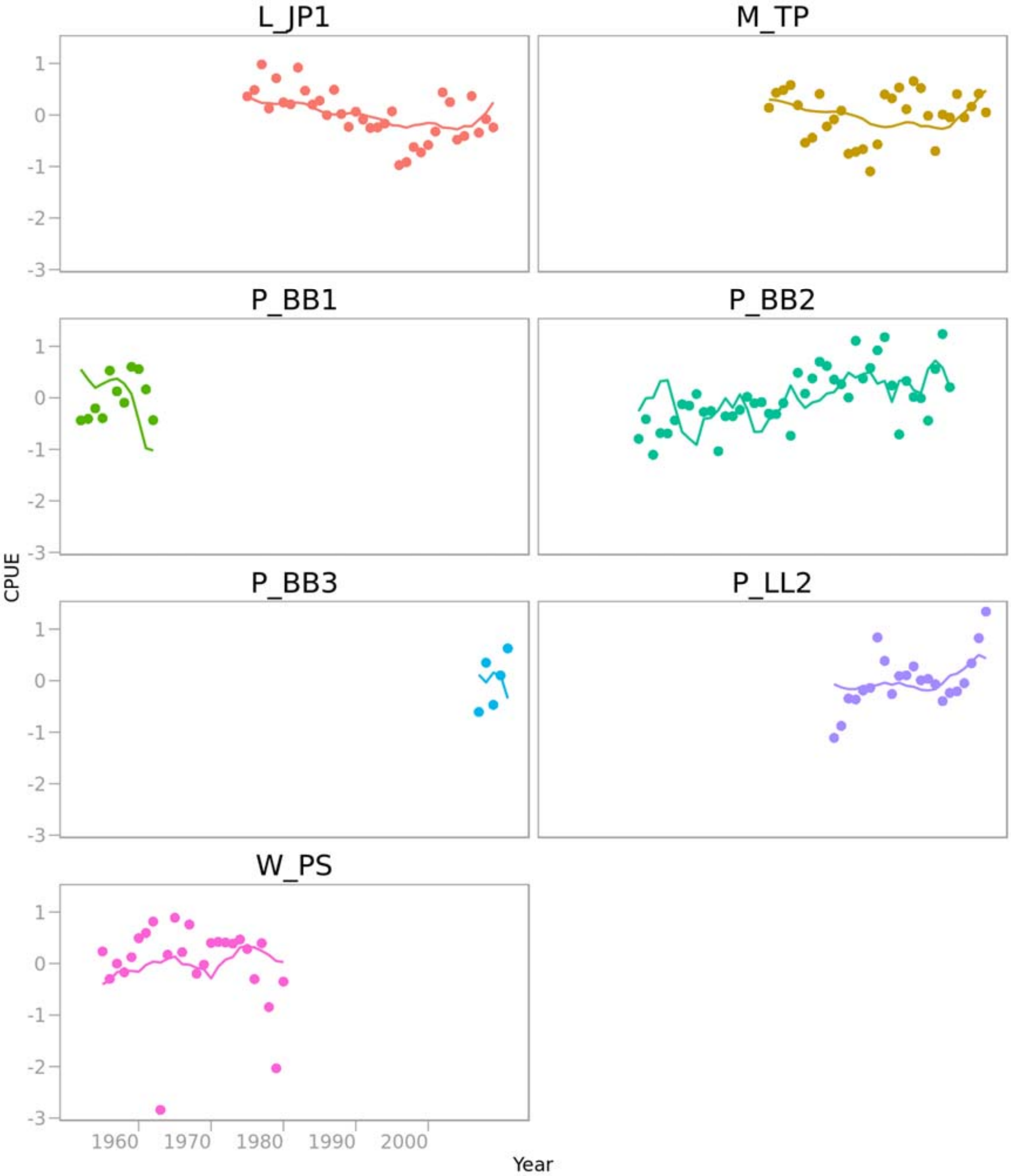


Figure 15 Eastern bluefin tuna. CPUE series (points) and fitted values (lines) resulting from the VPA of Run 2 using reported catch add the plot of the residuals + label cpue y-axis+ detailed caption

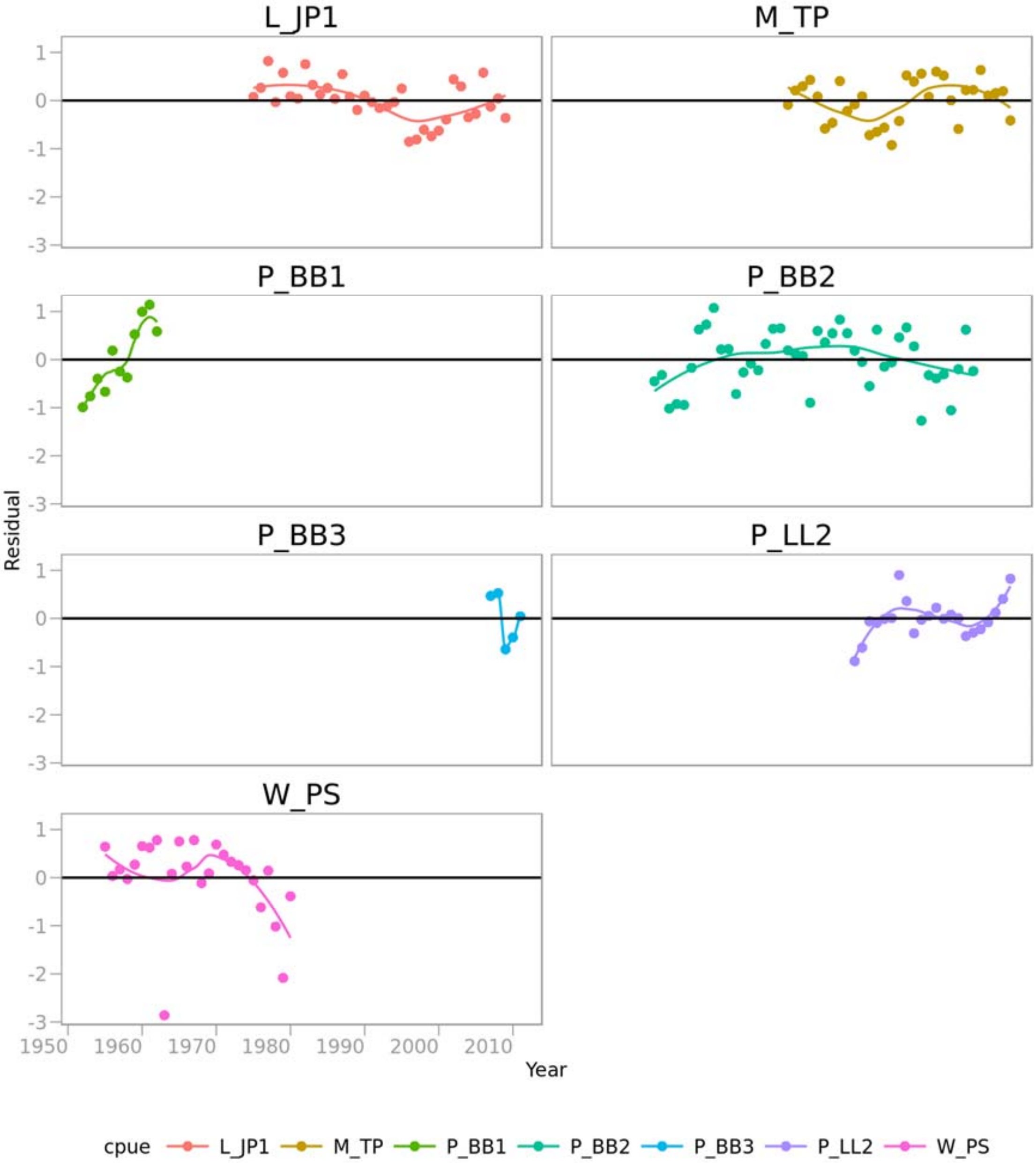


Figure 16 Eastern bluefin tuna. Plots of CPUE residuals by year from VPA Run 2 (reported catch) for the seven CPUES used in fitting.

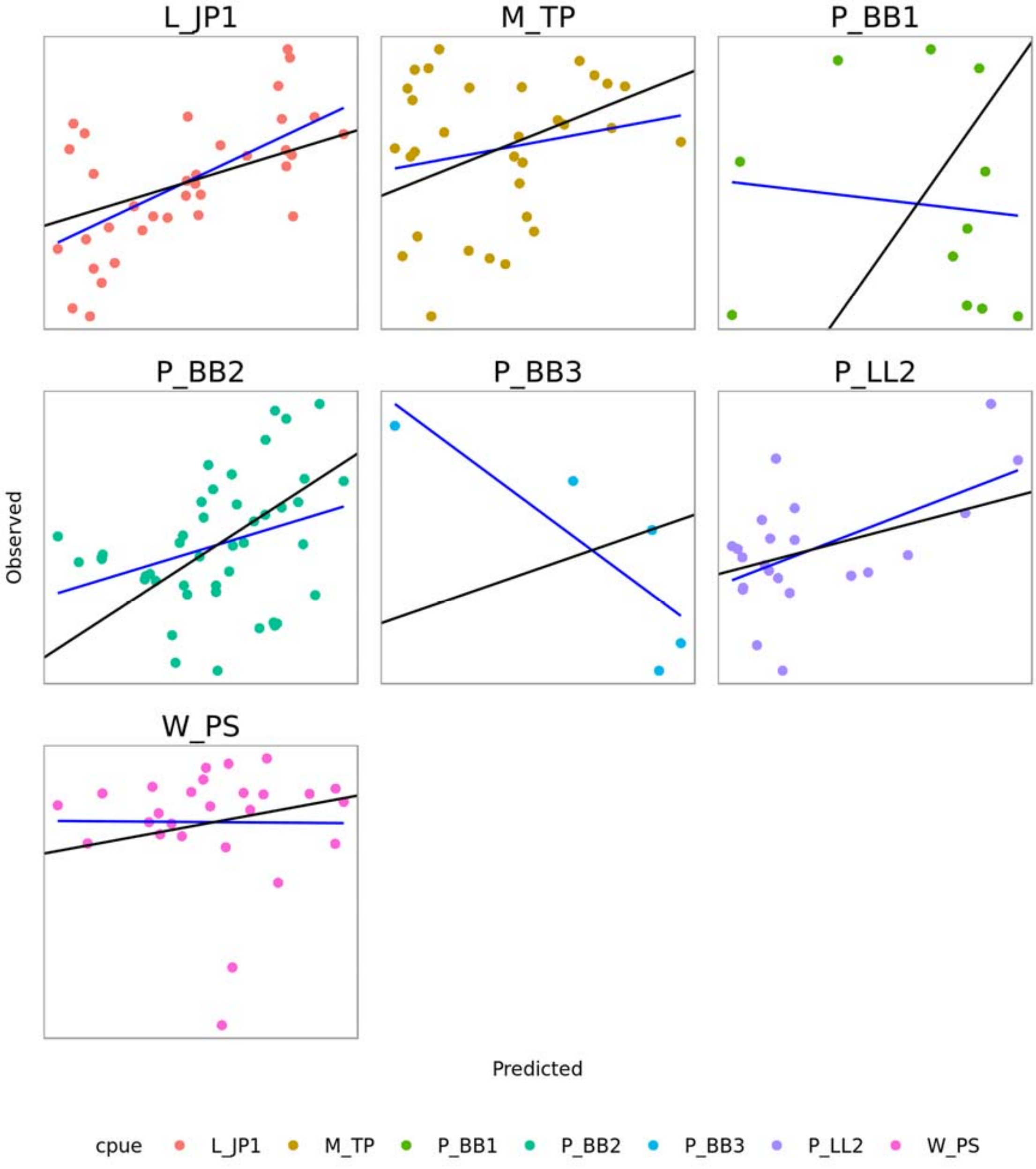


Figure 17 Eastern bluefin tuna. Observed and expected values of CPUE values are plotted against each other (Run 2 using reported catch). This allows a quick check of which indices are correlated with the population estimates, the black line is the Y=X line and the blue a linear regression fitted to the data. If an index agrees closely with the VPA results then the blue and black lines will near coincide.

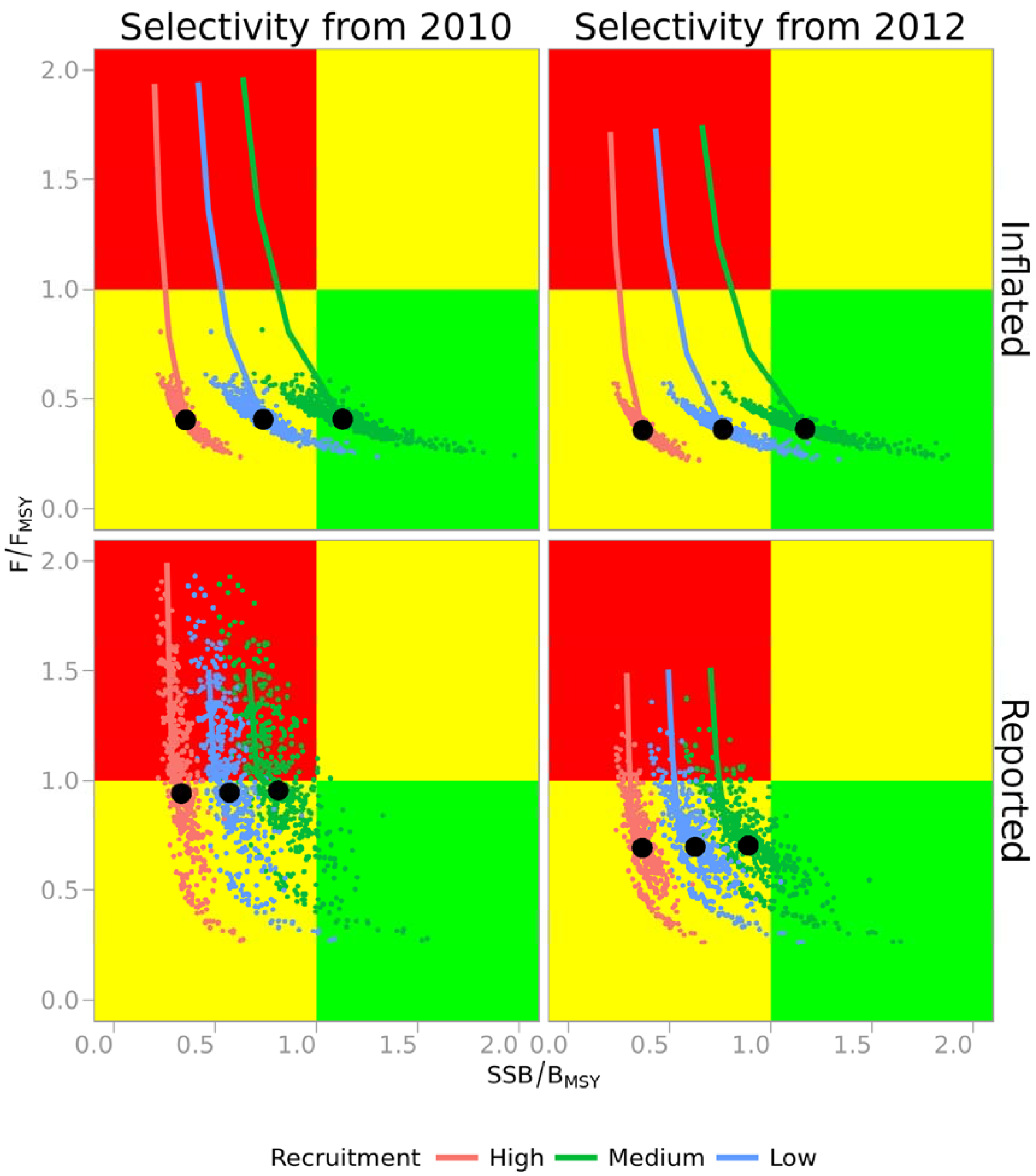


Figure 18 Eastern bluefin tuna. Kobe plot for 2011 stock status, individual realisations starting in 2008 with median for the two selectivity patterns (rows) and the catch scenarios (reported or inflated; column) and for the three recruitment scenarios (colors).

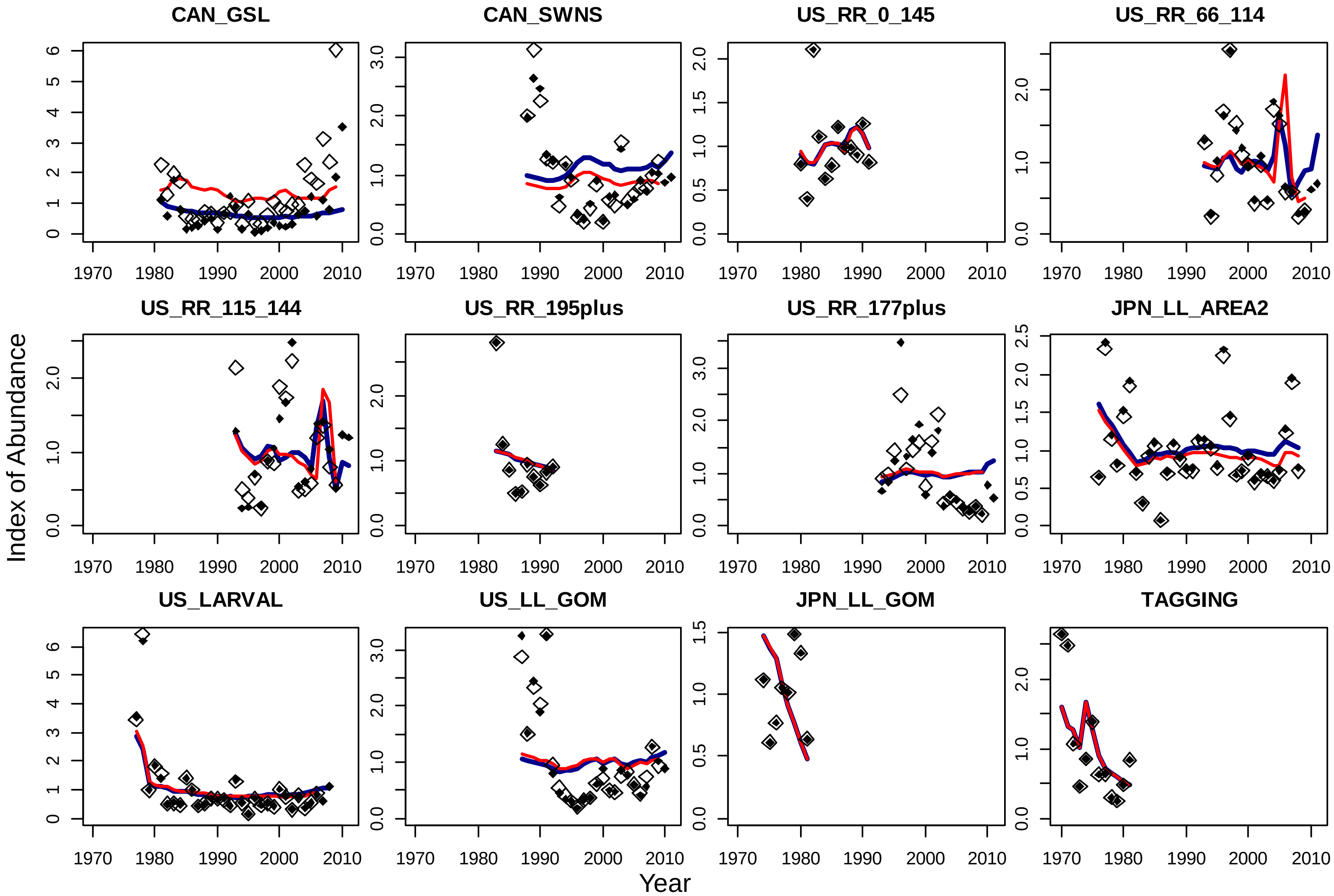


Figure 19 Fits to the CPUE indices for 2012 western Atlantic BFT continuity VPA (observed shown as black points, predicted shown as blue lines), compared the 2010 base model (observed shown as open points, predicted shown as red lines) .

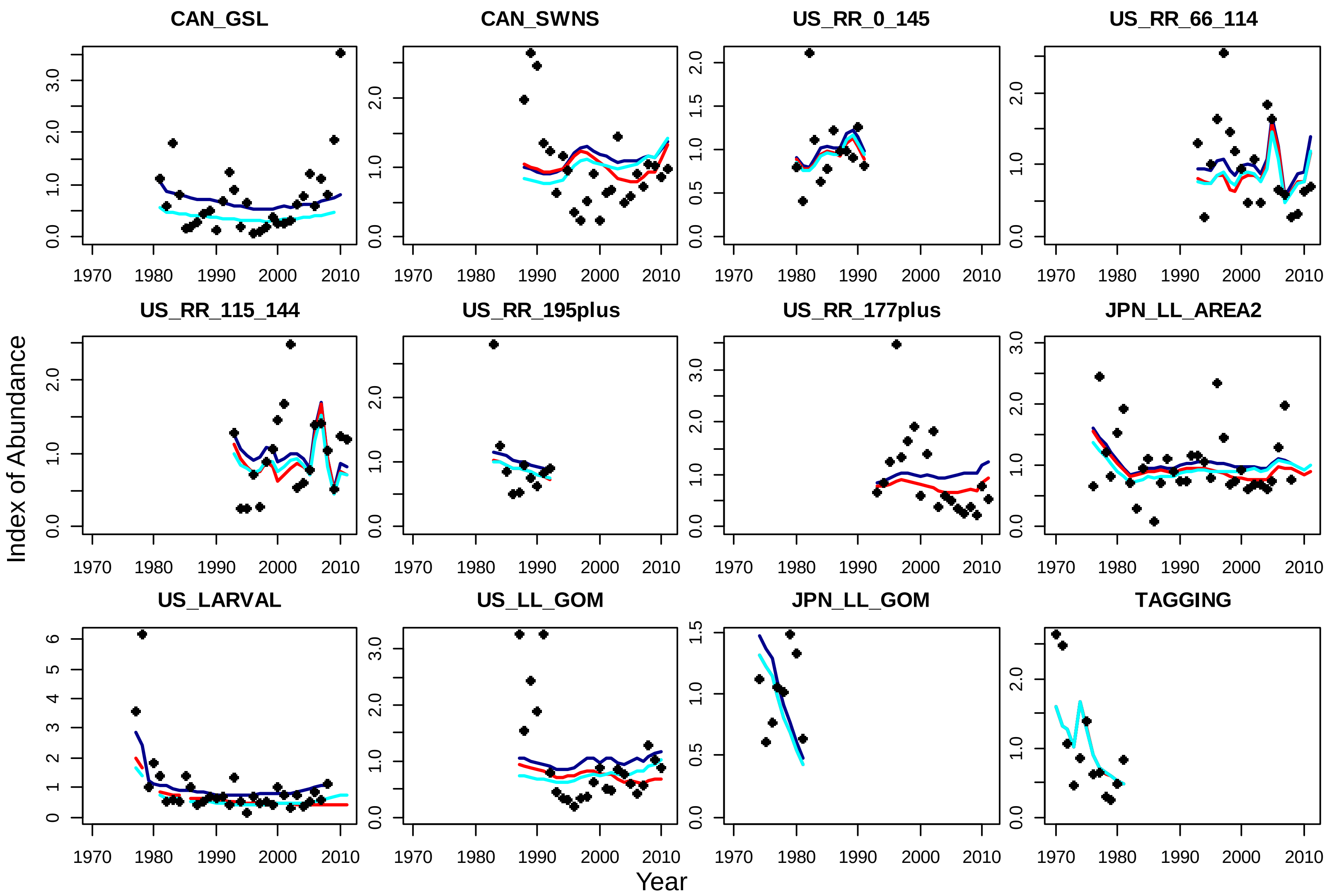
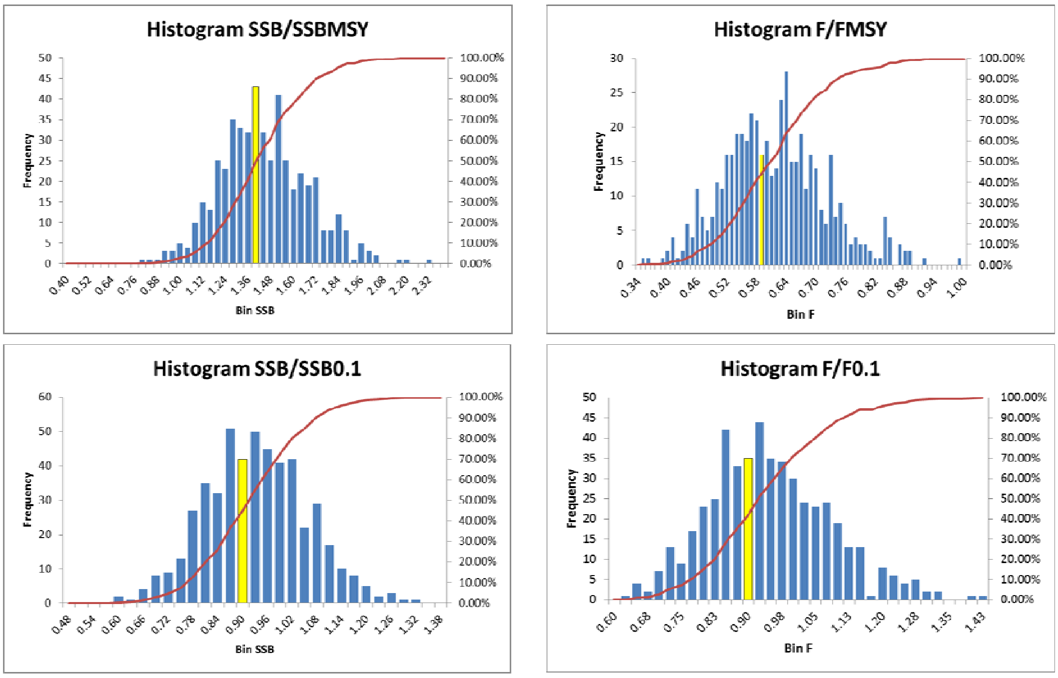


Figure 20 Fits to the CPUE indices (black points) for western Atlantic BFT base VPA runs without the Canadian GSL (red lines) and U.S RR >177 cm (turquoise lines) indices compared to the 2012 continuity model (dark blue lines).

Low Recruitment Scenario



High Recruitment Scenario

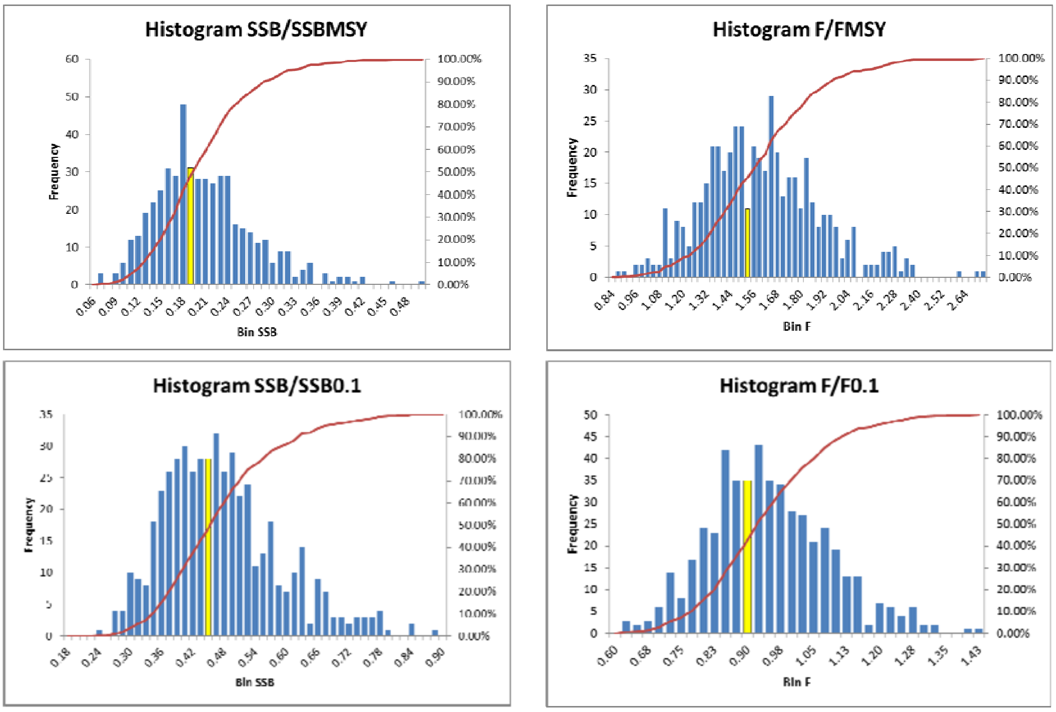


Figure 21 Histograms of bootstrap estimates of 2011 western bluefin tuna stock status at using F_{MSY} and $F_{0.1}$ references. The yellow bar contains the value corresponding to the continuity-case deterministic estimate. The cumulative frequency is shown as a solid red line.

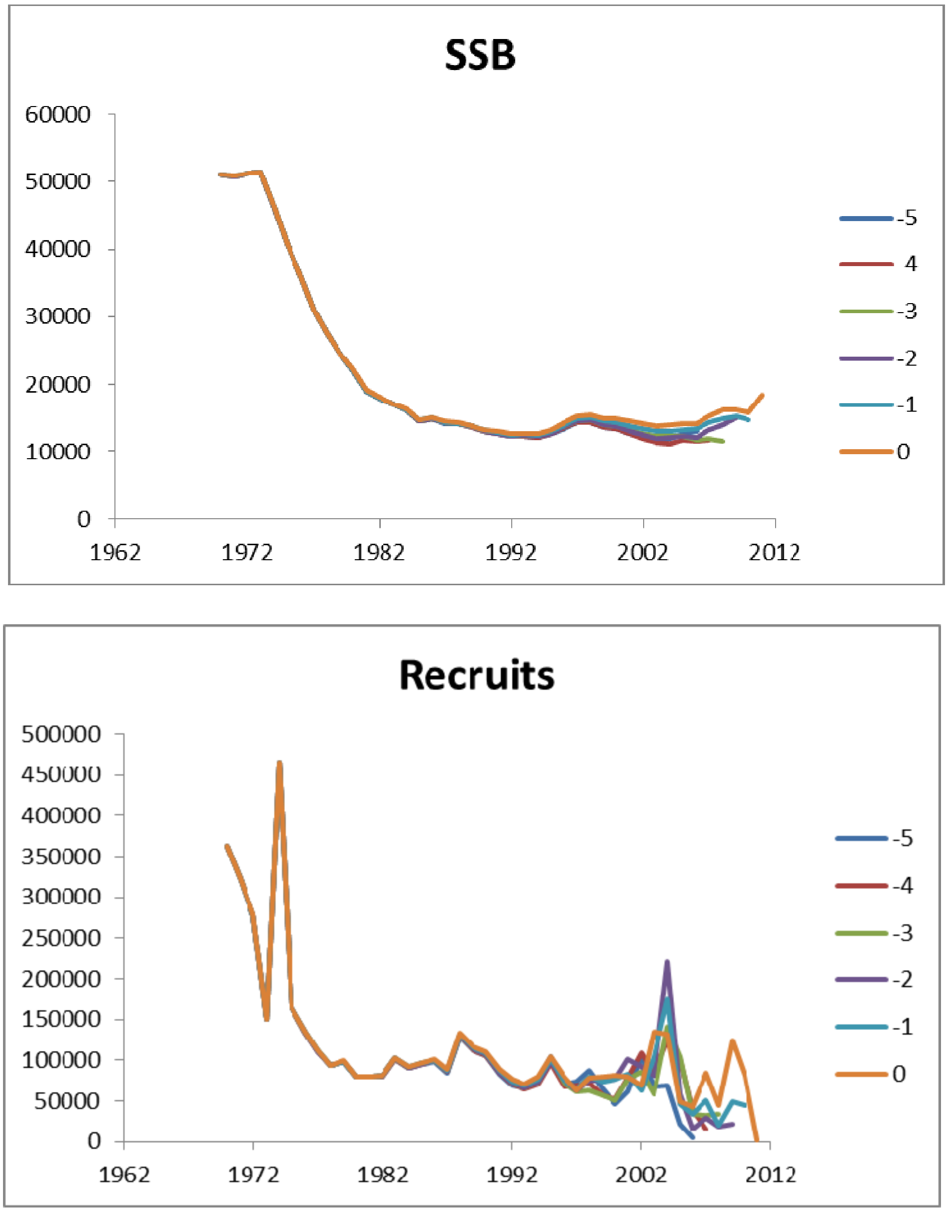


Figure 22 Retrospective trends of spawning stock biomass and recruitment (age 1) from the West BFT continuity model. The legend indicates the number of years removed from the 2012 base run. Recruitment estimates for the most recent three years are shown in this panel to demonstrate the retrospective pattern in those estimates.

Figure 23 Retrospective patterns of fishing mortality by age (FAA) from the West BFT continuity model. The legend indicates the number of years removed from the 2012 continuity run. Recruitment estimates (age 1) for the most recent three years are shown in this panel to demonstrate the retrospective pattern in those estimates.

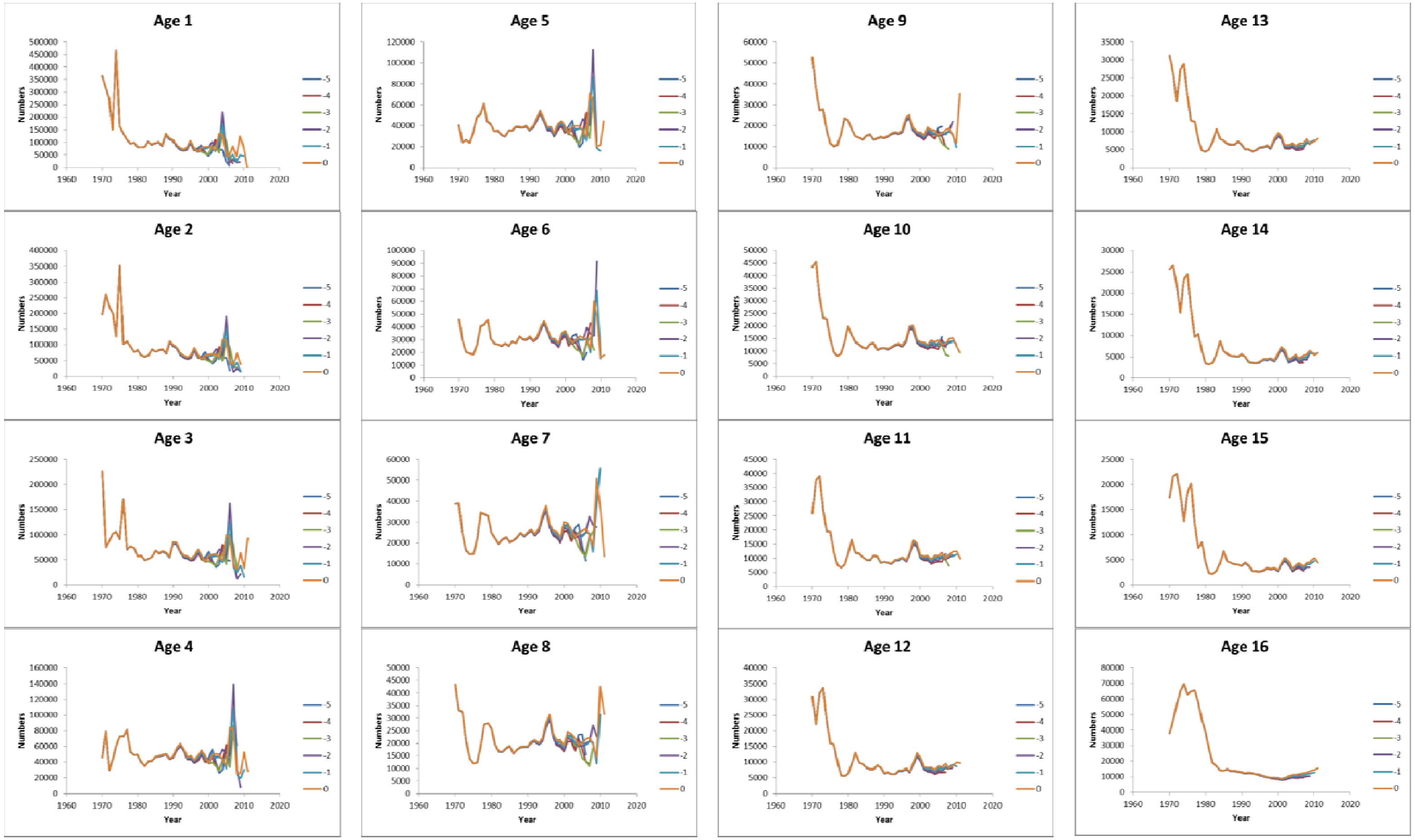


Figure 24 Retrospective patterns of numbers at age (NAA) from the West BFT continuity case model. The legends indicate the number of years removed from the 2012 continuity base run. Recruitment estimates (age 1) for the most recent three years are shown in this panel to demonstrate the retrospective pattern in those estimates.

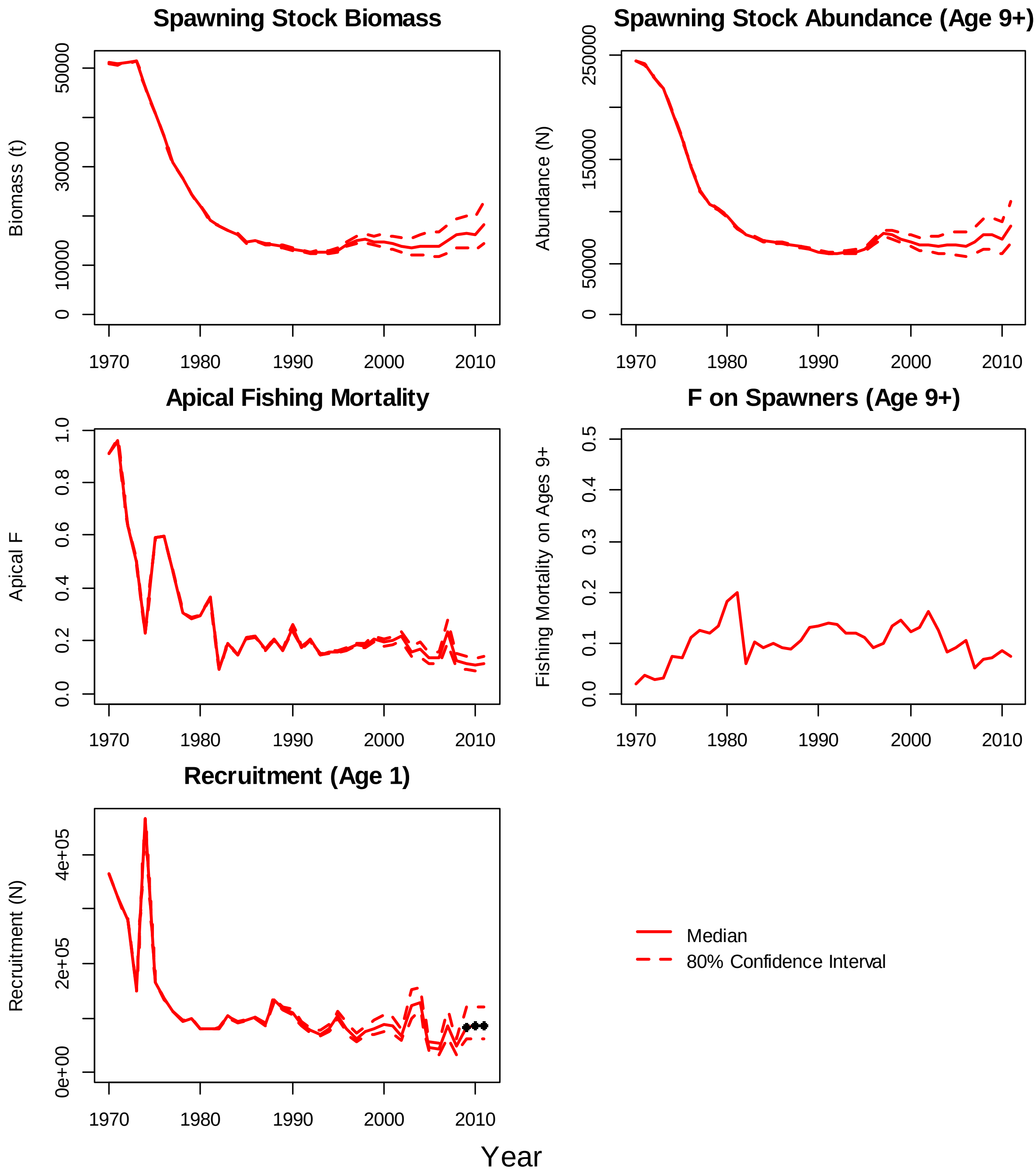


Figure 25 Median (solid red line) estimates of West Atlantic bluefin tuna spawning stock biomass, abundance of spawners (Age 9+), apical fishing mortality, fishing mortality on spawners, and recruitment. Dashed lines indicate the 80% confidence interval. Recruitment estimates for years 2009, 2010, and 2011 were replaced with the estimates from the 2-line model.

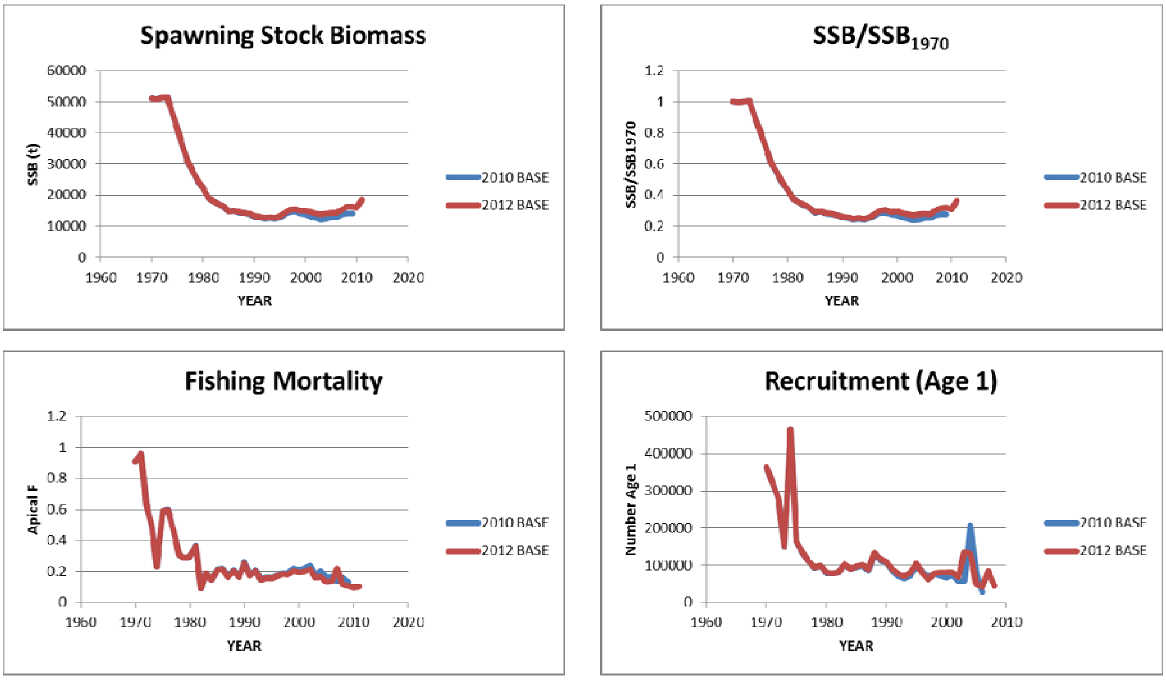


Figure 26 Western Atlantic bluefin tuna. Annual estimates of spawning stock biomass (SSB), depletion relative to 1970 (SSB/SSB_{1970}), recruitment and fishing mortality (Apical F) for the 2010 base and 2012 continuity models. The 2009 to 2011 recruitment estimates are not shown as they are not used for future projections.

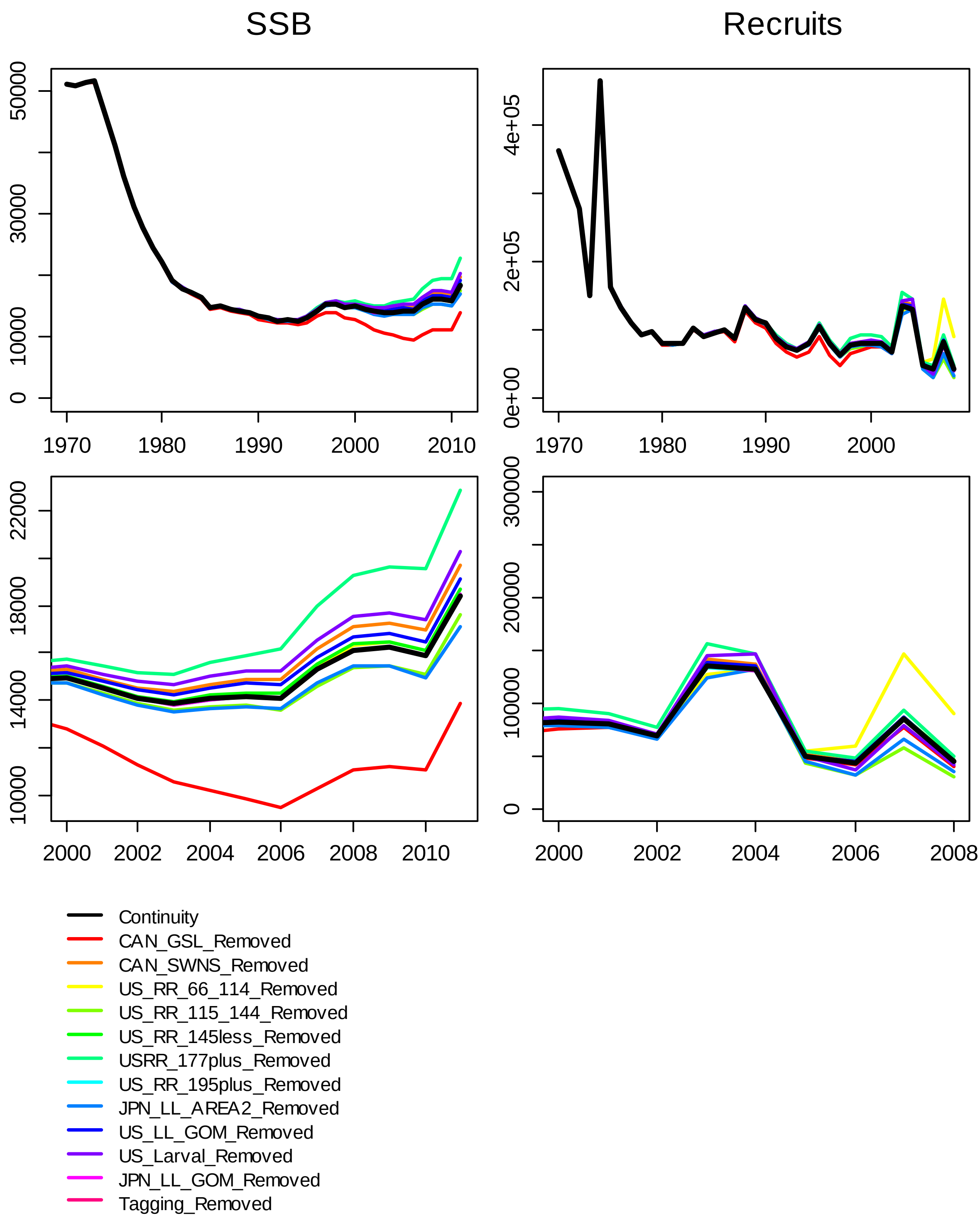


Figure 27 Western Atlantic bluefin tuna. Jack-knife analysis demonstrating the effects of iteratively removing individual relative abundance indices and associated partial catch-at-age matrices from the western BFT VPA continuity model.

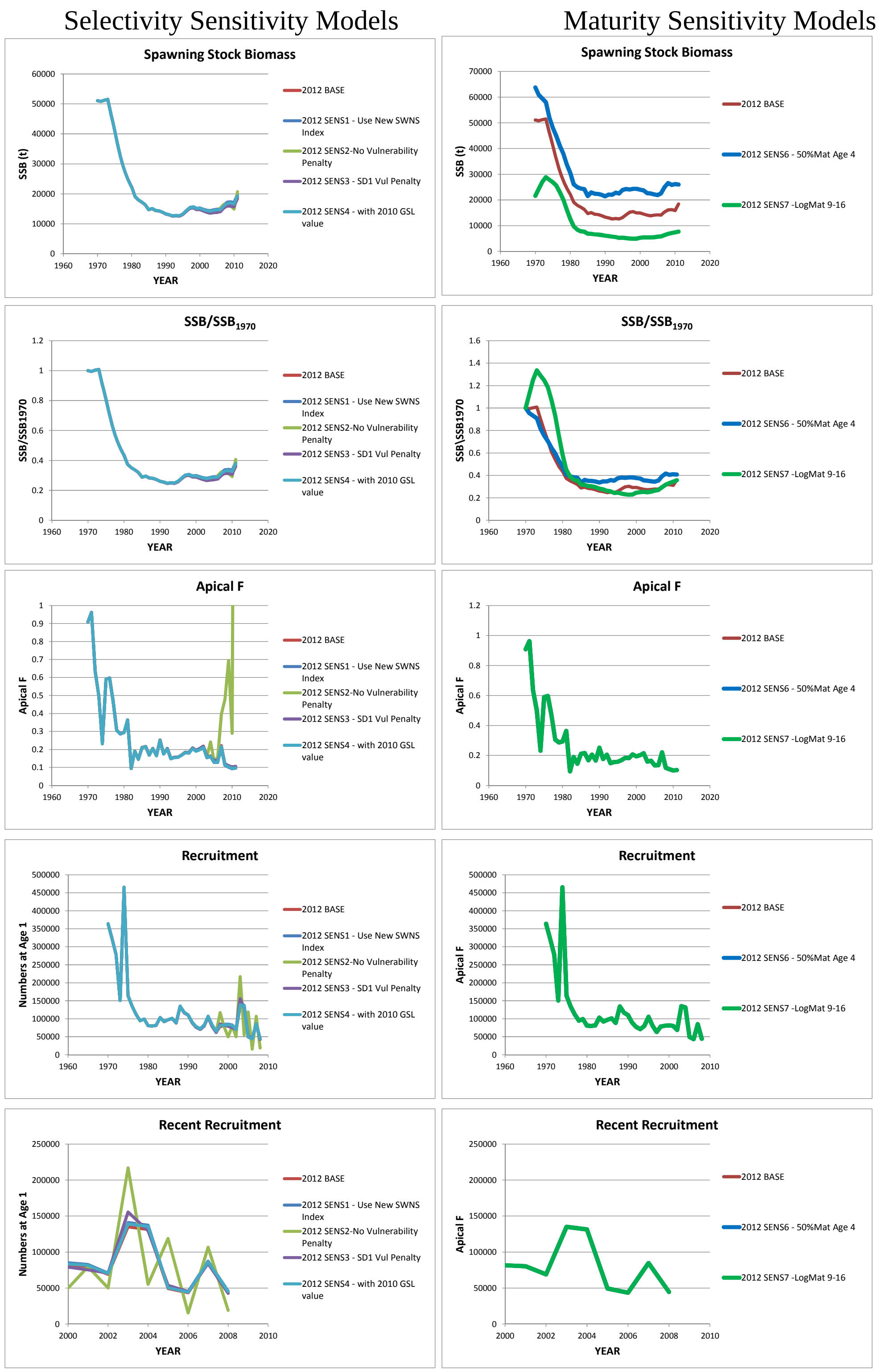


Figure 28 Western Atlantic bluefin tuna. Annual estimates of spawning stock biomass (SSB), depletion with regard to 1970 (SSB/SSB_{1970}), apical fishing mortality and recruitment for the VPA continuity and select sensitivity runs. Sensitivity run 2 displayed poor model behavior (e.g. Apical F = 5.0 in 2011 – the upper bound on F allowable in VPA).

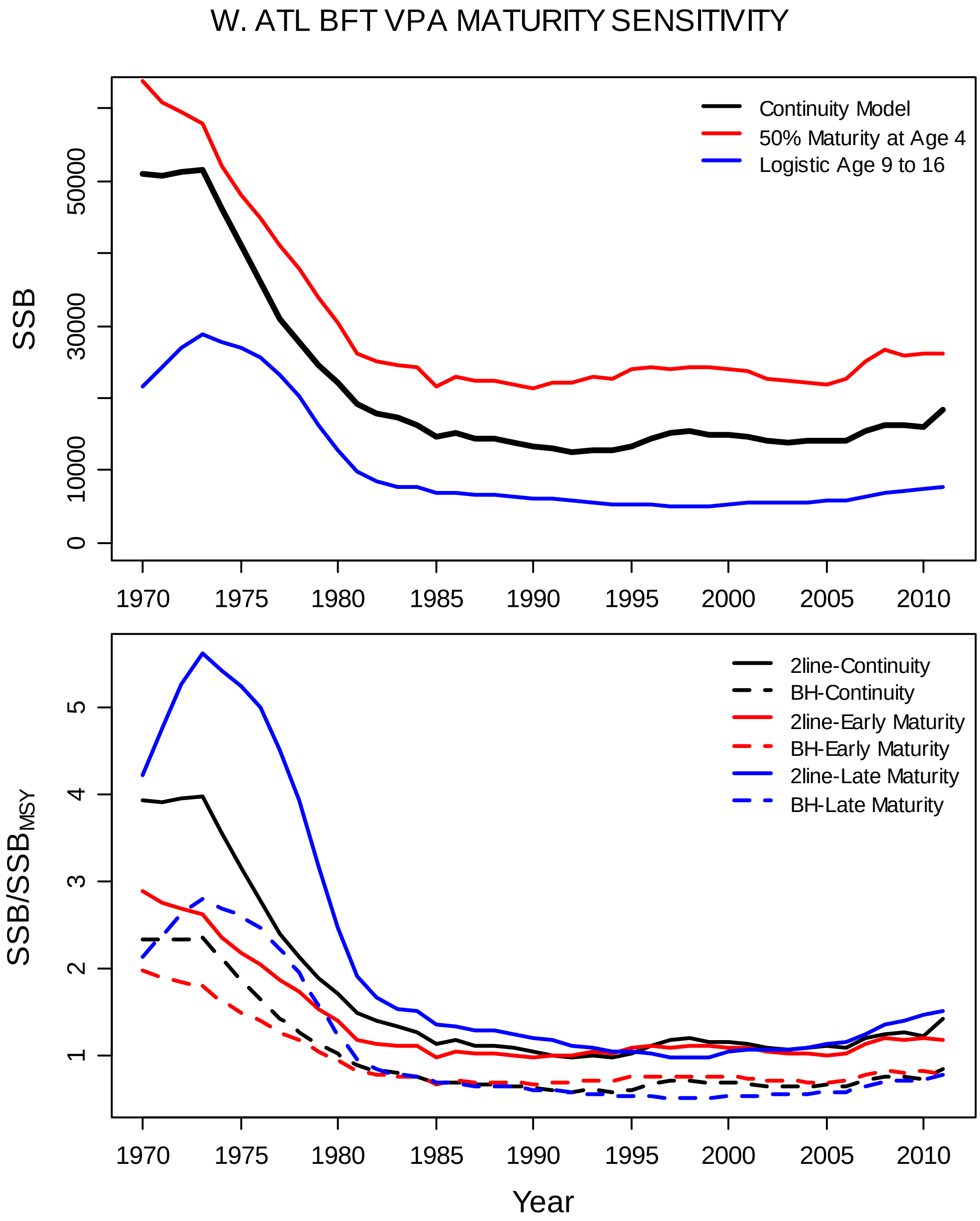


Figure 29 Western Atlantic bluefin tuna. Comparisons of estimated SSB and SSB/SSBMSY for the continuity run and maturity sensitivity runs under the low recruitment (2line) and high recruitment (Beverton-Holt) hypotheses.

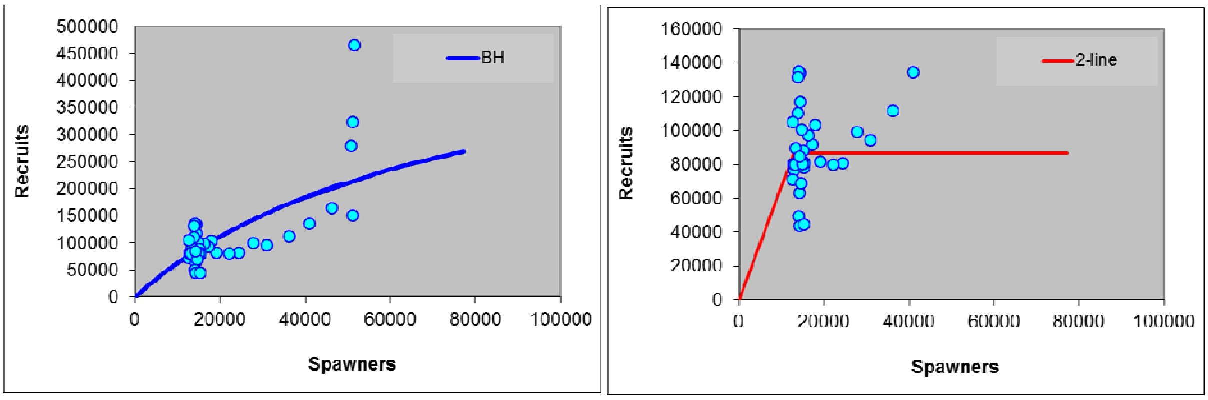


Figure 30 Western Atlantic bluefin tuna. The spawner-recruit relationships fit to the 2012 VPA continuity model. The two-line and Beverton and Holt formulations were used to calculate management reference points and project the population dynamics to 2019. Points represent the estimates from the VPA model.

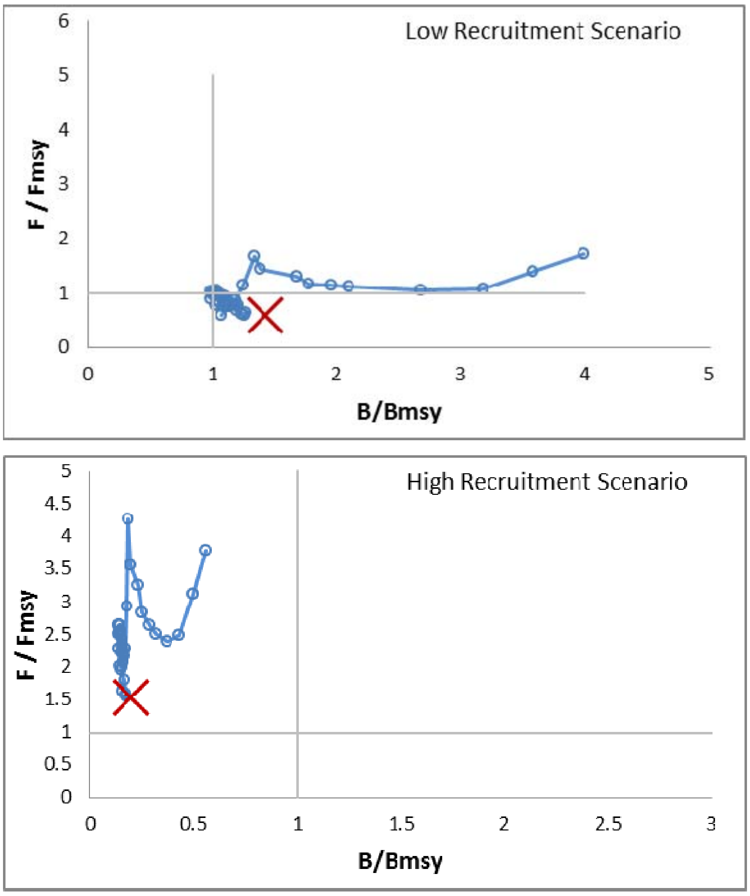
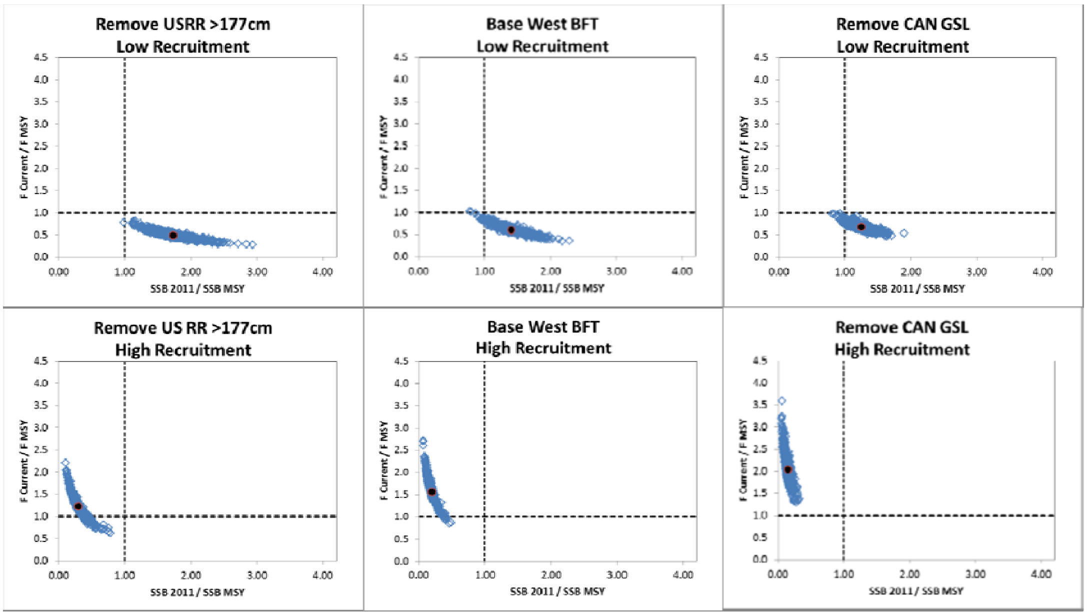


Figure 31 Western Atlantic bluefin tuna. Estimated status of stock relative to the Convention objectives (MSY) by year (1973 to 2011). The lines represent the time series of point estimates for each recruitment scenario. The estimated stock status in 2009 (the geometric mean fishing mortality during 2006-2008 is the proxy for F in 2009) in shown as a red "X".

F_{MSY} references



$F_{0.1}$ references

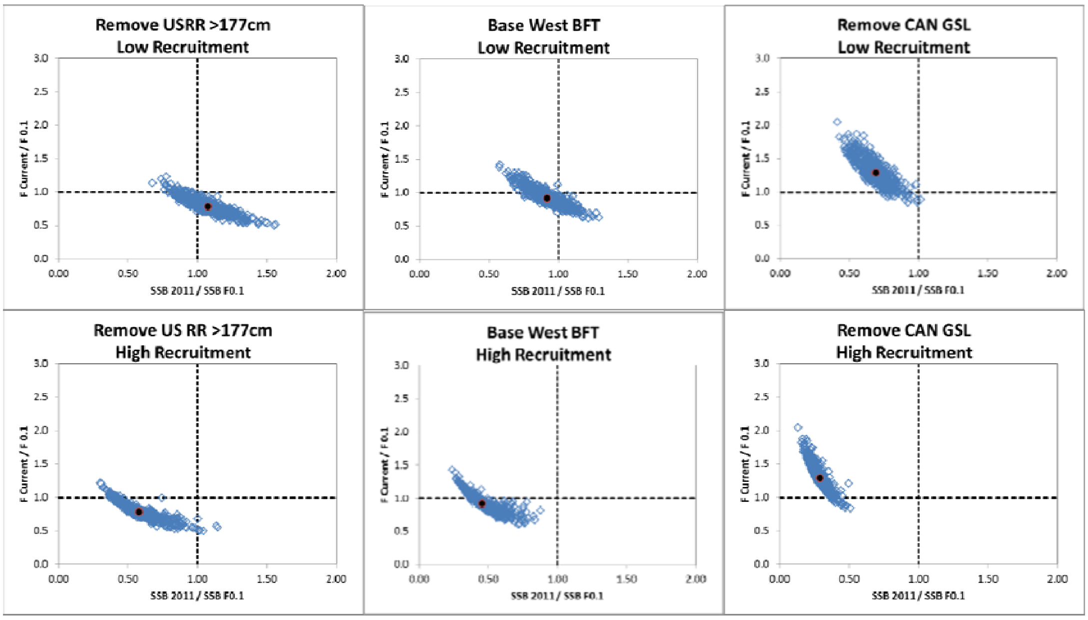


Figure 32 Western Atlantic bluefin tuna. Stock status in 2011 estimated by the VPA base and jack-knife runs removing the Canadian GSL and US RR > 177 cm indices. Two types of S-R relationships were examined, a two-line model (low recruitment) and the Beverton and Holt (high recruitment) option. F current is defined as the geometric mean fishing mortality during 2008-2010. The filled circle is the median result. The open circles are estimates of stock status from 500 bootstrap runs. The top set of panels use an FMSY reference whereas the bottom set use F0.1.

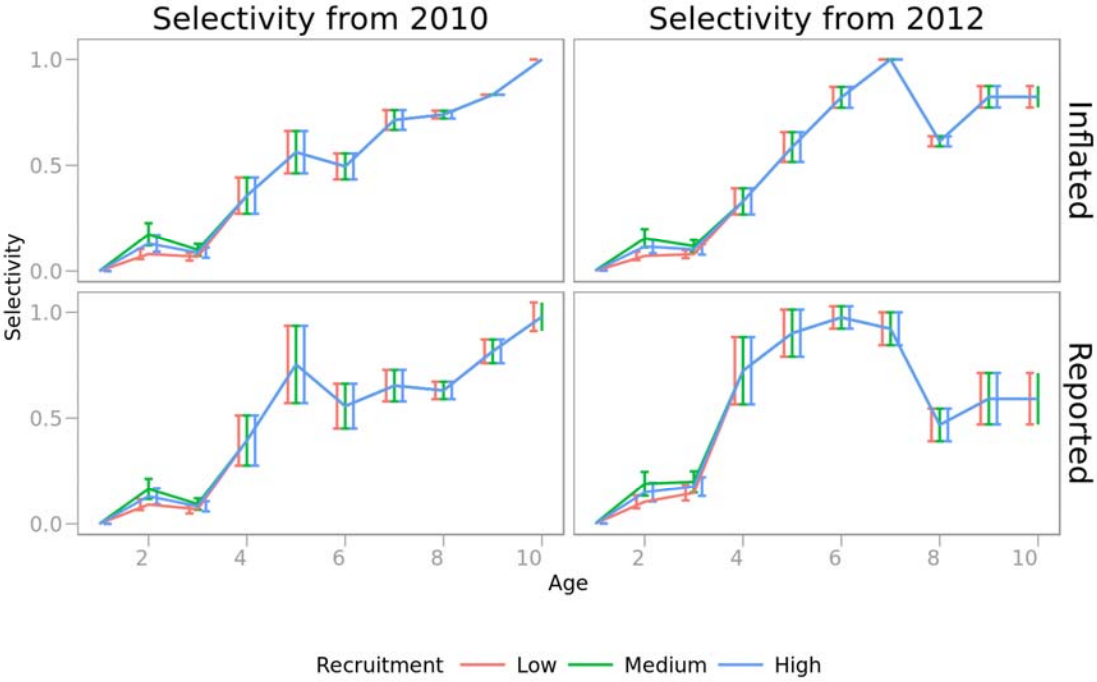


Figure 33 Eastern Atlantic bluefin tuna. Selectivity patterns used for calculation of benchmarks and projections, these show the medians (lines) and +- 1 sd (bars). Selectivity are assumed in the 2010 and 2012 projections for the three recruitment and two catch scenarios.

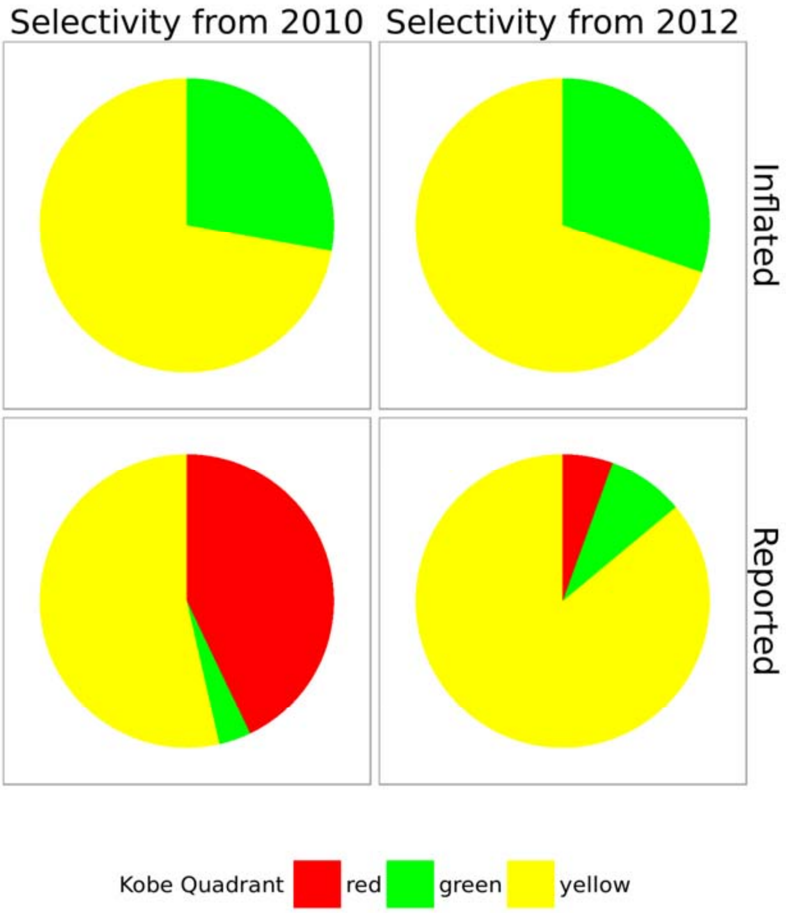


Figure 34 Eastern Atlantic bluefin tuna. Pie chart showing the proportion of the VPA continuity run results for the terminal year (2011) that are within the green quadrant of the Kobe plot chart (not overfished, no overfishing), the yellow quadrant (overfished or overfishing), and the red quadrant (overfished and overfishing). Split by catch scenario (reported and inflated) and benchmark (2010 and 2012).

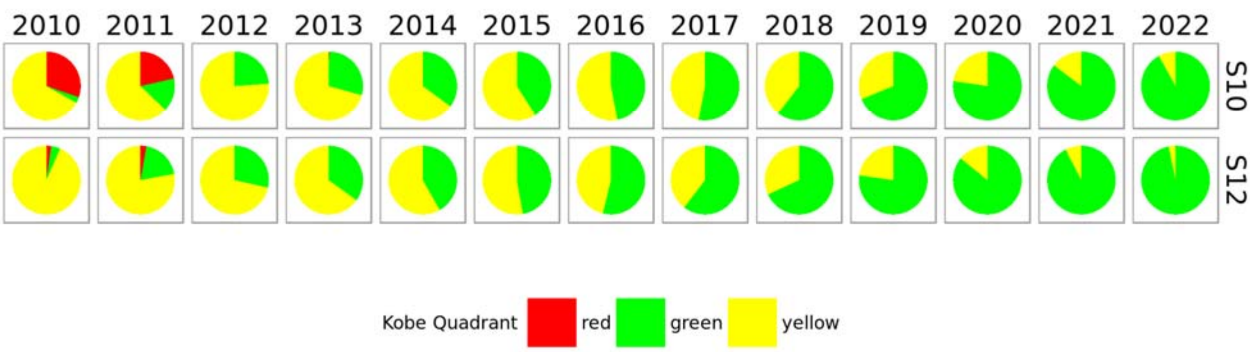


Figure 35 Eastern Atlantic bluefin tuna. Pie chart showing the proportion of the VPA continuity run results for the terminal

year (2011) (top line) 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 benchmark (i.e. as estimated in 2010 and 2012) and integrating over the 3 recruitment (low, medium and high) and two catch scenarios (reported and inflated).

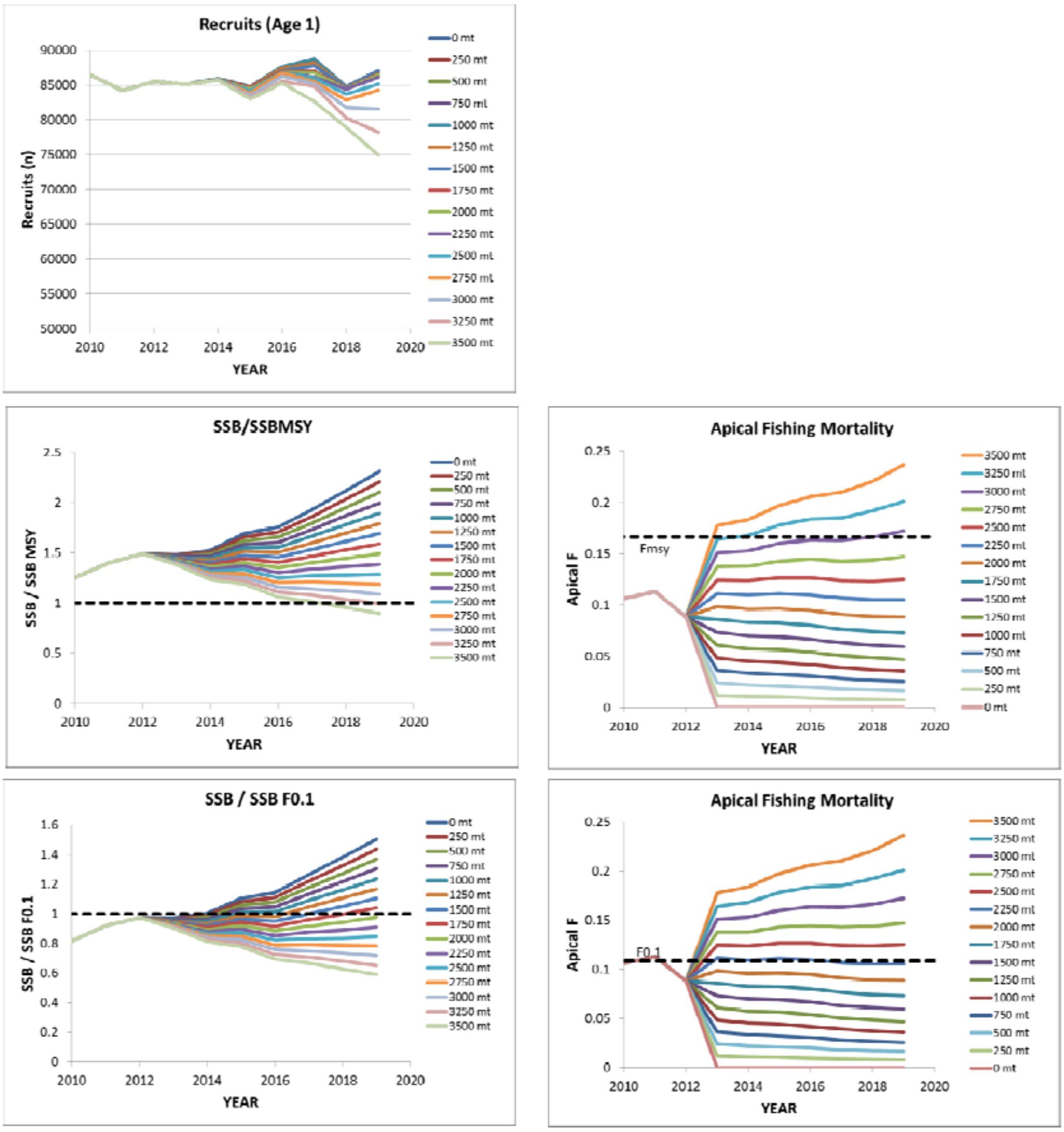


Figure 36 WBFT**:** Projection results for the low recruitment scenario projected at various levels of constant catch. The bottom panels use the alternative proxy reference F0.1 to illustrate the implications of that management reference. These trajectories are the median (50%) result of 500 bootstraps.

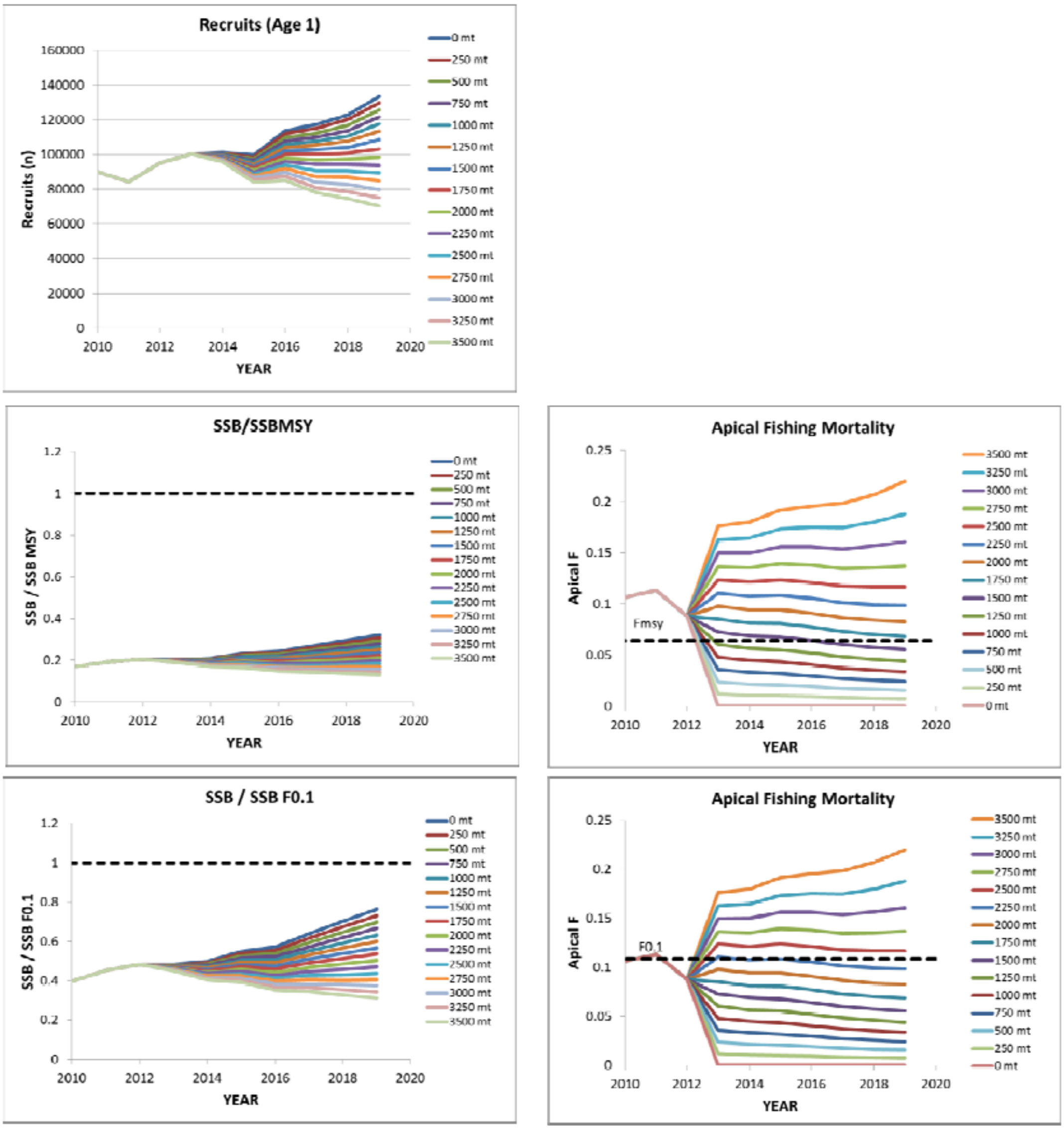
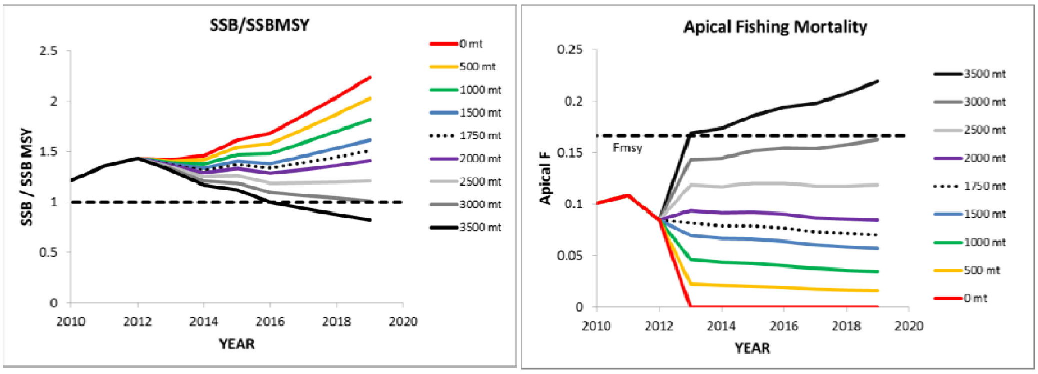


Figure 37 WBFT: Projection results for the high recruitment scenario projected at various levels of constant catch. The bottom panels use an alternative proxy reference F0.1 to illustrate the implications of that management reference. These trajectories are the median (50%) result of 500 bootstraps.

60% Probability – Low Recruitment Potential



60% Probability – High Recruitment Potential

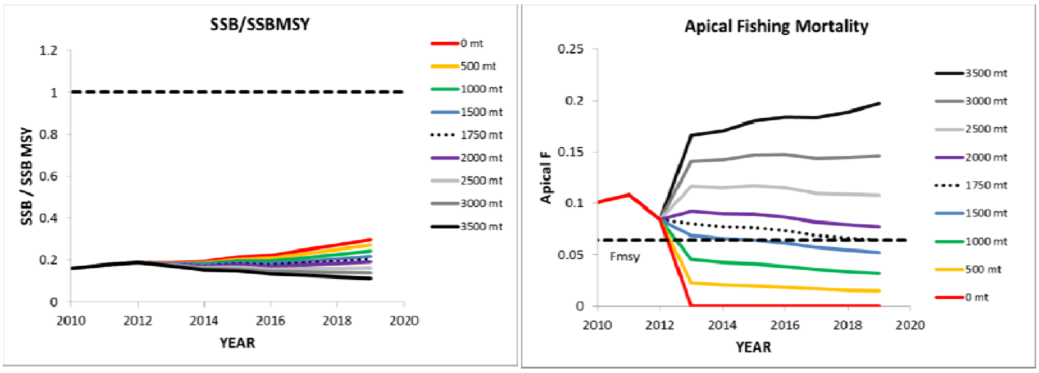


Figure 38 WBFT: The projected SSB/SSBMSY and F/FMSY trajectories at various catch levels for the two recruitment scenarios. These trajectories correspond to a 60% probability of achieving a given level of SSB/SSBMSY or F/FMSY.

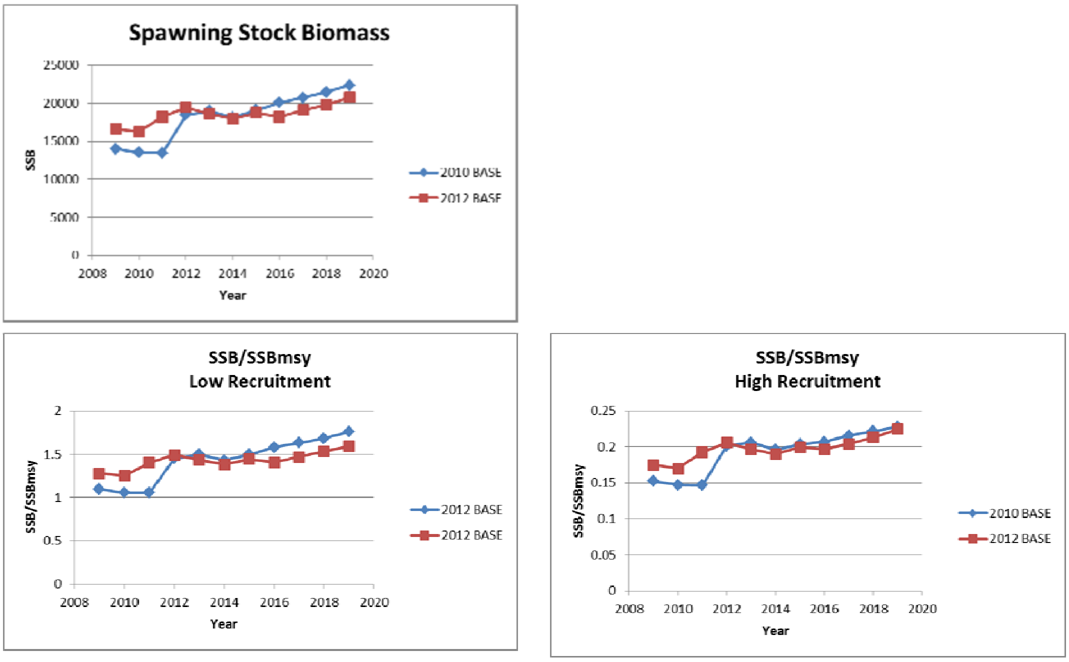


Figure 39 WBFT: Comparison of the spawning stock biomass (SSB) , and SSB relative to SSB at maximum sustainable yield (MSY) for the low and high recruitment scenarios. Projections were made at the current TAC of 1,750 mt [Rec. 10-03].

Appendix 1

AGENDA

1. Opening, adoption of the Agenda and meeting arrangements.
2. Review of the scientific papers presented at the WG
3. Review of the Rebuilding Plans for the Atlantic bluefin tuna and 2010 SCRS advice
4. Updating data for stock assessment
   4.1 Biology
   4.2 Catch Estimates
   4.3 Relative Abundance Estimates and CPUE
   4.4 Tagging
   4.5 Other Data
5. Methods relevant to the stock assessment
   5.1 Methods – East
   5.2 Methods – West
   5.3 Other methods
6. Updating Stock status
   6.1 Stock status – East
   6.2 Stock status – West
   6.3 Stock status – alternative models
7. Projections
   7.1 Projections – East
   7.2 Projections – West
8. Recommendations
   8.1 Research and statistics – East
   8.2 Research and statistics – West
   8.3 Management – East, including advice on the odds of achieving the current Rebuilding Plan objectives without further adjustment
   8.4 Management – West, including advice on the odds of achieving the current Rebuilding Plan objectives without further adjustment
9. Other matters
10. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS

SCRS/2012/119	Maguire J.J., Hanke A. and Neilson J. Changing selectivity patterns in the western Atlantic bluefin tuna fishery.
SCRS/2012/120	de la Serna J.M., Macías D., Ortiz de Urbina J.M. and Godoy D. Seguimiento de la Encomienda de la SGM al IEO para el estudio del atún rojo (Thunnus thynnus) del Atlántico Este (que incluye el Mediterráneo) utilizando las almadrabas como observatorios científicos durante 2012.
SCRS/2012/121	de la Serna J.M.,Belda E., Godoy M.D. and Majuelos E. Campañas de marcado de atún rojo (Thunnus thynnus) juvenil coordinadas por el IEO previstas en el Programa GBYP-ICCAT y realizadas en el Estrecho de Gibraltar durante Noviembre de 2011 y enero de 2012.
SCRS/2012/122	de la Serna J.M., Abascal F., Abid N. and Godoy M. D. Posible influencia sobre el comportamiento migratorio del atún rojo (Thunnus thynnus) de las distintas estrategias de marcado electrónico utilizadas en las almadrabas y en jaulas de engorde.
SCRS/2012/123	Quílez-Badia G., Cermeño P., Tudela S., Sainz Trápaga S. and Graupera E. Spatial movements of bluefin tuna revealed by electronic tagging in the Mediterranean Sea and in Atlantic waters of Morocco in 2011.
SCRS/2012/124	Fromentin J.M., Bonhommeau S. and Brisset B. Update of the index of abundance of juvenile bluefin tuna in the western Mediterranean Sea until 2011.
SCRS/2012/125	Justel Rubio A., Parrilla A. and Ortiz M. Preliminary analyses of the ICCAT VMS data 2010-2011.
SCRS/2012/126	Mielgo Bregazzi R. Size structure of northeast Atlantic and Mediterranean bluefin tuna (Thunnus thynnus, L. 1758) caught during the period 2001-2012 as revealed by Japanese daily fresh tuna market auction reports.
SCRS/2012/127	Mielgo Bregazzi R. Northeast Atlantic and Mediterranean bluefin tuna (Thunnus thynnus, L. 1758) caught duriing the period 1998-2011 as revealed by international trade official statistics.
SCRS/2012/128	Labidi N. and Nouar A. Quelques indices de la biologie du thon rouge (Thunnus thynnus) en Algerie.
SCRS/2012/129	Labidi N. and Nouar A. Evaluation du stock de thon rouge (Thunnus thynnus) en Algerie.
SCRS/2012/130	Kimoto, A., Itoh, T., Sakai, O. and Miyake, M. Overview of the Japanese longline fishery for bluefin tuna in the Atlantic Ocean, up to 2011.
SCRS/2012/131	Kimoto et al. Updated standardized bluefin tuna CPUE from the Japanese longline fishery in the Atlantic up to the 2011 fishing year.

SCRS/2012/132 Deguara, S., Cort, J.L., Galaz, T., Estruch, V.D., Belda Perez, E.J. Use of Fulton's condition factor to filter out outliers from Atlantic bluefin tuna (Thunnus thynnus, L.) length-weight relationships.

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SCRS/2012/134 Ota, S., Wada M., Kaneko, M., Iioka, M. Analysis and evaluation of the catch weights and growth factors of Atlantic bluefin tuna based on Bluefin Tuna Catch Documents (BCDs).

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SCRS/2012/136 Grubisic, L., Katavic, I., Segvic-Bubic, T., Ticina, V., Mislov, K. Preliminary experiences in applying the stereoscopic system in bluefin tuna size estimates.

SCRS/2012/137 Butterworth, D.S. and Rademeyer, R.A. A comparison of initial statistical catch-at-age and catch-at-length assessments of eastern Atlantic bluefin tuna.

SCRS/2012/138 Kerr, L.A., Cadrin, S.X., Secor, D.H. and Taylor, N. A simulation tool to evaluate effects of mixing between Atlantic bluefin tuna stocks.

SCRS/2012/145 Gagern A., Van den Bergh J. and Sumaila R. Trade-based estimation of Bluefin tuna catches in the Eastern Atlantic and Mediterranean, 2005-2011.

SCRS/2012/148 Gordoa A. Analyses of connections between Atlantic Bluefin tuna fisheries at both sites of the Atlantic comprising Balfegó catch rates in Balearic spawning ground.

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SCRS/2012/154 McAllister M.K. Using Bayesian methods to evaluate the credibility of stock-recruitment relationships for Western Atlantic bluefin tuna.

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SCRS/2012/156 Secor D.H., Gahagan B. and Rooker J.R. Atlantic bluefin tuna stock mixing within the U.S. North Carolina recreational fishery, 2011-2012.

SCRS/2012/157 Lutcavage M.E., Galuardi B., and Lam T.C.H. Predicting potential Atlantic spawning grounds of Western Atlantic bluefin tuna based on electronic tagging results, 2002-2011.

SCRS/2012/158 Lauretta M.W. and Brown C.A. Updated standardized catch rates of bluefin tuna,Thunnus thynnus, from the rod and reel/handline fishery off the northeast United States during 1980-2011.

SCRS/2012/159 Ingram, G.W. Jr. Annual indices of bluefin tuna (Thunnus thynnus) spawning biomass in the Gulf of Mexico (1977-2011).

SCRS/2012/160 Cass-Calay S.L. Standardized catch rates of bluefin tuna from the United States pelagic longline fishery in the Gulf of Mexico during 1987 to 2011.

SCRS/2012/161 Knapp J.M., Heinisch G., Rosenfeld H., and Lutcavage M.E. New results on maturity status of western Atlantic bluefin tuna, Thunnus thynnus.

SCRS/2012/162 Rosenberg A., Cooper A., Maunder M., McAllister M., Methot R., Miller S., Porch C., Powers J., Quinn T., Restrepo V., Scott G., Seijo J.C., Stefansson G. and Walter J. Scientific examination of western Atlantic bluefin tuna stock-recruit relationships.

SCRS/2012/163 Ramírez-López K. and, Abad Uribarren A. Análisis de la captura incidental del atún aleta azul (Thunnus thynnus) por la flota palangrera mexicana en el Golfo de México, 1994-2011.

SCRS/2012/164 Ingram G.W., Jr., Alemany F., Alvarez D. and García A. Development of indices of larval bluefin tuna (Thunnus thynnus) in the western Mediterranean sea.

Appendix 4

SUMMARIES OF DOCUMENTS SUBMITTED TO THE GROUP

Biology

Several papers were presented on biometry, size structure inferred from conversion factors, sex ratio and relative growth of Atlantic bluefin tuna.

Document SCRS/2012/104 presented length-weight and length-length relationships covering the areas of the North East Atlantic and West and Central Mediterranean. Most of these biometric relationships were new and some others updated the ICCAT conversion factor table for which East Atlantic and Mediterranean stock information is very limited. The obtained relationships provide detailed information by geographical area, month and sex. Authors indicated that differences with the currently used length-weight relationship for the Mediterranean will influence the estimation of biomass from length observations for this area. This paper also analyzed the bluefin tuna condition factor by geographic area and quarter.

Document SCRS/2012/105 updated the relationship between head length and pre-operculum length with curved fork length, obtaining a good fitting. This regression was used to estimate the size frequencies data from biological scraps for 2011 bluefin tuna catches coming from Moroccan Atlantic traps. The 2011 size structure was similar to that from the previous two years, which also were estimated by the same method.

Document SCRS/2012/132 proposed a method to filter out outliers in datasets used for the determination of ABFT L-W relationships in order to provide more meaningful L-W relationships. The method proposed was based on the application of the Tukey's Outlier method on the Fulton's Condition Factor (K) data derived from fork length (FL) and round weight (RWT) data points available in these datasets. In this analysis, the Tukey's Outlier method was applied to the K data derived from the FLs and RWTs of eight ABFT datasets from both wild (East and West stock, various gears) and farmed ABFT. The determined lower and upper filtering limits were then used to filter out outlying FL and RWT data points in the original datasets for the purpose of determining new L-W relationships. It was shown that application of the Tukey's Outlier filtering procedure significantly improved the coefficient of determination (R2) in these datasets in which R2 was initially low. This analysis clearly showed that applying Tukey's Outlier method to K can be used to provide more accurate L-W relationships for ABFT.

Document SCRS/2012/128 described some bluefin tuna biological parameters coming from the Japanese longline boats catches operating in the Algerian coast. Average size and relative growth by sex, sex ratio, length-weight and length-length relationships (total and fork length, round and gutted weight) by sex were estimated from a wide ten years sampling from 2000 between ther first of April and the first of June.

Document SCRS/2012/117 described Atlantic bluefin tuna sex ratio by size for the specimens caught by purse seiners in the western Mediterranean. Sex, weight and fork length data were collected from nearly 17000 specimens sampled from 2009 to 2012 when slaughtered after being farmed. The same sex ratio pattern was found as in Doc SCRS/2012/128, in which males dominate the first and last length classes while females dominate in the intermediate classes.

Document SCRS/2012/114 makes an analysis of the SFL of 2,458,028 Atlantic bluefin tuna were taken from 224 scientific publications and unpublished length data from scientific organizations and fishing companies spanning most of the known Atlantic and Mediterranean ABFT fisheries dating from 1605 to 2011, give SFL values ranging from Lmin= 20 cm and Lmax= 330 cm.

The results indicate that the parameter L∞ of the growth equations used by the SCRS ABFT assessment group for the Eastern and Western stocks of ABFT lies within the confidence limits of the maximum lengths presented in the study: Lmax= 319.93±11.3 cm.

Solutions are provided to recognise and remove outliers from ICCAT databases based on the application of fixed values of Fulton's condition factor (K) between 1.4 and 2.6 to correct this situation in the future.

Document SCRS 2012/101 considered the development of the 2003 year class. It was stated in the stock assessment of the Atlantic bluefin tuna in 2010 that the 2003 year class could be a strong year class originated from the west Atlantic stock. This year class appeared in the catch of Japanese longline fishery operated in the east Atlantic as a clear indication of the strong year class but does not seem so strong and not consistent way in the catches of the fishery in the west Atlantic. Concurrent appearance of this year class is identified in some of well documented important fisheries. Although the 2003 year class could be strong year class originated both in the west and east Atlantic, this year class seems to be more dominant and consistently appears in the eastern Atlantic stock. Full analyses for all other important fisheries in the whole Atlantic are required to determine relative strength of this year class.

Document SCRS/2012/142 presented an historical overview of the situation of bluefin tuna in the central-southern Atlantic, showing the reported catches and analysing the data for the last 20 years, where some mixing with southern bluefin tuna is very possible in the most southern areas. The distribution of the species is considered, taking into account all electronic or conventional tags reported so far and new anecdotic information for the most recent years. The presence of natural marks caused by cookiecutter sharks is discussed, even if this remains an unclear indication. The impact of current regulation on catch or by-catch reporting is also considered. The possible presence of potential spawning areas in various parts of central Atlantic was also discussed, also taking into account very recent data coming from pop-up tags. The need to better focus the attention on this huge part of the ICCAT area is pointed out.

Document SCRS/2012/152 presented first results on the natal origin of 470 juvenile and adult Bluefin tuna caught in the Bay of Biscay during 2009-2011. Authors used δ13C and δ18O isotopic ratios in otoliths as a tool for identifying natal origin. Maximum likelihood estimates of proportions of origin indicated that a large fraction (95-100%) of the Atlantic bluefin tuna caught in the Bay of Biscay fishery was originated in the Mediterranean. However, it was noted that individuals with most depleted δ18O values were all caught at similar times, suggesting that intermittent west to east migration pulses might occur, with potentially important implications to stock assessments (especially for the western stock). Thus, authors recommended continuing these analyses in order to better characterize the magnitude and periodicity of these migration events.

Document SCRS/2012/155 assigned population membership to historical and recent samples of Gulf of Mexico spawners and U.S. Atlantic "school" size category juveniles collected during the past 36 years, 1976-2012 on the basis of otolith stable isotope stock composition analysis. Gulf of Mexico spawners showed strong natal homing regardless of sampling period, although the most recent sample (2009-2010) showed slightly lower contribution rates from the Gulf of Mexico population (91.7% ±4.6% SD; N=80). The contribution of the Gulf of Mexico population has diminished substantially for school sized bluefin tuna (70-150 cm CFL) was quite high in 1976-1977 collections (84.8%±10.5% SD; N=26) in comparison to two decades (1997-2000) and three decades (2011-2012) later, when contributions were respectively 38.9%±6.3% SD (N=120) and 15.8%±6.0% SD (N=86). These preliminary results indicate that US school bluefin ("Rod and Reel") CPUE series do not exclusively nor consistently represent western stock status.

Document SCRS/2012/156 assigned population membership, Mediterranean or Gulf of Mexico, to North Carolina and Virginia (US) Atlantic bluefin (2011 and 2012), which included members of the abundant 2003 year-class. Maximum likelihood estimates of the sample's mixture were based on otolith stable isotope composition, $\delta^{18}O$ and $\delta^{13}C$. For the 2003 year-class, the estimated contribution rate of Gulf of Mexico members was 49.2% ± 13.2% SD. When all ages were included (3-17 years; CFL 117-285 cm; N=218), the contribution of the Gulf of Mexico population was estimated at 28.2% ± 4.6% SD. Results support the inference that the 2003 year-class, evident in US fisheries during the past 5 years, received notable contributions from the Mediterranean population, where a strong year-class was observed. Further, results suggest that US fisheries for school and medium size classes (<205 cm CFL) have shown increasing dependence on Mediterranean-origin individuals during the past 15 years.

The Group received several contributions concerning reproductive biology, including larval studies.

Document SCRS/2012/149 provided a general overview about the existing scientific knowledge of eastern bluefin tuna reproduction and reproductive areas, based on many published papers. The various larval campaigns were considered, as well as any additional data source concerning age 0 distribution and evidence of mature gonads in various Mediterranean areas over at least more than a century. It is evident that most of the Mediterranean Sea is a spawning area, with some areas more documented than others (maps were provided), but it is very clear that spawning aggregations can vary in time and space each year, according to several factors, mostly environmental. Some issues concerning the reproduction are still to be understood, but a lot of knowledge is already available. The possibility of having extra-Mediterranean spawning areas was also discussed, but without any definitive element.

Document SCRS 2012/161 provided new information on the reproductive and sexual maturity of 529 Atlantic bluefin tuna sampled from 2004–2010 on NW Atlantic foraging grounds off New England, Canada, and young of year from Virginia. Fish size was 107–292 cm CFL (excluding YOY), and gonadosomatic index (GSI) was 0.012–1.347. Although nearly all gonads sampled from fish >134 cm were regressed, sexual maturity evidence was detected via histology. Partially spent testes were present in males >145 cm and lipid stage oocytes were present in most females sampled in the Gulf of Maine during June–July. The authors obtained endocrine hormone profiles and compared pituitary gonadotropins (GtHs) across size classes, including YOY, presumably immature, and mature individuals. FSH/LH ratio was >2 among YOY (characteristic of immature fish) while FSH/LH ratio was <1 in ABFT >134 cm (characteristic of mature fish). Although some size gaps remain in the sampling (e.g., between YOY and 107 cm), the authors' results were consistent with histological and endocrine analyses of maturity patterns in eastern ABFT and a revision of the western ABFT maturity schedule was recommended.

Document SCRS/2012/115 presented other sources of information that could aid in assessing the effectiveness of the implementation of the ICCAT Recovery Plan as bluefin larval surveys. Within the EU financed MEDIAS project aiming at the assessment of pelagic resources off the Spanish Mediterranean coasts covering from Cape Creus in the NW Mediterranean to the neighboring waters of the Alboran Sea, an ichthyoplankton sampling program was implemented from 2009-2011. The MEDIAS surveys were undertaken in June-July during the Mediterranean peak spawning season and optimal for sampling bluefin larvae in the Balearic Sea. During the 2011 MEDIAS survey, important numbers of bluefin larvae (568) were collected along the Levantine coasts of Spain by means of bongo plankton tows. Bluefin larvae were concentrated along the shelf/slope waters from Cape La Nao towards the southwest Mediterranean.

Finally, the Group received information both in the form of presentations and working papers which addressed research of broader scope, including the Grande Bluefin Year Progream (GBYP).

The main research achievements obtained by the GBYP "Biological Sampling and Analysis" program were presented to the Group. During 2011 (Phase 2), a total of 1916 bluefin tuna were sampled (including larvae, YOY, juveniles, medium size fish, and large fish) from different regions (East, Central and Western Mediterranean, and Northeast and Central North Atlantic). From these individuals, 4309 biological samples (genetic samples, otoliths, spines and gonads) were taken. Genetic markers have been developed and stock structure and origin assignment analyses have been started. Regarding microchemistry, otoliths from the Central North Atlantic, Bay of Biscay, Strait of Gibraltar, Balearics, Malta, Sardinia and the Adriatic Sea have been analyzed, results showing >99% of Eastern origin fish except in the Central North Atlantic were 84% of the fish were of Eastern origin. Regarding age determination analyses, 374 otoliths and 375 spines have been interpreted already. Inter-reader agreement was high and preliminary age-length-keys were generated for both spines and otoliths. The comparison between ages estimated from different structures of the same specimen showed a good age agreement. This indicates that both structures may be used indistinctly for age determination of Atlantic bluefin tuna for the age ranges analyzed in this project. Histological analysis did not yet provide much insight into the reproductive biology of bluefin tuna because the sampling was not adapted to this objective (as it was mainly designed for stock structure). The aim during 2012, is to fill the strata that could not be sampled in 2011, as well as to have a temporal replicate, and continue the analyses on the 4 main axes of the program (genetics, microconstituents, ageing and reproduction).

Catches and Fishery Trends – West

SCRS/2012/116 in this document Task II size frequency data of bluefin tuna was reviewed and preliminary analysis performed for its potential use with integrated catch statistical models and or to estimate Catch at Size (CAS). The size data was also compared with historic data of size distributions recently obtained through the G-BYP research program. Year, month, gear and fleet were evaluated as explanatory factors of the mean size observed variability. A GLM model was used to estimate the predicted annual mean size and to identify main explanatory factors.

Document SCRS/2012/148 analysed CPUE series. The updated CPUE time series from Balfego continued the positive trend in 2012, tripling the catch rates estimated in 2011. Positive correlations between some western and eastern fisheries were found which can be indicative of significant harvest of Eastern stock juveniles (< 4 yrs) by North American fisheries and also significant harvest of Eastern stock spawners (ages 8 and 9) in the Gulf of St. Lawrence fisheries and by Japanese longliners operating in Area2. These results showed the need to revise the current Western and Eastern fisheries categorization and stock indices.

SCRS/2012/110 this document considered the effect on future stock recovery of delaying the BFT fishing season in the Mediterranean by 2 weeks. The authors hypothesized that any change in the fishing season that results in an increased rate of eggs fertilization in optimal spawning areas can help to speed up the recovery rate of the stock without requiring additional reduction of the TAC. However, the author acknowledged that it is not possible to quantitatively assess the effect of the proposed change on stock recovery with the current available data. The author indicated that other positive effects of delaying the fishing season by 2 weeks (as assessed by using available data from the Balfego's vessel production) are: a) reduction on the fishing active time and over the operating costs by 43%, b) keep wages at same level, reduction of work time at sea and increments of safety on board (in the same proportion of fishing time reduction), c) slightly increase of the average size of individuals, which may result in a 6% reduction in fishing mortality and a 3% increase in revenue associated with better prices for individuals of greater size, d) reduction on the level of environmental impact by gas emissions (in the same proportion of the fishing time reduction), and e) reduction of control costs and simplification of monitoring of the fishing activities.

SCRS/2012/119 this document responded to Rec. [10-03]. ICCAT Rec 10-03 (Supplemental Recommendation by ICCAT Concerning the Western Atlantic Bluefin Tuna Rebuilding Program) asks the SCRS to 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. This paper responds to Rec 10-03 by providing yield and spawner per recruit analyses to evaluate the effectiveness of current size limits in the fishery for conserving and rebuilding spawning stock biomass and comment on alternative approaches. The analyses include scenarios which account for undocumented post-release mortality in the recreational fisheries and consider impacts of the various components of the fishery on stock productivity, including revisions of measures of yield- and spawner-per-recruit. The analyses demonstrates that shifting the fishery size-selectivity towards larger, older individuals offers advantages in terms of sustainable yield and spawning stock biomass, but acknowledges that changes to the status quo selectivity would raise problematic allocation issues, both domestically and internationally. To meet the requirement of Rec. 10-03 that calls on all ICCAT Contracting Parties to monitor and report on all sources of fishing mortality, further work is recommended to provide estimates of post-release mortality in all catch and release fisheries for Western Atlantic bluefin tuna.

SCRS/2012/163 this document presented an analysis of the incidental catch of bluefinm tuna (Thunnus thynnus) by the Mexican longline fleet operating in the Gulf of Mexico targeting yellowfin tuna during the period 1994-2011. The results of the analysis indicate that annual catches were below to 25 t. The total number of BFT caught were 757 with a total weight of 172 t. The size frequency distribution ranges from 115 to 379 cm FL showing a normal distribution with an average length of 245 cm FL. Males were predominant in the catch comprising 51% (259 fish) of all animals caught. A spatial analysis was performed using 5ox5o quadrants with the goal of characterizing the size frequency and sex distribution. It is concluded that the catch of BFT is reduced in numbers, with a higher proportion of males and a reduced catch of juveniles.

SCRS/2012/130 this paper overviewed the operation pattern, fish size, and trends in total catch, effort and nominal CPUE of the Japanese longline fishery in the Atlantic for bluefin tuna up to December 2011. In the both west and east Atlantic, the recent fishing grounds for bluefin changed and/or shrank substantially, due to the introduction of IQ system for Japanese longline vessels. In the east Atlantic, the Japanese longline vessels operated almost solely in the Northeast Atlantic (north of 40N). The total catch in the West Atlantic has been relatively stable between 280 and 420 tons in the past five years, whereas the caches in the east Atlantic substantially decreased from 2200 to 1100 tons; following the reductions in the national quota. The nominal

CPUEs in the West Atlantic fluctuated significantly since 2007 fishing year, showing considerably high values for 2007, 2009, and 2011 fishing years, while a steep increasing trend since 2009 fishing year was observed in Northeast Atlantic.

Tagging

Several papers were presented to the Group in relation to conventional and electronic tagging:

Document SCRS/2012/112 provided information on electronic tagging in western Mediterranean. A total of 46 Pop-up tags (34 MK10 and 12 MiniPAT tags, Wildife Computers®) were deployed on Atlantic bluefin tuna spawners caught by purse-seine in the Balearic Sea in June, 2009-2011. Although the tags were programmed to detach 10-12 months after their deployment, the maximum retention time recorded was 149 days. The mean retention rate of miniPATs appears to be higher than that of MK10s. Thirteen of the 46 tags (28.26%) detached earlier than 15 days after deployment, 20 (43.48%) popped-off between 15 and 44 days, and 13 (28.26%) remained attached to the fish for more than 44 days. The majority of bluefin tuna tagged during the reproductive season in the western Mediterranean Sea appeared to migrate back to the Atlantic Ocean soon after spawning, some of them moving first northwards to high latitudes (~60ºN) and then turning southwards to the central Atlantic.

Document SCRS/2012/121 provided information on the conventional tagging surveys using pole and line vessels that were conducted in the Strait of Gibraltar during November-December, 2011 and February, 2012.A total of 1389 bluefin ranging 15-40 kg were tagged, 46 % of which had double tagging.

Document SCRS/2012/122 described the differences observed in the behavior of bluefin tuna tagged in traps when tunas were taken on board and released alone or when were tagged underwater and released together with other tunas. In the first case, tuna made migrations to the Central Atlantic, and in the latter case the tunas entered in the Mediterranean and exit after several weeks. Regarding the tagging and release in cages for fattening, it was observed that, tuna behavior after release was affected by the time of confinement in the farm. When released these bluefin remained in the vicinity of the fattening farm in and took some time for their return to the wild.

Document SCRS/2012/123 reported tagging carried out during 2011. Eleven tagging expeditions were carried out in the NW Mediterranean, the Adriatic Sea and in the Atlantic coast of Morocco in order to determine Atlantic bluefin tuna trajectories and behavior, following the tagging work carried out in 2008, 2009 and 2010. Pop-up satellite archival tags and internal archival tags were used on adults and juveniles. In total 22 pop-up and 5 archival tags were deployed. Tagged bluefin tuna weight ranged from 40 to up to 290 kg, and retention rates of pop-up tags ranged from 3 to 304 days. None of the tunas tagged within the Mediterranean Sea left the basin during the whole tracking period. Results reinforce available evidence for: 1. a strong connection of some fish to the western Mediterranean basin and 2. a strong connection of fish to the deeper areas of the Adriatic Sea. Only one of the tunas tagged in Morocco entered the Mediterranean Sea showing, together with a tuna tagged in Moraira (east coast of Spain), a behavior that could suggest spawning in the well-known breeding area south of the Balearic Islands. In addition, this year's results seem to indicate that the Azores and the Canary Islands could be relevant residence areas for the species in the NE Atlantic.

Document SCRS/2012/143 showed the very preliminary results of the GBYP tagging activity carried out with pop-up tags in Atlantic coast of Morocco in May 2012. The tagging was conducted according to the recommendations provided by the SCRS, tagging both underwater and on board. Several tags had a premature release, but this fact did not prevent to get some very interesting results, showing a much differentiated behavior, with some tunas entering in the Mediterranean for spawning and others going directly to some Atlantic areas. One tuna crossed the Atlantic ridge going westward, while another one went up to Norway after spawning in the Mediterranean. No behavioral difference between tunas tagged underwater or on board was noticed so far. Some tags are still on seven tunas and they should provide additional info. The relevance of this tagging activity on pre-spawners was pointed out, because it is able to provide improvements in scientific knowledge in almost real time.

Document SCRS/2012/157 analyzed dispersal patterns of Atlantic bluefin tuna (ABFT) released from New England and Canadian foraging grounds in 2002 to 2011 (n=126 , estimated sizes 150-185 cm curved fork length, CFL) with PSATS. Findings showed that most of the individuals retaining tags until the following April-June (20/36) did not enter the Gulf of Mexico (GOM), their presumed spawning ground. Spatial and environmental information returned by the tags suggested that some ABFT spawn elsewhere, possibly in late winter or spring, near the Gulf Stream margin, the Bahamas, and Caribbean Sea. Most of the fish utilizing the GOM during the observed period (all > 185 cm CFL) did so between February and March, and remained there for several months. None of the smaller (i.e., 150 - <185cm CFL) tagged individuals entered the GOM, but were at times located in oceanographic conditions similar to known spawning areas (e.g., SST from 22-26 o C, recirculation zones). Dispersal patterns exhibited by mature ABFT were consistent with life history models predicting that smaller/younger fish should reproduce in areas closer to foraging grounds than larger individuals. Authors indicated that confirmation of reproductive activity in the Atlantic, while difficult to accomplish, is key to obtaining an accurate assessment of spawning stock biomass for western ABFT.

Appendix 5

REPORT OF THE INFORMAL GROUP ON TRADE-MARKET DATA

Int roduction

The small group (lead by M. P. Miyake) was informaly established during the ICCAT 2012 bluefin tuna stock assessment sesson to review four SCRS documents, containing studies based on trade and market data, Those are the followings;

SCRS/2012/126 Size structure of northeast Atlantic and Mediterranean bluefin tuna (Thunnus thynnus, L. 1758) caught during the period 2001-2012 as revealed by Japanese daily fresh tuna market auction reports. By Mielgo Bregazzi R

SCRS/2012/127 Northeast Atlantic and Mediterranean bluefin tuna (Thunnus thynnus, L. 1758) caught during the period 1998-2011 as revealed by international trade official statistics. Mielgo Bregazzi R.

SCRS/2012/134 Analysis and evaluation on the catch weights and growth factors of Atlantic bluefin tuna based on bluefin tuna catch documents. S. Ota, S., Wada M., Kaneko, M., Iioka, M.

SCRS/2012/145(144) Trade-based estimation of Bluefin tuna catches in the Eastern Atlantic and Mediterranean, 2005-2011 Gagern A., Van den Bergh J. and Sumaila R.

The Group briefly reviewed these documentss particularly in respect to the objective of study, data sources, methods used, assumptions adopted and associated uncertainties..

Based on these review, the Group recognized the value of these sources of information in improvement of ICCAT bluefin tuna statistics, although the uncertainty of the estimations based on them have not allowed its use by the SCRS. Therefore, the Group further studied the possibility of using these sources of data to improve the BFT statistics. Particular attention was paid in identifying the main source of bias and the improvements needed, evaluating the benefits and difficulties of these studies based on market and trade data, and making recommendations for future studies.

One of the main use of trade data is to provide information pertaining to the level of total catches that needs to be estimated for stock assessment purpose. For this purpose, information from all available sources should be compared and synthesized to provide bounds on possible catch levels.

The Group considered that the potential relevance of trade data to the work of the SCRS is not to monitor compliance, Therefore, the group limited its discussion to the contributions on scientific aspects and avoided reference to compliance purpose.

Review of current studies

Characteristics of the documents presented.

Document SCRS/2012/126

Objectives: Provision of an alternative insight into demographic trends, particularly of those spawners in the east Atlantic, including Mediterranean.

Methods: Estimate the size at capture of wild and farmed fish by back-calculating round weight at catch from the product weight in Japanese fresh fish auction market.

Data source: Daily records (of product weight) of bluefin tuna auctioned in over 64 Japanese fish markets, provided by the market sellers/traders during the period January 2002 to June 2012.

Assumptions:

Product type in market is gilled and gutted (GG) for <70 kg fish and dressed (DR) for ≥70 kg fish. Conversion factors to round weight used are 1.16 and 1.25 for GG and DR, respectively.

Fattening ratios: assumed as follows; for E-BFTs weighing 70 kgs and above at auction, it is assumed that such fish corresponds to catches of adult E-BFT ranched during a standard 6 to 7 months fattening season. The retained cross-board fattening ratio for such fish is: 1,25 (25%)

For E-BFTs weighing less than 70 kgs at auction, with the exception of those ranched at Croatian tuna ranches, it is assumed that such fish corresponds to catches ranched during a standard 6 to 7 months fattening season. The retained cross-board fattening ratio for such fish is: 1,60 (60%)

For Croatian ranched E-BFTs weighing less than 70 kgs at auction, it is assumed that such fish corresponds to catches of juvenile E-BFT practiced by the Croatian domestic PS fishing fleet inside the Adriatic Sea. Such fish is normally ranched at Croatian tuna ranches for a period of two (2) to three (3) years. The retained cross-board fattening ratio for such fish is: 2,00 (100%

Basic assumption is that the Japanese fresh tuna auction market is taking mostly large Mediterranean bluefin tuna of high quality.

Uncertainties: Market bias is to be noted. Important market structure and market trend changes have taken place in Japan over the recent years. Information about the off-market selling fish and frozen fish was purposely not taken into account or included in this paper.

Uncertainty related to crossboard fattening ratios used in this paper .can nevertheless have effects on size and weight estimates of fish at capture.

The assumption of different presentations (whether Gilled and Gutted or Dressed) depending of the weight, have to be proved.

Document SCRS/2012/127

Purpose: Clarification of the gaps existed between ICCAT TACs and the amounts of equivalent wild E-BFT being effectively traded worldwide since 1998.

Methods: Estimate the yearly total catch of east Atlantic bluefin tuna in round weight, based on the Trade-flux data records, for the purpose of comparison with reported catch by fishing nations from 1998 to 2011.

Data source Official export/import records from a variety of primary official trade data sources (Japan, USA, EU, Korea, China and other importing countries for fresh and frozen bluefin tuna). Products were converted into round weight and farmed fish are back calculated to the weight before farming

Assumption: Conversion factors to round weight used are 1.25, 1.67, and 1.13 for DR, FL, and GG, respectively.

Various fattening ratios (e.g. for Croatian fish, 2.00 for 1998-2001 and 2008-2012 fish, 1.50 for 2002-2007 fish. for the other fish, 1.60 for <60 kg fish, 1.25 for >60 kg fish.

Uncertainties; Potential of double count of same individual in trading data of processed product. Also potential of double count because of export route (mixing of export and re-export data). Uncertainty in fattening ratios applied.

Document SCRS/2012/145

Objective; Catch estimation using trade statistics.

Methods: Estimate the annual catch (in round weight) using EUROSTAT, GITS and Japanese import statistics. from 2005 to 2011. GTIS data include trade data of over 40 countries that have been involved in EBFT trade. Several conversion steps are applied to make up for i) weight loss during commodification, ii) weight gain of farmed fish during fattening process, iii) double counting due to re-export and commodity types (no belly-meat used), iv) local consumption, v) carry-overs due to ranching. The processed fish weights were converted into round weight. The back calculations to original weight were done only for the farmed fish. Furthermore a sensitivity analysis is presented that quantifies the impact of potential error around every variable used.

Data: Eurostat, GTIS (Global Trade Information Service), and Japanese import statistics.

Assumption: Assumption for the conversion factor, EU consumption/re-exports, and fattening ratio under the hypothetical scenarios.

Weighted average conversion factors (from product weight to round weight) were calculated based on Japanese import data and ICCAT conversion factors. Weighted average factors calculated ranged from 1.43 – 1.51. Since commodity types of EBFT in the Japanese market might not be representative for commodity types in other markets, the author of the paper also present lower and higher values in the model. The conversion factors used in the model are hence 1.35, 1.45 and 1.55. Since 1.45 is the conversion factor closest to the one calculated for Japan, the author use it for their "preferred scenario.

Based on trade data, it was assumed that 75% of all EBFT import goes to Japan, 20% to Italy, Spain and France, and 5 % to other countries (Mainly South Korea and USA). For the 20% going to Italy, Spain and France, double counting due to re-exports are difficult to detect. This paper therefore eliminates all trade going to Italy, Spain and France and replaces it by a fraction of global imports. This fraction is assumed to be 10% in our "preferred scenario", a very conservative estimate given that trade data suggest 20% going to these countries.

Uncertainties;

The group discussed great uncertainties in Eurostat (e.g. live-fish trade is not properly coded before 2007). For years 2005, 2006 and 2007, no explanation is given as to the avoidance of double-counting when exports and imports records included live BFT as normal BFT Commodities between fishing and farming countries but with common trade code for bluefin tuna.

The assumptions on the share of the Japanese market in the world bluefin tuna consumption is not tested. Also procedures used to eliminate double count of import and re-export are not very clear. Besides the Group felt elimination of belly meat in trade data would not be sufficient for eliminating all double count of individuals in trade.

It was pointed out that as Japanese import statistics had a single category for "Bluefin tuna species" until 2011 (even southern bluefin tuna were combined into one category until 2002) and we cannot clearly distinguish Atlantic bluefin tuna from Pacific bluefin tuna in the import statistics (i.e. there is a possibility of including import data of other bluefin tuna in the estimation, such as Pacific bluefin from Mexico and Korea, particularly those countries have a small quota for the Atlantic pbluefin tuna). This study used imports to Japan only from countries with east Atlantic bluefin quota. The group concerned that there are increasing export of bluefin tuna to Japan through a third country, which have no bluefin quota (e.g. Thailand).

The Group discussed other sources of uncertainties on assumptions of constant shares of Japanese market throughout the period of survey, application of weighted average conversion factors estimated for Japanese market (combined products of all types to round weights) to other counties which have different market and consumption environment, and growth factor of fish during farming. The group felt that these must be verified with data before the evaluation of this method can be made.

Document SCRS/2012/134

Objectives: to analyze quota management of each flag state and the validity of SCRS growth factors of Atlantic Bluefin Tuna during the farming.

Data Source: Data from the BCDs which accompanied to all the Atlantic bluefin tuna cleared by the Japanese customs by the end of 2011. In this assessment, only validated records in the BCDs were used.

Methods: The weight at harvest recorded (in round weight) in the BCDs for farmed tuna were back-calculated applying the "ICCAT standard growth conversion factors for farmed tuna" to estimate their weight at capture. These estimated weights (at capture, at start of farming, at the harvest and at the export point) were compared with those reported in the BCDs.

Assumptions: This study covers only BCDs came with tuna imported to Japan. Therefore, the analyses would not give the whole picture of the fisheries (see the section of coverage), or estimates of total weight at captures can not be made, unless a certain assumptions are made on the share of the Japanese market and/or representativeness of the fish imported to Japan.

Uncertainties: As many BFTs had been accompanied with multiple and different BCDs, indicating fish from different origins are farmed in the same cage, these fish cannot be traced back, the identities of fish of the origins are doubtful. In order to overcome the matter, in its analysis, a growth factor was synthetically verified on the basis of a group BCD which has the same document number and farming facility.

Also, it was recognized that there was a tendency that bigger fish are farmed in a relatively short period and harvested while smaller fish are farmed in a longer period and harvested when several harvests are made from a group of fish covered by one same BCD. In this case, there was a tendency that growth factors in the initial harvesting stage looked large relative to the SCRS growth factors while growth factors in the later harvesting stage were getting to diminish because the average farming weight is the average of all the fish.

Data sources

The Group recognized the followings have been mainly used in these studies and possible sources in future; Bluefin catch documents (BCD), official export documents, import permits (customs import statistics), buyer/s records, market auction records, EUROSTAT data base, GTIS and reports by fish farmers and whole sellers.

The Group noted that most of these data sources contain relatively reliable and accurate weight information. The classifications and accuracies in records of product status of fish vary among sources and periods. It was noted that the best sources of information to track fish and to eliminate double counting would be the BCD. However this data base is not in the public domain and hence not accessible for most of the national researchers, except for the records of fish imported to their own countries.

Methods

The ICCAT conversion factors to round weights are available for belly meat, gilled and gutted, dressed, fileted, loins, etc. for farmed and wild individuals of Atlantic bluefin tuna. However, one paper presented here used average factors for compounds products.

Also the growth factors (through fattening) adopted by the ICCAT SCRS in 2009 were applied to back calculate the weight of individual farmed tuna to the round weight at capture, except two documents, where .arbitrary lower factors were used, which would provide a higher estimates for fish at capture.

Benefits and uncertainties involved in trade and market research

Benefits of studies of trade and market

The data sources are. in principle, accurate and detailed with little uncertainties., as far as the items covered in the data sources. However, due to the obvious reasons of the nature of the data, these data themselves can not substitute fishery data (e.g. catch, size data) but those can be used for verification of current fishery statistics, if data coverage is adequate, data are unbiased and a proper procedures are applied for analyses..

If the conversions (both in terms of products and growth) are correctly applied, these data could be more useful for size verifications, (if assumptions can be proved), rather than catch verifications. The data will be particularly valuable if used together with BCD.

Uncertainties in the estimates and actions for removing problems

Double counting in terms of trade

The Group recognized that double counting in terms of trade is one of the major sources of uncertainties. Repeated imports and re-exports among countries and within EU, can cause double counting of products. There are many ways to detect such double counting through careful comparison of export and import documents, it still remains as problems, at a different level of significance, in most of the studies presented at this time. The Group noted that the best way to eliminate such errors is to check against BCDs.

Double counting of the same fish when traded in different lots

There are many cases where a fish is exported to the Japanese market in pieces (e.g. belly meat, loins, collars) in different lots. The only positive solution for identifying such duplications is to examine each commodity against

BCD. If BCD is not available, careful check of individual shipping and comparisons between close shipping dates are essential. The group noted that this problem appeared more serious for farmed tuna exported to Japan.

Data coverage

The most important market for bluefin tuna is Japan and since the bluefin tuna at its market chain is very well controlled and records are reliable, the most of the studies of this nature heavily depend on the Japanese market information (including custom import statistics and auction markets). Until about 2006-7, almost all the bluefin tuna products ended up at the Japanese market and hence the sample coverage of products at the Japanese market was not a problem. Since 2008 to current, the Japanese market share of bluefin tuna products in the world market has been declining. Although it would be very difficult to estimate its share, it would be essential to have an accurate proportion of products in the Japanese market of the world. The examination of the entire BCD data base may provide such information, although the bias in products or size of fish as discussed below still remains as a problem..

An expansion of the survey to the market of other countries would be a solution but currently it would be very difficult as these markets are not as well controlled or concentrated as the Japanese market.

Sampling bias

This problem is very serious as discussed under the presentations. They are particularly serious in the light of rapidly changing structures of the Japanese market (e.g. auctions vs. direct distribution through a cold chain), and that the commercial strategies by the farming enterprises for shipping their products, in terms of timing, size of fish and quality of fish in response to the destination market conditions that change constantly. This means that any fish sampled at a certain points (imports, market, exports etc.) are subjects of bias. Therefore, sufficient coverage of all the fish is essential for understanding the fishery. Again, BCDs are very powerful tool to evaluate the bias in market sampling. It was noted that such market selectivity does not invalidate the use of traded volumes to obtain lower bounds on total catches, if substantial coverage is warrant.

Data gap by time lag among capture, harvests, exports and imports

There are always time lags among time of capture, harvest, export, import and market. For farmed tuna, further time lags are inevitable between entry to the farming and harvest. Very frequently there is a year difference between catch and import/consumption. Besides, many fish are carried over a year and often over several years in the farming cages. These time lags cause significant gaps in reported quantities of fish (which is often on annual basis)

Careful analysis of disaggregated data can in many cases minimize the uncertainty due to time lags. The accurately recorded BCDs can further help interpretations of time lags found between reported records of catches and trade.

Mix up in countries of origin

When tuna are exported to one country and re-exported to a third country, there could be some confusion to identify the country of origin. This is particularly serious when using import and export information only. Well recorded BCDs of farming with a good compliance would solve this problem. However, this could be still a problem even with BCDs, as noted in Doc. 134.

Mix up in species of Bluefin Tuna

All these studies presented, with an exception of Doc 134 used substantially, Japanese import statistics. However, even the Japanese import statistics used the same code for Atlantic and Pacific bluefin tuna until 2011 (and even for southern bluefin tuna until 2002). Therefore, certain hypothetical assumptions would be required to estimates Atlantic bluefin imports, separated from other bluefin tunas, for example by country of origins. However, increasing re-exports by a third country makes such work very difficult.

Uncertainties in growth factor through farming

In all these studies, except of Doc. 126 and 127, ICCAT growth factors (fattening rates) for various size of fish during the farming were used to back calculate the catch weight of fish from harvest weight or export weight. Validity of using the ICCAT factors for such purpose is very critical. Doc. 134 suggested that the estimated catches by back-calculations with ICCAT factors are far less than reported catches, indicating that the growth (fattening) factors applied are too high on an average.

Some participants pointed out that the growth factor adopted by ICCAT is the maximum gain in weight for BFT of a given size at caging, depending on the duration of the caging operation and the size of the fish at caging (as obtained under the best conditions). The Group considered that the growth factors are very variable depending on many other elements including stocking density, environmental factors, strategies of farmers, and harvesting activities; even during towing from fishing grounds to farms there may be a significant loss of condition reaching up to 10% of body weight. Therefore, caution should be applied to when back-calculating to determine the initial catch is conducted.

Possibly, BCDs records can provide with the range of possible rate of gain of fish in weight during the farming, as doc 134 suggested. Further biological research with association of BCDs records would have a good potential in comprehending the current growth factors.

In this respect, the Group encourage to continue with the development of modern technology (such as under water stereo camera) applied to estimate fish size and abundance..

Estimates of total catches of east Atlantic bluefin catches in recent years

The group recognized that the estimation of total catch of east Atlantic bluefin tuna (including the Mediterranean Sea) from trade information for recent years is very difficult, due to various uncertainties discussed in this report. It requires a good unbiased coverage of flows of bluefin tuna through trade, without double counting. Besides the catch estimate is a function of conversion factors from products to round weights, and growth factors (fattening factors) through farming, which are applied in back calculation.

Future research through trade and market data, and recommendations. .

After studying all these presentations, and examining the assumptions used, and uncertainties accompanied, the Group concluded that; the trade and market information could be a useful tool to get information and/or to improve by cross-checking the landing statistics and size of fish at captures, but only if the data are properly processed and verified and accurate conversion factors (such as processed weight to round weight and for fattening during farming) are available. In addition, special attention should be also paid in the sampling coverage and bias, important sources of uncertainties.

The group noted that the use of BCDs will solve many of such problems, and if properly applied with trade data, since it becomes possible to trace all the bluefin tuna from capture to the market, including farming process.

The compilation and analysis of data obtained through BCDs will clearly provide a better picture on the relationship among catch weight, caged weight, harvested weight and exported weight.

On the other hand, it should also be born in mind that BCDs have some weak points as well, as described in the uncertainties under Doc 134.

The Group listed the following recommendations;

- The group did not attempt to provide updated estimates of total BFT catches in recent years but recognized that it remains an open issue.
- Recognizing the advantage of BCDs traceability, the Group considers that it is essential that future research based on trade and market information should mainly depend on BCDs. Also, the BCD (whch provide accurate or at least minimal catch information) does assist to a great extent the scientific work of SCRS, particularly in cross-checking Task I data, as well as providing with size frequencies of fish captured.
- As the BCDs are not in the public domain, as the first step, it is recommended that the Secretariat prepare a report to summarize the information obtained from the entire BCDs, concerning the weight of bluefin tuna at each stage (i.e. capture, entry to farming, harvest, export and import).
- The second step would be a more profound analysis of BCDs in association with the information from trade data. This is a very complicated work. The Commission may decide to expand the function of the Secretariat or this, can be achieved by a team of fisheries and trade experts attached to the Commission.
- The group recommended that the growth factor (fattening rate) during farming, which was adopted by the ICCAT in 2009 be further investigated for its appropriateness and variability in applying them for back

calculation from fish weight at harvest weight to fish weight at capture. One possibility is to develop factors to back calculate, independently from the growth factors currently adopted, based on the BCDs itself. As the growth factors have a significant impact in estimating the fish weight of capture from the marketed products, the study on variability on growth factors should be made as soon as possible and if appropriate, modifications on the table should be made immediately according to its intended use.

Appendix 6

SELECTED VPA: DATA INPUTS AND RESULTS

Input - Total Catch at Age:

#	YEAR	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
	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	16532	3730	5693	3463	2613	2192	2271	2471	1393	1102	834	737	611	7371
	1982	3608	3652	1517	523	245	460	490	391	298	502	666	604	460	240	177	1603
	1983	3474	2463	3091	771	615	860	705	1102	953	773	682	585	739	705	463	2717
	1984	1126	7240	1691	1493	2005	1578	928	451	522	643	703	745	679	863	557	1787
	1985	776	5395	12162	2131	3523	3882	1959	729	480	436	457	614	838	802	1076	2223
	1986	967	5898	6478	2914	1437	1177	1136	657	436	381	303	367	608	672	867	2712
	1987	2326	12579	8766	4517	3830	3741	1240	1316	985	1037	507	414	441	492	501	1578
	1988	4935	9303	11087	3821	3362	3300	3133	1575	1064	926	903	619	547	524	527	1768
	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	1111	903	629	584	544	1515
	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	832	569	472	361	287	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	610	885	1585	1017	638	505	403	366	1552
	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	991	2963	2542	1576	1125	950	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	0	543	1597	1519	2054	1289	568	2898	2187	649	643	572	550	406	321	1134

Input - Partial Catch at Age: Canada Gulf of St Lawrence

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	2.2	6.8	39.0	51.0	67.6	170.4
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	4.9	11.0	35.3	37.4	136.1
1972	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	1.2	4.7	28.5	46.4	311.9
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	6.0	3.0	20.7	44.2	488.8
1974	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	1.1	5.1	14.8	51.7	748.3
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	535.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	2.2	10.6	842.4
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.2	4.8	5.9	729.4
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.0	0.0	0.0	2.6	5.6	467.9
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	6.3	476.1
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	3.6	5.1	620.1
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2	626.3
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	5.7	506.3
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.1	10.2	1011.6
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	545.8
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.6	2.7	266.2
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	92.7
1987	0.0	0.0	0.0	0.0	0.4	1.5	0.8	1.5	2.3	0.4	0.8	0.8	0.8	1.2	2.3	41.2
1988	0.0	1.0	0.0	0.0	1.0	5.8	21.7	64.4	33.6	139.8	330.6	156.0	42.5	28.8	28.7	260.6
1989	0.0	0.0	0.0	0.0	0.0	1.0	21.7	399.1	508.1	391.4	269.5	210.3	137.9	118.4	76.3	524.3
1990	0.0	0.0	0.0	0.0	0.0	1.0	48.7	274.5	550.4	384.9	142.0	94.4	62.9	66.1	80.7	348.5
1991	0.0	0.0	0.0	0.0	0.0	1.2	76.1	287.7	379.3	500.5	300.9	129.1	115.2	106.9	87.8	343.9
1992	0.0	0.0	0.0	0.0	3.3	2.0	32.5	149.7	188.0	183.2	240.8	242.0	161.4	106.6	106.7	407.1
1993	0.0	0.0	0.0	0.0	0.0	0.0	12.2	14.7	89.3	185.6	156.6	130.3	121.6	95.6	64.6	479.4
1994	0.0	0.0	0.0	0.0	0.0	3.1	6.0	64.8	66.2	124.3	161.4	133.9	97.7	73.6	51.6	302.3
1995	0.0	0.0	0.0	0.0	0.6	10.5	14.0	12.8	60.8	251.2	229.9	172.1	100.1	93.9	70.7	600.6
1996	0.0	0.0	0.0	0.0	0.0	1.0	21.8	40.8	57.0	69.0	135.4	187.5	131.6	98.3	96.1	597.9
1997	0.0	0.0	0.0	0.0	1.0	12.0	24.7	71.1	156.8	133.5	95.6	76.6	91.6	77.2	78.7	538.3
1998	0.0	0.0	0.0	0.0	0.0	10.2	10.2	43.2	210.8	351.1	308.3	136.6	133.6	107.4	94.9	463.7
1999	0.0	0.0	1.1	0.0	1.9	1.0	28.8	113.1	153.4	321.7	346.7	284.0	145.0	64.6	35.6	451.0
2000	0.0	0.0	0.0	0.0	1.0	3.0	4.4	20.6	107.6	138.6	134.5	160.3	150.7	121.0	71.0	680.6
2001	0.0	0.0	0.0	0.0	3.4	11.7	219.8	268.8	99.9	205.4	249.9	176.1	162.7	143.5	99.8	426.8
2002	0.0	0.0	0.0	0.0	0.0	2.8	41.2	384.4	478.2	130.7	136.1	166.8	147.6	150.1	126.7	601.0
2003	0.0	0.0	0.0	0.0	0.0	1.1	11.5	229.9	668.2	439.1	120.5	40.2	28.5	49.7	55.4	356.5
2004	0.0	0.0	0.0	0.0	4.1	16.9	98.3	332.6	349.5	268.6	148.6	135.5	86.6	48.5	79.1	528.6
2005	0.0	0.0	0.0	2.0	23.2	20.3	23.1	77.5	134.9	203.9	273.9	279.3	174.6	115.4	142.7	684.6
2006	0.0	0.0	0.0	0.0	12.8	24.5	138.0	142.3	218.2	317.2	306.6	312.1	247.3	162.8	123.9	741.0
2007	0.0	0.0	0.0	0.0	1.0	26.7	53.3	121.7	166.0	115.8	127.5	138.8	134.1	111.5	94.0	464.9
2008	0.0	2.2	2.4	43.0	370.2	761.0	469.9	296.9	180.2	65.5	26.4	16.1	44.0	63.1	72.7	492.9
2009	0.0	0.0	0.0	0.0	0.0	55.1	45.0	124.4	180.9	183.2	116.8	137.8	123.1	172.2	144.6	463.6
2010	0.0	0.0	0.0	0.0	0.0	2.6	39.2	45.3	47.6	88.9	93.4	78.4	82.4	117.7	106.8	529.3
2011	0.0	0.0	0.0	0.0	1.1	0.0	38.3	116.1	113.1	69.7	100.3	91.1	92.6	91.0	81.4	423.8

Input - Partial Catch at Age: Canada Southwest Nova Scotia

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	2.2	6.8	39.0	51.0	67.6	170.4
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	4.9	11.0	35.3	37.4	136.1
1972	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	1.2	4.7	28.5	46.4	311.9
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	6.0	3.0	20.7	44.2	488.8
1974	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	1.1	5.1	14.8	51.7	748.3
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	535.0
1976.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	2.2	10.6	842.4
1977.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	1.2	4.8	5.9	729.4
1978.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.0	0.0	0.0	2.6	5.6	467.9
1979.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	6.3	476.1
1980.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	3.6	5.1	620.1
1981.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2	626.3
1982.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	5.7	506.3
1983.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.1	10.2	1011.6
1984.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	545.8
1985.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.6	2.7	266.2
1986.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	92.7
1987.0	0.0	0.0	0.0	0.0	0.4	1.5	0.8	1.5	2.3	0.4	0.8	0.8	0.8	1.2	2.3	41.2
1988.0	0.0	1.0	0.0	0.0	1.0	5.8	21.7	64.4	33.6	139.8	330.6	156.0	42.5	28.8	28.7	260.6
1989.0	0.0	0.0	0.0	0.0	0.0	1.0	21.7	399.1	508.1	391.4	269.5	210.3	137.9	118.4	76.3	524.3
1990.0	0.0	0.0	0.0	0.0	0.0	1.0	48.7	274.5	550.4	384.9	142.0	94.4	62.9	66.1	80.7	348.5
1991.0	0.0	0.0	0.0	0.0	0.0	1.2	76.1	287.7	379.3	500.5	300.9	129.1	115.2	106.9	87.8	343.9
1992.0	0.0	0.0	0.0	0.0	3.3	2.0	32.5	149.7	188.0	183.2	240.8	242.0	161.4	106.6	106.7	407.1
1993.0	0.0	0.0	0.0	0.0	0.0	0.0	15.2	18.8	108.5	217.9	170.7	133.3	135.8	108.8	77.8	509.7
1994.0	0.0	0.0	0.0	0.0	0.0	5.1	17.0	103.7	90.2	153.2	191.3	147.9	104.7	80.5	55.6	310.3
1995.0	0.0	0.0	0.0	0.0	0.6	11.9	15.4	21.1	84.4	281.8	275.3	194.9	128.8	104.4	82.2	623.6
1996.0	0.0	0.0	0.0	0.0	0.0	1.0	21.8	40.8	57.0	72.9	153.1	207.2	152.1	114.1	103.0	623.4
1997.0	0.0	0.0	0.0	0.0	1.0	12.0	27.6	85.3	172.0	147.8	108.9	90.0	110.5	96.2	88.2	559.3
1998.0	0.0	0.0	0.0	0.0	0.0	10.2	12.0	51.0	225.6	371.5	327.7	165.9	153.9	125.6	104.8	472.9
1999.0	0.0	0.0	1.1	0.0	1.9	1.0	32.1	122.1	179.7	372.6	386.4	321.4	161.3	74.3	42.1	457.9
2000.0	0.0	0.0	0.0	0.0	1.0	3.0	4.4	20.6	110.9	143.1	143.4	167.1	159.1	130.3	79.5	683.9
2001.0	0.0	0.0	0.0	0.0	4.4	18.7	279.9	288.8	102.9	213.4	258.9	184.1	165.7	154.5	100.8	428.8
2002.0	0.0	0.0	0.0	0.0	0.0	3.6	43.2	396.9	489.4	135.1	137.3	176.0	155.6	153.7	128.7	601.0
2003.0	0.0	0.0	0.0	0.0	0.0	1.1	12.2	232.2	674.4	442.5	123.2	41.1	33.3	55.7	59.9	359.9
2004.0	0.0	0.0	0.0	0.0	6.7	20.7	103.0	346.0	359.4	274.5	149.7	139.0	87.8	48.5	80.3	528.6
2005.0	0.0	0.0	0.0	2.0	23.2	20.3	23.1	78.5	134.9	206.4	285.6	294.5	181.9	120.2	149.6	692.5
2006.0	0.0	0.0	0.0	0.0	12.8	24.5	139.0	143.3	223.2	322.2	316.6	323.1	259.3	178.8	128.9	754.0
2007.0	0.0	0.0	0.0	0.0	2.0	29.6	58.1	126.6	169.1	117.7	139.2	151.9	143.9	124.4	97.2	470.8
2008.0	0.0	2.2	4.7	65.3	392.4	774.4	494.9	374.1	211.8	72.5	31.0	16.1	44.0	63.1	72.7	492.9
2009.0	0.0	0.0	0.0	0.0	0.0	55.2	45.0	124.5	180.9	183.3	116.8	138.0	123.3	172.5	144.8	463.9
2010.0	0.0	0.0	0.0	0.0	0.0	2.6	39.2	45.3	47.6	88.9	93.4	78.4	82.4	117.7	106.8	529.3
2011.0	0.0	0.0	0.0	0.0	1.1	0.0	38.3	116.1	113.1	69.7	100.3	91.1	92.6	91.0	81.4	423.8

Input - Partial Catch at Age: U.S Rod and reel < 145 cm.

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	785.7	4118.6	290.3	160.1	66.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	2974.7	1484.2	422.4	59.4	19.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	2708.3	3009.2	619.0	117.3	50.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	1640.3	2343.8	812.7	114.9	37.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	922.4	5542.9	1084.9	299.7	185.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	741.2	5266.9	5481.7	85.2	49.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	963.3	5764.2	5250.4	678.3	47.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	2297.4	12227.9	7212.2	2193.1	669.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	4782.9	8902.5	7322.0	73.9	147.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	778.6	12588.7	1185.8	1943.2	1596.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	1952.6	2066.4	13030.1	644.8	584.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	3812.3	11614.0	8492.7	1502.2	417.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	507.4	5813.1	1423.5	121.6	256.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	396.7	1016.4	3659.6	1983.0	1005.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	2026.9	644.5	912.5	574.4	652.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	826.6	1288.1	2956.5	1834.7	2170.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	471.9	9166.2	1103.9	3267.9	2155.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	215.4	1094.7	6174.0	325.2	579.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	316.6	880.1	3230.8	2357.9	116.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	73.0	507.3	1805.4	1002.5	513.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	76.0	249.2	572.1	377.9	256.4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	1396.6	327.4	2344.5	4231.3	768.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	819.6	5476.7	4026.1	4434.9	4436.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	175.7	2084.8	3481.0	1755.9	808.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	781.6	2630.9	6703.6	2036.5	1136.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	718.9	4818.8	1865.9	1910.9	301.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	207.1	436.3	859.0	1035.6	1942.4	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	61.4	209.5	3958.4	6830.8	1173.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	62.6	684.3	1993.9	1217.0	4554.8	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	49.0	190.5	1905.3	987.1	721.7	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	55.3	990.4	734.2	1464.7	409.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	0.0	392.6	1443.0	1097.7	600.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Input - Partial Catch at Age: U.S. Rod and Reel 66-114 cm

1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	161.3	4118.6	290.3	34.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	1701.6	1484.2	409.2	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	117.1	3009.2	619.0	50.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	344.0	2343.8	812.7	29.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	191.9	5542.9	1084.9	53.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	197.7	5266.9	5481.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	382.6	5764.2	5250.4	19.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	889.1	12227.9	6630.8	264.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	8902.5	7322.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	65.6	12588.7	1185.8	245.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	919.4	2066.4	13030.1	140.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	1634.0	11614.0	8492.7	152.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	429.2	5813.1	1423.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	120.9	1016.4	3659.6	650.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	36.7	644.5	912.5	257.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	282.7	1288.1	2956.5	340.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	183.7	9166.2	1103.9	457.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	38.2	1094.7	6174.0	111.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	80.4	880.1	3230.8	673.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	29.0	507.3	1805.4	338.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	249.2	572.1	46.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	36.7	327.4	2344.5	570.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	548.6	5476.7	4026.1	235.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	120.7	2084.8	3481.0	347.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	517.6	2630.9	6703.6	44.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	371.9	4818.8	1865.9	582.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	129.1	436.3	859.0	105.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	9.4	209.5	3958.4	1754.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	18.6	684.3	1993.9	117.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	26.0	190.5	1905.3	123.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	12.3	990.4	734.2	71.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	0.0	392.6	1443.0	456.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Input - Partial Catch at Age: U.S. Rod and Reel 115-144 cm

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	125.9	66.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	13.2	52.8	19.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	67.0	50.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	85.0	37.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	246.0	185.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	85.2	49.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	658.7	47.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	581.4	1929.1	669.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	73.9	147.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	1697.3	1596.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	504.8	584.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	1349.4	417.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	121.6	256.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	1332.6	1005.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	317.1	652.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	1494.5	2170.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	2810.1	2155.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	213.4	579.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	1684.2	116.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	663.8	513.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	331.1	256.4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	3660.4	768.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	4199.7	4436.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	1408.9	808.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	1992.3	1136.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	1328.7	301.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	930.6	1942.4	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	5076.3	1173.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	1099.2	4554.8	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	864.0	721.7	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	1393.4	409.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	641.2	600.3	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Input - Partial Catch at Age: U.S. Rod and Reel > 195 cm

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.4	50.6	28.3	26.2	36.9	21.9	21.2	296.6
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.6	138.8	179.8	127.4	67.0	45.2	49.4	249.2
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.9	210.0	156.7	134.8	42.2	34.1	198.3
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	82.2	109.8	91.0	142.8	185.0	140.8	439.6
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	63.8	102.4	130.2	167.6	168.3	142.5	307.1
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	54.2	69.8	82.3	145.2	136.3	164.1	288.1
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	34.1	32.0	50.9	35.5	55.4	53.8	135.4
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.4	53.8	46.3	43.0	47.3	51.1	43.0	158.5
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	56.8	43.0	39.6	32.5	44.8	38.9	180.9
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.3	57.7	42.1	61.5	48.2	46.1	46.9	206.6
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.3	119.3	47.0	58.3	47.1	70.0	85.0	399.2
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.9	62.6	73.0	111.7	76.4	89.0	105.1	251.3
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	60.0	72.2	117.3	127.7	119.0	83.5	351.8
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28.5	199.5	135.5	78.0	69.9	75.1	73.3	251.7
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.3	163.0	121.5	191.8	107.2	114.8	75.7	199.4
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.1	360.8	257.5	162.7	138.2	143.6	156.8	450.3
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.3	121.4	138.5	167.0	127.0	111.0	98.1	262.2
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	81.9	406.3	189.9	209.6	277.7	276.9	233.3	476.7
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.9	243.1	232.1	154.5	188.0	225.4	198.1	391.8
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.1	288.9	452.2	471.2	275.7	264.0	253.2	474.6
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	72.6	232.0	344.6	348.0	345.1	365.8	194.7	336.6
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.7	185.4	455.1	435.0	647.6	566.3	400.7	658.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.3	131.4	284.6	271.8	415.3	595.0	516.3	681.3
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.7	144.1	156.3	121.1	225.9	265.7	317.9	503.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.4	89.6	129.3	87.6	71.8	84.3	85.4	226.4
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5	68.9	76.7	79.4	79.7	60.9	37.5	122.6
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.8	27.1	42.4	33.9	33.5	23.9	149.4
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	19.5	39.2	34.7	29.7	17.0	19.3	94.8
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	25.6	18.0	18.8	15.2	33.4	21.6	106.2
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.4	63.7	58.5	60.6	33.8	43.3	45.9	379.3
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	37.1	283.1	304.1	139.9	89.0	106.5	126.5	261.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	74.0	194.0	141.0	179.0	169.0	116.0	87.0	244.0

Input - Partial Catch at Age: U.S. Rod and Reel > 177 cm

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	72.3	50.6	28.3	26.2	36.9	21.9	21.2	296.6
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	44.8	138.8	179.8	127.4	67.0	45.2	49.4	249.2
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.4	56.4	100.9	210.0	156.7	134.8	42.2	34.1	198.3
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	126.5	82.2	109.8	91.0	142.8	185.0	140.8	439.6
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.2	68.4	63.8	102.4	130.2	167.6	168.3	142.5	307.1
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.1	56.1	54.2	69.8	82.3	145.2	136.3	164.1	288.1
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.8	43.6	34.1	32.0	50.9	35.5	55.4	53.8	135.4
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.6	41.7	53.8	46.3	43.0	47.3	51.1	43.0	158.5
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.6	63.6	56.8	43.0	39.6	32.5	44.8	38.9	180.9
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	196.7	147.8	57.7	42.1	61.5	48.2	46.1	46.9	206.6
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.5	136.3	119.3	47.0	58.3	47.1	70.0	85.0	399.2
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.5	61.4	62.6	73.0	111.7	76.4	89.0	105.1	251.3
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.2	208.6	60.0	72.2	117.3	127.7	119.0	83.5	351.8
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	104.2	124.2	199.5	135.5	78.0	69.9	75.1	73.3	251.7
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	295.8	526.1	163.0	121.5	191.8	107.2	114.8	75.7	199.4
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	146.5	232.3	360.8	257.5	162.7	138.2	143.6	156.8	450.3
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	619.6	253.3	121.4	138.5	167.0	127.0	111.0	98.1	262.2
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	448.1	657.5	406.3	189.9	209.6	277.7	276.9	233.3	476.7
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	279.7	786.5	243.1	232.1	154.5	188.0	225.4	198.1	391.8
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	377.5	290.2	288.9	452.2	471.2	275.7	264.0	253.2	474.6
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	204.3	232.0	344.6	348.0	345.1	365.8	194.7	336.6
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	308.2	121.9	185.4	455.1	435.0	647.6	566.3	400.7	658.1
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	401.3	280.8	131.4	284.6	271.8	415.3	595.0	516.3	681.3
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	183.9	211.6	144.1	156.3	121.1	225.9	265.7	317.9	503.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.0	72.6	89.6	129.3	87.6	71.8	84.3	85.4	226.4
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7	94.9	68.9	76.7	79.4	79.7	60.9	37.5	122.6
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.0	11.8	21.8	27.1	42.4	33.9	33.5	23.9	149.4
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.3	60.2	19.5	39.2	34.7	29.7	17.0	19.3	94.8
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	147.1	39.0	25.6	18.0	18.8	15.2	33.4	21.6	106.2
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.2	107.7	63.7	58.5	60.6	33.8	43.3	45.9	379.3
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	556.9	219.6	283.1	304.1	139.9	89.0	106.5	126.5	261.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	381.0	480.0	194.0	141.0	179.0	169.0	116.0	87.0	244.0

Input - Partial Catch at Age: Japanese Longline

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0	42.9	60.6	42.9	55.0	58.6	27.9	13.7
1971	12.7	243.5	31.0	131.5	89.2	271.5	830.4	1524.9	1114.0	698.5	679.2	537.9	393.0	228.9	112.1	240.3
1972	26.6	49.2	52.4	15.2	130.6	49.9	40.6	94.0	327.1	188.0	46.2	65.8	67.1	59.7	23.7	108.3
1973	83.9	427.2	542.6	458.1	665.7	249.7	218.0	571.6	1076.7	670.1	169.6	275.8	301.0	260.6	85.8	236.6
1974	104.3	2549.1	2668.8	1555.6	494.2	96.9	449.3	599.3	517.4	493.4	438.5	419.1	387.7	247.0	257.4	323.8
1975	2.3	36.9	54.1	76.4	186.5	20.3	16.0	159.4	334.5	614.4	1146.3	910.2	855.3	821.1	841.6	1837.4
1976	174.7	1175.9	5491.0	2375.3	2501.7	981.8	173.4	104.2	617.1	569.5	346.4	675.8	1462.3	1816.5	1664.4	4156.8
1977	57.6	411.2	5173.4	9268.8	2230.2	1777.2	1702.0	394.4	151.8	238.7	207.5	330.5	466.7	928.8	1350.5	5898.1
1978	78.6	187.4	1392.0	2719.1	2454.2	2611.0	967.0	385.2	309.1	169.0	171.8	316.1	453.3	460.1	906.3	6193.2
1979	46.6	332.0	1410.4	1208.8	669.1	1536.8	2512.9	1712.7	509.8	298.9	296.4	389.7	649.7	909.5	1105.4	4975.9
1980	133.8	476.8	1752.6	2661.3	1222.4	1322.1	2256.9	4582.3	3070.2	767.7	483.6	453.5	511.4	594.3	979.7	6883.0
1981	354.4	1453.4	8404.4	3335.0	4344.5	3033.1	2513.5	2042.5	1679.2	1005.4	438.9	654.6	578.2	544.8	442.2	5210.7
1982	14.2	78.2	156.0	224.5	152.4	351.9	370.0	280.4	135.8	186.0	125.6	96.6	123.9	87.0	39.8	100.9
1983	6.0	119.5	2150.5	577.0	550.0	773.5	559.5	921.5	528.5	365.0	223.0	114.0	113.0	47.0	35.0	44.0
1984	56.3	1523.3	602.3	1188.5	1805.3	1480.5	767.3	351.6	308.0	277.0	178.9	102.5	60.5	108.6	2.0	110.2
1985	34.9	127.6	6652.9	2013.4	3462.8	3695.3	1740.2	590.0	358.4	244.8	154.6	112.1	180.1	66.8	238.5	331.5
1986	3.5	133.0	1221.8	2209.9	1340.2	1043.3	972.3	496.3	326.3	270.9	71.9	38.7	55.1	37.9	27.7	72.8
1987	7.3	346.4	1436.2	1958.8	3020.0	3436.8	1023.2	989.8	719.9	621.0	164.9	107.8	18.2	27.4	29.5	60.9
1988	56.2	260.3	3308.8	3227.2	2767.5	2412.6	2485.6	1132.6	741.4	331.5	159.2	80.1	84.4	23.1	55.7	134.4
1989	0.0	176.6	128.8	461.3	633.3	748.5	730.3	763.7	519.2	204.7	89.9	72.3	64.3	42.4	18.1	95.0
1990	0.0	91.7	697.5	329.3	1224.7	1187.0	740.2	573.8	598.8	388.3	211.4	72.5	73.1	9.0	22.5	103.1
1991	0.0	147.9	460.6	822.2	1384.7	1179.4	1370.1	908.4	421.0	302.4	184.2	165.3	92.0	21.9	7.1	109.0
1992	10.2	13.6	255.1	284.0	743.3	802.9	524.7	811.4	842.6	200.9	138.8	74.4	80.3	62.5	38.3	87.0
1993	0.0	10.0	322.8	860.8	1008.8	1283.3	1182.7	490.0	540.0	444.0	187.8	68.8	38.0	28.6	13.0	96.5
1994	0.0	72.5	239.5	1220.8	1811.1	1554.7	535.2	418.7	439.1	217.3	63.5	61.5	22.6	9.0	0.0	4.5
1995	53.6	53.6	120.5	389.5	605.1	2448.2	995.2	50.4	200.2	89.7	0.0	0.0	0.0	0.0	0.0	0.0
1996	5.5	175.5	407.5	696.9	1020.5	524.5	886.4	654.8	234.6	44.3	106.6	94.7	69.8	48.8	20.9	63.1
1997	0.0	0.0	65.8	131.5	635.0	495.6	824.7	463.8	505.7	116.1	34.4	26.4	15.9	31.8	7.9	15.9
1998	0.0	0.0	142.8	714.3	461.9	840.7	601.7	680.2	837.0	1133.6	301.8	140.8	23.8	93.5	4.2	105.6
1999	0.0	25.2	26.8	397.9	1061.8	532.5	573.0	580.2	293.9	110.0	73.4	57.3	86.9	33.6	11.9	17.5
2000	0.0	10.9	13.5	231.6	1908.8	1285.2	730.8	445.7	270.7	76.9	12.2	27.9	7.9	18.8	9.2	31.6
2001	23.5	5.9	14.7	29.3	100.5	213.5	812.0	842.0	295.9	268.8	172.4	255.7	103.3	73.0	73.2	87.5
2002	10.7	20.9	30.8	81.6	34.6	67.9	283.5	1128.0	967.6	769.1	284.9	140.2	107.9	43.4	9.3	73.6
2003	0.0	9.7	10.2	158.2	203.1	162.6	88.0	51.3	25.2	15.0	10.1	10.0	0.1	0.0	0.0	0.0
2004	0.0	0.0	0.0	230.5	1378.3	2208.0	1047.2	488.2	200.4	238.1	70.1	84.9	15.4	45.7	0.7	15.4
2005	0.0	40.1	590.2	605.7	641.3	396.0	499.5	580.4	303.7	107.8	176.2	115.9	43.3	9.4	28.2	23.8
2006	0.0	128.4	271.1	542.1	328.1	1141.3	585.8	549.1	905.3	562.7	270.7	235.8	148.2	85.1	115.4	245.3
2007	0.0	3.0	2430.0	1894.7	666.1	603.5	365.4	213.9	152.8	65.9	70.4	80.2	32.1	29.1	14.6	58.3
2008	0.0	3.1	4.2	215.3	573.3	344.7	833.5	715.4	560.8	391.7	311.4	238.2	216.7	68.3	73.0	102.5
2009	1.6	0.0	5.6	0.0	0.0	0.0	0.0	64.7	193.7	169.0	106.5	74.5	34.3	26.1	19.7	38.3
2010	0.0	0.0	0.0	35.0	77.7	15.8	129.0	223.5	262.8	436.7	358.6	206.8	121.2	63.0	59.1	101.7
2011	0.0	0.0	0.0	41.8	952.9	413.8	288.9	1323.2	932.6	192.1	161.2	162.1	158.9	98.5	53.0	111.0

Input - Partial Catch at Age: U.S. GOM Larval Survey

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	1.0	2.0	0.0	0.0	3.0	12.0	45.0	107.0	146.0	159.0	149.0	125.0	125.0	294.0
1976	0.0	0.0	0.0	0.0	2.0	1.0	5.0	7.0	29.0	34.0	83.0	172.0	387.0	413.0	404.0	1042.0
1977	0.0	0.0	0.0	0.0	0.0	3.0	2.0	2.0	10.0	24.0	26.0	84.0	137.0	250.0	338.0	1607.0
1978	0.0	0.0	0.0	0.0	0.0	2.0	4.0	2.0	4.0	32.0	50.0	196.0	418.0	368.0	680.0	5030.0
1979	0.0	0.0	0.0	1.0	0.0	3.0	0.0	0.0	2.0	6.0	17.0	66.0	178.0	236.0	264.0	1300.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	4.0	9.0	36.0	62.0	83.0	252.0	1711.0
1981	0.0	0.0	0.0	0.0	1.0	1.0	1.0	2.0	6.0	10.0	7.0	17.0	48.0	49.0	54.0	463.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	17.6	11.6	10.7	17.3	53.3	33.1	6.5	45.6
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.5	52.7	5.6	21.6	10.3	140.0	28.1
2007	0.0	0.0	0.0	1.0	1.0	11.6	0.0	12.8	9.0	15.8	52.3	11.3	40.5	17.8	54.2	54.8
2008	0.0	0.0	0.0	0.0	0.9	0.9	0.0	22.9	20.6	48.2	77.2	29.3	8.5	11.7	82.8	65.9
2009	0.0	0.0	0.0	2.0	0.0	2.5	0.0	21.6	1.8	10.9	50.7	30.1	26.1	27.3	63.8	109.3
2010	0.0	0.0	0.0	0.0	0.0	11.9	0.0	2.0	3.9	0.0	19.5	13.5	21.0	24.6	22.6	80.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	2.0	1.0	1.6	7.9	5.9	9.3

Input - Partial Catch at Age: U.S. GOM Pelagic Longline

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	17.6	11.6	10.7	17.3	53.3	33.1	6.5	45.6
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.5	52.7	5.6	21.6	10.3	140.0	28.1
2007	0.0	0.0	0.0	1.0	1.0	11.6	0.0	12.8	9.0	15.8	52.3	11.3	40.5	17.8	54.2	54.8
2008	0.0	0.0	0.0	0.0	0.9	0.9	0.0	22.9	20.6	48.2	77.2	29.3	8.5	11.7	82.8	65.9
2009	0.0	0.0	0.0	2.0	0.0	2.5	0.0	21.6	1.8	10.9	50.7	30.1	26.1	27.3	63.8	109.3
2010	0.0	0.0	0.0	0.0	0.0	11.9	0.0	2.0	3.9	0.0	19.5	13.5	21.0	24.6	22.6	80.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	2.0	1.0	1.6	7.9	5.9	9.3

Input - Partial Catch at Age: Japanese Longline – Gulf of Mexico

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	0.0	0.0	1.0	2.0	0.0	0.0	3.0	12.0	45.0	107.0	146.0	159.0	149.0	125.0	125.0	294.0
1976	0.0	0.0	0.0	0.0	2.0	1.0	5.0	7.0	29.0	34.0	83.0	172.0	387.0	413.0	404.0	1042.0
1977	0.0	0.0	0.0	0.0	0.0	3.0	2.0	2.0	10.0	24.0	26.0	84.0	137.0	250.0	338.0	1607.0
1978	0.0	0.0	0.0	0.0	0.0	2.0	4.0	2.0	4.0	32.0	50.0	196.0	418.0	368.0	680.0	5030.0
1979	0.0	0.0	0.0	1.0	0.0	3.0	0.0	0.0	2.0	6.0	17.0	66.0	178.0	236.0	264.0	1300.0
1980	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	4.0	9.0	36.0	62.0	83.0	252.0	1711.0
1981	0.0	0.0	0.0	0.0	1.0	1.0	1.0	2.0	6.0	10.0	7.0	17.0	48.0	49.0	54.0	463.0
1982	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Input - Partial Catch at Age: Tagging Index

Year	Age1	Age2	Age3	Age4	Age5	Age6	Age7	Age8	Age9	Age10	Age11	Age12	Age13	Age14	Age15	Age16
1970	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1971	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1972	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1974	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1975	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1976	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1979	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1980	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1981	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1982	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1983	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1984	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1985	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1986	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1987	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1988	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1989	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1994	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1995	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1997	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1998	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1999	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2000	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2001	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2002	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2003	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2004	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2005	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2008	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	1.0	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Input - Weight at 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	3.2	8.3	16.9	35.5	47.7	67.0	85.4	113.3	145.5	154.6	173.7	198.7	223.2	248.0	264.6	327.7
1971	3.5	8.3	20.9	31.4	51.2	69.9	86.7	106.9	126.8	149.1	172.5	198.5	224.1	248.8	273.0	317.2
1972	4.4	9.7	19.2	37.7	51.6	62.4	90.0	112.5	129.3	149.6	176.8	202.2	227.6	246.9	271.5	330.9
1973	3.7	8.9	20.7	38.2	47.9	69.2	89.0	115.6	134.1	152.9	180.0	208.2	230.8	249.7	277.7	333.9
1974	3.6	10.0	17.1	34.9	49.4	64.2	87.7	101.5	131.8	151.3	170.0	196.8	219.9	247.5	263.3	323.1
1975	3.9	8.6	22.4	32.6	47.1	66.9	83.8	110.5	134.7	152.3	168.0	193.8	216.4	243.3	264.6	321.6
1976	4.0	10.2	18.8	32.1	45.1	64.2	91.8	113.9	144.2	160.4	176.0	195.7	218.1	236.7	256.8	322.2
1977	4.8	10.3	20.5	33.8	45.6	63.0	81.3	102.9	128.3	150.5	173.0	195.6	218.2	241.3	258.4	325.9
1978	5.1	10.9	21.5	31.0	47.0	64.4	83.6	108.9	138.7	163.1	185.7	200.1	219.0	242.2	259.2	339.2
1979	5.3	11.2	21.6	35.7	44.2	65.7	84.8	108.1	133.9	160.4	183.2	202.1	220.0	240.0	260.0	337.9
1980	5.0	12.2	20.7	32.5	46.8	69.5	91.7	112.9	136.2	167.6	191.8	215.4	237.2	255.2	267.4	343.0
1981	5.6	11.1	21.5	32.2	45.5	65.5	85.7	108.9	133.9	158.1	184.0	205.0	226.1	240.9	259.8	371.8
1982	4.1	10.8	20.8	31.6	52.6	68.1	89.2	113.2	139.4	160.6	186.8	208.8	233.7	251.0	271.8	392.4
1983	4.0	10.1	19.6	33.6	50.5	66.9	91.5	115.4	140.5	163.9	188.3	213.9	236.5	257.0	279.3	377.5
1984	5.3	11.3	22.9	35.7	51.0	74.3	92.8	114.9	139.7	162.1	186.8	208.0	234.0	262.6	281.8	382.0
1985	4.6	10.2	17.2	31.2	43.6	61.9	79.6	101.6	125.7	152.6	178.8	201.8	223.0	246.5	265.1	337.7
1986	5.3	10.3	19.7	38.1	50.6	70.1	91.9	114.9	137.9	162.7	182.3	204.6	229.2	253.2	278.7	350.4
1987	5.1	9.8	22.3	36.6	49.9	67.2	85.6	109.7	130.4	155.5	180.4	202.5	230.0	258.8	279.7	349.1
1988	3.9	11.2	20.1	34.6	49.8	67.7	87.0	110.5	133.0	157.7	182.8	208.5	232.3	251.8	280.5	354.3
1989	4.5	11.1	21.5	36.0	47.8	68.4	90.0	111.9	134.0	160.9	182.9	205.2	229.8	254.9	277.0	356.3
1990	5.2	12.2	18.8	35.1	47.0	66.4	85.8	112.0	138.0	162.8	185.2	206.4	231.3	253.3	278.5	347.0
1991	5.4	13.5	19.6	36.9	53.4	70.2	93.3	114.3	142.2	166.1	184.5	205.7	232.9	255.7	277.6	348.7
1992	5.9	12.7	19.0	35.9	50.1	71.1	88.6	110.3	134.9	160.8	183.6	205.6	231.7	252.1	275.4	347.6
1993	5.1	11.6	23.8	33.4	51.2	66.9	89.3	110.9	135.7	157.9	182.2	204.8	227.2	250.5	275.5	364.0
1994	4.7	12.0	22.1	31.9	45.5	62.8	82.9	109.2	132.4	157.3	183.8	203.8	226.7	249.7	269.6	350.7
1995	4.9	13.6	22.4	35.1	48.6	71.0	89.6	109.2	137.5	160.0	182.2	204.7	228.3	251.2	273.3	369.7
1996	5.2	11.1	22.8	34.8	48.7	69.9	92.6	113.2	137.7	159.8	187.9	209.8	234.8	257.8	282.5	361.9
1997	5.0	12.7	20.3	36.3	51.2	68.4	91.2	112.0	135.7	157.2	183.6	207.7	233.4	257.2	276.9	356.0
1998	5.0	11.7	20.5	32.7	52.6	68.8	90.9	116.6	139.3	162.0	182.9	207.5	233.2	254.4	275.1	352.5
1999	5.4	11.2	21.8	35.5	54.0	71.6	93.7	113.9	136.2	159.0	184.1	206.7	230.9	254.1	276.9	355.4
2000	4.8	11.8	19.1	34.1	46.5	73.2	90.8	110.8	139.0	159.5	188.7	211.8	236.2	264.3	284.5	376.5
2001	4.7	12.8	22.5	33.9	49.1	68.2	95.0	116.0	141.8	166.0	190.7	215.1	242.8	265.5	289.9	352.6
2002	6.3	10.9	19.9	35.2	48.0	63.7	90.7	114.1	137.9	160.9	186.7	209.6	238.1	265.8	284.8	352.4
2003	5.7	11.5	21.6	34.0	50.7	69.2	92.1	115.3	137.4	158.8	184.1	210.2	241.6	265.2	286.9	342.3
2004	6.3	11.9	21.9	35.5	46.1	64.9	89.1	111.4	134.7	158.9	184.6	210.1	230.6	259.7	277.5	344.9
2005	5.4	9.8	19.8	30.7	47.6	62.3	82.6	105.7	132.2	160.1	184.0	207.9	232.0	254.6	276.6	349.0
2006	5.5	12.6	17.8	33.3	46.9	64.0	84.6	109.6	128.0	155.1	182.2	206.8	232.0	255.9	269.4	348.3
2007	4.5	11.8	22.4	30.4	49.6	63.5	82.4	111.8	136.6	162.1	186.4	211.8	237.7	262.7	278.8	365.8
2008	4.6	11.9	21.8	36.7	49.1	70.1	93.3	114.7	138.3	157.9	179.4	207.8	231.3	259.4	278.9	377.8
2009	5.4	13.2	21.8	34.4	51.3	69.4	83.9	112.1	133.4	156.4	180.3	207.5	235.6	260.5	277.3	372.5
2010	5.1	11.0	22.0	35.6	49.0	67.9	89.4	113.0	133.6	157.3	182.6	210.6	237.2	264.1	286.5	366.3
2011	5.1	10.8	23.1	31.6	48.2	64.1	87.8	111.1	135.1	159.6	184.2	212.1	239.0	264.4	288.0	361.6

Result - Goodness of fit statistics.
Total objective function = 2.02
(with constants) = 333.26
Number of parameters (P) = 28
Number of data points (D)= 245
AIC : 2*objective+2P = 722.53
AICc: 2*objective+2P(...)= 730.05
BIC : 2*objective+Plog(D)= 820.56
Chi-square discrepancy = 223.24

Loglikelihoods (deviance)= -12.92 (245.12)
effort data = -12.92 (245.12)

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

Constraints = 10.90
terminal F = 10.90
stock-rec./sex ratio = 0.00

Out of bounds penalty = 0.00

Result – Fishing Mortality at 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	0.190	0.827	0.908	0.518	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	0.775	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	0.635	0.528	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	0.374	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	0.232	0.104	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	0.331	0.590	0.080	0.215	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	0.227	0.597	0.038	0.059	0.028	0.010	0.010	0.077	0.079	0.043	0.059	0.160	0.155	0.122	0.122
1977	0.015	0.238	0.146	0.468	0.149	0.072	0.084	0.031	0.031	0.083	0.140	0.107	0.072	0.137	0.154	0.154
1978	0.065	0.125	0.306	0.103	0.223	0.188	0.045	0.017	0.027	0.030	0.035	0.066	0.074	0.062	0.189	0.189
1979	0.031	0.159	0.256	0.207	0.287	0.067	0.097	0.077	0.025	0.028	0.051	0.093	0.190	0.208	0.213	0.213
1980	0.044	0.230	0.207	0.193	0.136	0.063	0.105	0.212	0.178	0.054	0.057	0.104	0.165	0.241	0.294	0.294
1981	0.088	0.170	0.364	0.104	0.188	0.151	0.134	0.127	0.142	0.175	0.095	0.133	0.198	0.281	0.328	0.328
1982	0.049	0.063	0.034	0.016	0.008	0.019	0.027	0.025	0.021	0.040	0.061	0.051	0.071	0.075	0.094	0.094
1983	0.037	0.040	0.066	0.020	0.022	0.034	0.035	0.073	0.074	0.067	0.065	0.066	0.076	0.139	0.190	0.190
1984	0.013	0.094	0.033	0.039	0.063	0.069	0.044	0.027	0.042	0.061	0.075	0.088	0.095	0.113	0.145	0.145
1985	0.009	0.076	0.211	0.049	0.113	0.156	0.107	0.042	0.034	0.042	0.053	0.082	0.127	0.146	0.187	0.187
1986	0.010	0.078	0.115	0.067	0.040	0.047	0.058	0.045	0.030	0.032	0.035	0.052	0.102	0.134	0.216	0.216
1987	0.029	0.168	0.150	0.103	0.110	0.130	0.060	0.084	0.082	0.087	0.051	0.058	0.076	0.105	0.131	0.131
1988	0.040	0.143	0.206	0.085	0.098	0.123	0.144	0.095	0.084	0.097	0.095	0.076	0.095	0.114	0.147	0.147
1989	0.008	0.132	0.030	0.077	0.069	0.053	0.077	0.131	0.125	0.110	0.112	0.121	0.111	0.145	0.166	0.166
1990	0.030	0.039	0.252	0.041	0.067	0.072	0.050	0.077	0.131	0.157	0.115	0.118	0.106	0.104	0.161	0.161
1991	0.050	0.176	0.137	0.059	0.054	0.055	0.077	0.093	0.114	0.153	0.152	0.154	0.142	0.131	0.140	0.140
1992	0.008	0.092	0.031	0.018	0.027	0.045	0.039	0.086	0.119	0.089	0.130	0.183	0.198	0.205	0.142	0.142
1993	0.006	0.017	0.083	0.067	0.046	0.039	0.067	0.067	0.117	0.149	0.100	0.103	0.118	0.113	0.120	0.120
1994	0.028	0.013	0.024	0.050	0.060	0.044	0.038	0.077	0.156	0.092	0.112	0.122	0.108	0.129	0.103	0.103
1995	0.010	0.021	0.068	0.069	0.082	0.128	0.038	0.024	0.055	0.149	0.110	0.097	0.100	0.120	0.158	0.158
1996	0.007	0.117	0.032	0.124	0.096	0.039	0.052	0.082	0.037	0.048	0.126	0.128	0.131	0.128	0.169	0.169
1997	0.004	0.017	0.103	0.021	0.045	0.054	0.058	0.084	0.082	0.063	0.055	0.097	0.136	0.176	0.184	0.184
1998	0.005	0.018	0.065	0.070	0.017	0.046	0.032	0.075	0.139	0.147	0.093	0.081	0.140	0.182	0.175	0.175
1999	0.001	0.009	0.046	0.042	0.043	0.024	0.036	0.095	0.091	0.143	0.142	0.150	0.159	0.207	0.200	0.200
2000	0.001	0.004	0.019	0.033	0.101	0.095	0.061	0.077	0.084	0.099	0.108	0.113	0.129	0.161	0.194	0.194
2001	0.019	0.005	0.043	0.098	0.033	0.045	0.066	0.102	0.053	0.079	0.127	0.181	0.167	0.168	0.202	0.202
2002	0.013	0.091	0.074	0.101	0.133	0.052	0.041	0.142	0.152	0.143	0.118	0.132	0.215	0.189	0.209	0.209
2003	0.002	0.050	0.093	0.083	0.052	0.054	0.016	0.067	0.137	0.129	0.101	0.058	0.105	0.151	0.159	0.159
2004	0.007	0.025	0.165	0.066	0.077	0.100	0.065	0.088	0.062	0.083	0.078	0.087	0.080	0.076	0.116	0.116
2005	0.016	0.047	0.027	0.079	0.034	0.029	0.029	0.054	0.060	0.053	0.102	0.134	0.124	0.086	0.116	0.116
2006	0.005	0.016	0.014	0.023	0.095	0.076	0.043	0.054	0.093	0.112	0.085	0.102	0.095	0.097	0.135	0.135
2007	0.001	0.007	0.221	0.131	0.032	0.088	0.056	0.032	0.035	0.029	0.052	0.046	0.056	0.056	0.078	0.078
2008	0.002	0.012	0.079	0.094	0.118	0.029	0.111	0.106	0.070	0.062	0.068	0.056	0.052	0.054	0.093	0.093
2009	0.001	0.006	0.038	0.050	0.055	0.108	0.033	0.055	0.072	0.063	0.063	0.059	0.056	0.066	0.101	0.101
2010	0.001	0.011	0.027	0.038	0.032	0.042	0.020	0.049	0.069	0.090	0.099	0.070	0.066	0.089	0.100	0.100
2011	0.001	0.008	0.019	0.059	0.051	0.079	0.046	0.103	0.069	0.076	0.073	0.064	0.075	0.076	0.082	0.082

Result- Abundance at Age at Beginning of Year

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	363697	196708	226202	46153	40517	46189	38685	43465	52612	43505	25793	30856	31215	25646	17362	38032
1971	322112	261413	74762	79344	23908	29155	38823	33200	37636	45698	37580	22018	26419	26527	21614	46399
1972	278368	222393	87195	29955	26371	20360	24541	32488	27316	31621	39022	31921	18399	22008	22046	56290
1973	150701	199845	102419	44688	23702	19241	16563	21249	27806	23314	27217	33752	27375	15316	18153	65035
1974	465421	126297	105572	61251	33384	18508	14455	14038	17866	22991	19496	23415	28871	23200	12667	69823
1975	164002	352711	91261	72797	48002	26257	14743	11971	11516	14978	19420	16140	19875	24541	18283	63080
1976	134799	102389	170010	73239	51062	40886	22166	12553	10171	9622	12300	15682	13047	16273	20215	64957
1977	111875	112038	70962	81323	61272	41838	34555	19084	10804	8189	7733	10246	12848	9667	12121	65516
1978	94538	95855	76792	53308	44295	45891	33859	27629	16083	9105	6554	5842	8004	10397	7328	57852
1979	99236	77007	73536	49151	41794	30813	33072	28140	23603	13604	7681	5504	4755	6459	8491	46898
1980	80743	83639	57104	49497	34754	27277	25055	26106	22652	20003	11502	6343	4359	3417	4559	38908
1981	79956	67172	57771	40358	35479	26373	22269	19617	18366	16488	16484	9442	4971	3213	2334	28157
1982	81497	63657	49271	34887	31615	25552	19707	16929	15015	13855	12037	13034	7183	3546	2109	19099
1983	103201	67491	51941	41422	29842	27257	21786	16676	14353	12776	11577	9844	10769	5817	2860	16782
1984	92009	86484	56380	42277	35292	25370	22895	18283	13472	11591	10387	9430	8014	8674	4401	14119
1985	97312	78940	68448	47440	35364	28815	20587	19040	15474	11226	9478	8376	7504	6335	6738	13921
1986	100847	83877	63605	48203	39258	27466	21440	16075	15873	13006	9353	7814	6710	5744	4761	14893
1987	88453	86772	67429	49269	39193	32791	22782	17582	13363	13394	10952	7849	6452	5268	4369	13761
1988	134320	74731	63740	50468	38629	30509	25028	18651	14060	10700	10679	9049	6438	5199	4122	13828
1989	116810	112177	56316	45108	40318	30454	23454	18844	14749	11233	8441	8443	7291	5088	4032	13470
1990	110211	100766	85499	47522	36326	32706	25098	18881	14373	11320	8751	6561	6503	5672	3827	12895
1991	89498	93026	84265	57795	39640	29526	26446	20756	15197	10964	8415	6785	5070	5085	4445	12380
1992	76928	73978	67806	63888	47376	32651	24287	21282	16438	11782	8177	6282	5058	3823	3877	12712
1993	71082	66329	58648	57158	54561	40081	27145	20303	16976	12687	9373	6242	4550	3608	2707	12509
1994	80360	61408	56671	46905	46449	45314	33514	22069	16504	13131	9504	7374	4897	3517	2801	11728
1995	105261	67950	52715	48117	38785	38039	37692	28061	17772	12272	10409	7390	5673	3821	2686	11390
1996	80001	90640	57819	42810	39058	31056	29108	31548	23827	14626	9195	8103	5831	4462	2947	10454
1997	63203	69059	70101	48704	32885	30846	25954	24016	25269	19964	12123	7049	6199	4445	3412	9836
1998	78339	54714	59010	54995	41477	27343	25418	21300	19188	20245	16296	9976	5562	4704	3240	9579
1999	80650	67787	46738	48055	44568	35451	22713	21393	17180	14523	15195	12908	7998	4202	3410	9356
2000	81597	70019	58410	38820	40055	37107	30076	19054	16908	13631	10948	11462	9662	5934	2970	9091
2001	80308	70846	60604	49798	32655	31474	29349	24600	15335	13512	10730	8540	8904	7383	4392	8639
2002	68981	68485	61254	50450	39243	27470	26148	23888	19314	12647	10853	8218	6198	6549	5426	9252
2003	134999	59180	54365	49453	39646	29855	22666	21810	18011	14427	9529	8389	6261	4344	4712	10354
2004	131369	117099	48931	43055	39585	32722	24589	19401	17737	13654	11023	7491	6880	4899	3246	11171
2005	49309	113449	99310	36082	35023	31852	25742	20023	15450	14490	10922	8867	5970	5523	3946	11166
2006	43473	42196	94074	84036	28984	29439	26908	21738	16498	12649	11942	8572	6740	4583	4407	11695
2007	84741	37597	36097	80624	71431	22916	23728	22403	17899	13065	9831	9532	6731	5328	3615	12230
2008	44558	73609	32445	25167	61455	60126	18253	19498	18858	15025	11029	8110	7912	5534	4380	12744
2009	123732	38657	63259	26073	19923	47471	50768	14196	15248	15287	12271	8958	6664	6528	4558	13563
2010	81965	107500	33400	52954	21555	16401	37045	42684	11678	12339	12474	10012	7345	5480	5315	14242
2011	1190	71195	92435	28255	44331	18147	13670	31562	35337	9472	9801	9827	8118	5977	4356	15389

Result – Spawning Stock Biomass and Recruitment

YEAR	Spawning Stock Biomass	Recruits (Age 1)
1970	51074	363697
1971	50820	322112
1972	51227	278368
1973	51500	150701
1974	46209	465421
1975	40993	164002
1976	36133	134799
1977	30995	111875
1978	27696	94538
1979	24503	99236
1980	22215	80743
1981	19091	79956
1982	17957	81497
1983	17203	103201
1984	16337	92009
1985	14724	97312
1986	15076	100847
1987	14454	88453
1988	14328	134320
1989	13889	116810
1990	13308	110211
1991	13007	89498
1992	12614	76928
1993	12764	71082
1994	12640	80360
1995	13186	105261
1996	14287	80001
1997	15241	63203
1998	15466	78339
1999	14920	80650
2000	14949	81597
2001	14517	80308
2002	14103	68981
2003	13861	134999
2004	14077	131369
2005	14200	49309
2006	14141	43473
2007	15326	84741
2008	16140	44558
2009	16228	123732
2010	15895	81965
2011	18426	1190

Result – Fit to Canada GSL Index

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1981	-0.14	-0.515	0.375	0.639	2.31E-05	0.869	0.597	0.069
1982	-0.81	-0.703	-0.107	0.639	2.31E-05	0.445	0.495	0.142
1983	0.323	-0.732	1.055	0.639	2.31E-05	1.381	0.481	3.56
1984	-0.476	-0.797	0.32	0.639	2.31E-05	0.621	0.451	0.03
1985	-2.126	-0.827	-1.299	0.639	2.31E-05	0.119	0.437	1.198
1986	-1.879	-0.856	-1.023	0.639	2.31E-05	0.153	0.425	0.99
1987	-1.586	-0.897	-0.689	0.639	2.31E-05	0.205	0.408	0.692
1988	-1.076	-0.908	-0.167	0.639	2.31E-05	0.341	0.403	0.191
1989	-0.934	-0.924	-0.01	0.639	2.31E-05	0.393	0.397	0.074
1990	-2.255	-0.957	-1.298	0.639	2.31E-05	0.105	0.384	1.197
1991	-0.649	-1.006	0.356	0.639	2.31E-05	0.522	0.366	0.053
1992	-0.031	-1.035	1.004	0.639	2.31E-05	0.969	0.355	2.97
1993	-0.376	-1.077	0.701	0.639	2.31E-05	0.687	0.341	0.818
1994	-1.955	-1.11	-0.845	0.639	2.31E-05	0.142	0.33	0.837
1995	-0.678	-1.129	0.451	0.639	2.31E-05	0.508	0.323	0.155
1996	-2.993	-1.167	-1.825	0.639	2.31E-05	0.05	0.311	1.495
1997	-2.552	-1.194	-1.359	0.639	2.31E-05	0.078	0.303	1.238
1998	-1.886	-1.222	-0.664	0.639	2.31E-05	0.152	0.295	0.667
1999	-1.223	-1.197	-0.027	0.639	2.31E-05	0.294	0.302	0.084
2000	-1.606	-1.138	-0.469	0.639	2.31E-05	0.201	0.321	0.475
2001	-1.661	-1.116	-0.545	0.639	2.31E-05	0.19	0.328	0.551
2002	-1.392	-1.137	-0.254	0.639	2.31E-05	0.249	0.321	0.268
2003	-0.709	-1.113	0.404	0.639	2.31E-05	0.492	0.328	0.097
2004	-0.536	-1.056	0.52	0.639	2.31E-05	0.585	0.348	0.274
2005	-0.06	-1.047	0.987	0.639	2.31E-05	0.942	0.351	2.791
2006	-0.785	-1.016	0.23	0.639	2.31E-05	0.456	0.362	0.001
2007	-0.163	-0.964	0.801	0.639	2.31E-05	0.849	0.381	1.32
2008	-0.503	-0.898	0.395	0.639	2.31E-05	0.605	0.408	0.088
2009	0.363	-0.86	1.223	0.639	2.31E-05	1.438	0.423	6.212
2011	1.001	-0.76	1.761	0.639	2.31E-05	2.721	0.468	27.755

Result – Selectivity of Canada GSL

Age 13	Age 14	Age 15	Age 16
0.359	0.385	0.447	1

Result – Fit to Canada SW Nova Scotia Index

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1988	2.021	1.071	0.95	0.639	6.18E-05	7.543	2.918	2.428
1989	2.313	1.04	1.273	0.639	6.18E-05	10.108	2.829	7.246
1990	2.243	1.008	1.235	0.639	6.18E-05	9.419	2.739	6.443
1991	1.633	0.978	0.655	0.639	6.18E-05	5.12	2.659	0.643
1992	1.558	0.973	0.585	0.639	6.18E-05	4.748	2.646	0.425
1993	0.864	1.003	-0.14	0.639	6.18E-05	2.372	2.728	0.168
1994	1.498	1.043	0.454	0.639	6.18E-05	4.471	2.839	0.16
1995	1.306	1.131	0.175	0.639	6.18E-05	3.69	3.098	0.002
1996	0.277	1.255	-0.978	0.639	6.18E-05	1.319	3.51	0.953
1997	-0.084	1.323	-1.407	0.639	6.18E-05	0.919	3.755	1.269
1998	0.667	1.329	-0.662	0.639	6.18E-05	1.948	3.775	0.665
1999	1.248	1.285	-0.037	0.639	6.18E-05	3.482	3.613	0.091
2000	-0.125	1.244	-1.369	0.639	6.18E-05	0.883	3.469	1.245
2001	0.886	1.219	-0.334	0.639	6.18E-05	2.424	3.385	0.343
2002	0.935	1.172	-0.236	0.639	6.18E-05	2.548	3.227	0.252
2003	1.708	1.137	0.571	0.639	6.18E-05	5.516	3.117	0.388
2004	0.647	1.15	-0.503	0.639	6.18E-05	1.91	3.158	0.509
2005	0.819	1.155	-0.336	0.639	6.18E-05	2.269	3.174	0.345
2006	1.24	1.154	0.086	0.639	6.18E-05	3.456	3.171	0.025
2007	1.022	1.199	-0.177	0.639	6.18E-05	2.778	3.315	0.199
2008	1.391	1.224	0.168	0.639	6.18E-05	4.02	3.399	0.003
2009	1.369	1.188	0.18	0.639	6.18E-05	3.931	3.282	0.001
2010	1.203	1.286	-0.083	0.639	6.18E-05	3.33	3.617	0.123
2011	1.316	1.386	-0.071	0.639	6.18E-05	3.728	4.001	0.114

Result – Selectivity of Canada SW Nova Scotia

Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14
0.359	0.618	0.818	0.882	0.906	0.922	1

Result: Fit to U.S. Rod and Reel < 145 cm

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1980	-0.224	-0.158	-0.066	0.639	6.08E-06	0.799	0.854	0.111
1981	-0.919	-0.281	-0.638	0.639	6.08E-06	0.399	0.755	0.642
1982	0.743	-0.283	1.026	0.639	6.08E-06	2.102	0.754	3.215
1983	0.108	-0.191	0.299	0.639	6.08E-06	1.114	0.826	0.02
1985	-0.462	-0.065	-0.397	0.639	6.08E-06	0.63	0.937	0.405
1986	-0.251	-0.036	-0.215	0.639	6.08E-06	0.778	0.964	0.232
1987	0.198	-0.049	0.247	0.639	6.08E-06	1.219	0.952	0.004
1988	-0.012	-0.063	0.05	0.639	6.08E-06	0.988	0.939	0.04
1989	-0.012	0.098	-0.11	0.639	6.08E-06	0.988	1.103	0.144
1990	-0.101	0.141	-0.242	0.639	6.08E-06	0.904	1.151	0.257
1991	0.232	0.067	0.165	0.639	6.08E-06	1.261	1.069	0.003
1992	-0.198	-0.079	-0.12	0.639	6.08E-06	0.82	0.924	0.152

Result: Selectivity of U.S. Rod and Reel < 145 cm

Age 1	Age 2	Age 3	Age 4	Age 5
0.269	1	0.831	0.173	0.11

Result: Fit to U.S. Rod and Reel >195 cm

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1983	1.031	0.01	1.022	0.639	2.89E-05	2.805	1.01	3.17
1984	0.22	-0.01	0.229	0.639	2.89E-05	1.246	0.991	0.001
1985	-0.154	-0.044	-0.111	0.639	2.89E-05	0.857	0.957	0.145
1986	-0.687	-0.095	-0.592	0.639	2.89E-05	0.503	0.909	0.597
1987	-0.637	-0.113	-0.524	0.639	2.89E-05	0.529	0.893	0.53
1988	-0.061	-0.134	0.073	0.639	2.89E-05	0.941	0.874	0.03
1989	-0.27	-0.169	-0.102	0.639	2.89E-05	0.763	0.845	0.138
1990	-0.468	-0.211	-0.257	0.639	2.89E-05	0.626	0.809	0.27
1991	-0.198	-0.252	0.054	0.639	2.89E-05	0.82	0.777	0.039
1992	-0.094	-0.301	0.207	0.639	2.89E-05	0.91	0.74	0

Result: Selectivity of U.S. Rod and Reel >195 cm

Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
0.248	0.297	0.455	0.571	0.783	1	0.91

Result: Fit to U.S. Rod and Reel 66-114 cm

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
----	-----------	-----------	-----------	-----------	-----------	-----------	-----------	-----------
1993	0.265	-0.21	0.475	0.639	1.01E-05	1.304	0.811	0.192
1994	-1.328	-0.238	-1.09	0.639	1.01E-05	0.265	0.788	1.044
1995	0.008	-0.266	0.274	0.639	1.01E-05	1.008	0.767	0.01
1996	0.493	-0.105	0.597	0.639	1.01E-05	1.637	0.901	0.46
1997	0.933	-0.083	1.016	0.639	1.01E-05	2.541	0.92	3.1
1998	0.37	-0.261	0.632	0.639	1.01E-05	1.448	0.77	0.563
1999	0.172	-0.332	0.504	0.639	1.01E-05	1.188	0.718	0.242
2000	-0.056	-0.171	0.116	0.639	1.01E-05	0.946	0.843	0.014
2001	-0.753	-0.151	-0.602	0.639	1.01E-05	0.471	0.86	0.607
2002	0.076	-0.179	0.255	0.639	1.01E-05	1.079	0.836	0.005
2003	-0.747	-0.307	-0.44	0.639	1.01E-05	0.474	0.736	0.447
2004	0.608	-0.087	0.694	0.639	1.01E-05	1.836	0.917	0.792
2005	0.493	0.333	0.16	0.639	1.01E-05	1.638	1.396	0.004
2006	-0.42	0.058	-0.479	0.639	1.01E-05	0.657	1.06	0.485
2007	-0.538	-0.765	0.227	0.639	1.01E-05	0.584	0.466	0.001
2008	-1.28	-0.503	-0.778	0.639	1.01E-05	0.278	0.605	0.775
2009	-1.139	-0.287	-0.852	0.639	1.01E-05	0.32	0.75	0.843
2010	-0.475	-0.269	-0.206	0.639	1.01E-05	0.622	0.764	0.224
2011	-0.351	0.154	-0.504	0.639	1.01E-05	0.704	1.166	0.511

Result: selectivity of U.S. Rod and Reel 66-114 cm

Age 2	Age 3
0.448	1

Result: Fit to U.S. Rod and Reel 115-144 cm

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
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1993	0.255	0.08	0.176	0.639	1.11E-05	1.291	1.083	0.002
1994	-1.44	-0.099	-1.34	0.639	1.11E-05	0.237	0.905	1.226
1995	-1.336	-0.176	-1.159	0.639	1.11E-05	0.263	0.838	1.097
1996	-0.364	-0.256	-0.108	0.639	1.11E-05	0.695	0.774	0.142
1997	-1.321	-0.215	-1.106	0.639	1.11E-05	0.267	0.807	1.057
1998	-0.121	-0.058	-0.063	0.639	1.11E-05	0.886	0.944	0.109
1999	0.048	-0.1	0.148	0.639	1.11E-05	1.049	0.905	0.006
2000	0.376	-0.274	0.65	0.639	1.11E-05	1.456	0.76	0.624
2001	0.518	-0.225	0.742	0.639	1.11E-05	1.678	0.799	1.005
2002	0.912	-0.163	1.076	0.639	1.11E-05	2.49	0.849	3.83
2003	-0.627	-0.149	-0.478	0.639	1.11E-05	0.534	0.862	0.485
2004	-0.514	-0.228	-0.286	0.639	1.11E-05	0.598	0.796	0.298
2005	-0.243	-0.373	0.129	0.639	1.11E-05	0.784	0.689	0.01
2006	0.32	0.118	0.202	0.639	1.11E-05	1.377	1.125	0
2007	0.344	0.376	-0.032	0.639	1.11E-05	1.41	1.456	0.088
2008	0.035	-0.218	0.253	0.639	1.11E-05	1.036	0.804	0.005
2009	-0.652	-0.801	0.149	0.639	1.11E-05	0.521	0.449	0.006
2010	0.204	-0.3	0.503	0.639	1.11E-05	1.226	0.741	0.241
2011	0.185	-0.36	0.545	0.639	1.11E-05	1.203	0.698	0.326

Result: Selectivity of U.S. Rod and Reel 115-144 cm

Age 4	Age 5
1	0.924

Result: Fit to U.S. Rod and Reel >177 cm

Year	Observed	Predicted	Residuals (Obs-pred)	Standard Deviation	Q Catchabil.	Untransfrmd Observed	Untransfrmd Predicted	Chi-square Discrepancy
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1993	-0.403	-0.417	0.013	0.639	1.95E-05	0.668	0.659	0.06
1994	-0.185	-0.401	0.216	0.639	1.95E-05	0.831	0.67	0
1995	0.223	-0.343	0.566	0.639	1.95E-05	1.25	0.71	0.376
1996	1.25	-0.265	1.515	0.639	1.95E-05	3.489	0.767	14.523
1997	0.281	-0.242	0.523	0.639	1.95E-05	1.324	0.785	0.279
1998	0.502	-0.251	0.753	0.639	1.95E-05	1.652	0.778	1.057
1999	0.659	-0.267	0.925	0.639	1.95E-05	1.932	0.766	2.211
2000	-0.507	-0.286	-0.222	0.639	1.95E-05	0.602	0.751	0.238
2001	0.328	-0.267	0.595	0.639	1.95E-05	1.388	0.766	0.453
2002	0.591	-0.283	0.874	0.639	1.95E-05	1.806	0.754	1.8
2003	-0.949	-0.317	-0.632	0.639	1.95E-05	0.387	0.728	0.637
2004	-0.511	-0.316	-0.195	0.639	1.95E-05	0.6	0.729	0.214
2005	-0.691	-0.297	-0.394	0.639	1.95E-05	0.501	0.743	0.402
2006	-1.05	-0.279	-0.771	0.639	1.95E-05	0.35	0.757	0.769
2007	-1.309	-0.242	-1.068	0.639	1.95E-05	0.27	0.785	1.026
2008	-0.997	-0.206	-0.791	0.639	1.95E-05	0.369	0.814	0.787
2009	-1.411	-0.216	-1.195	0.639	1.95E-05	0.244	0.806	1.124
2010	-0.233	-0.1	-0.133	0.639	1.95E-05	0.792	0.905	0.162
2011	-0.609	-0.03	-0.579	0.639	1.95E-05	0.544	0.971	0.584

Result: Selectivity of U.S. Rod and Reel >177 cm

Age 8	Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
0.225	0.311	0.292	0.393	0.456	0.612	0.858	1	0.773

Result: Fit to Japanese Longline

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1976	-0.42	0.365	-0.785	0.639	3.85E-06	0.657	1.44	0.782
1977	0.886	0.257	0.629	0.639	3.85E-06	2.424	1.292	0.555
1978	0.182	0.171	0.012	0.639	3.85E-06	1.2	1.186	0.061
1979	-0.196	0.084	-0.28	0.639	3.85E-06	0.822	1.088	0.292
1980	0.411	-0.04	0.451	0.639	3.85E-06	1.508	0.96	0.155
1981	0.648	-0.155	0.803	0.639	3.85E-06	1.912	0.857	1.331
1982	-0.336	-0.283	-0.052	0.639	3.85E-06	0.715	0.753	0.102
1983	-1.16	-0.245	-0.915	0.639	3.85E-06	0.313	0.783	0.899
1984	-0.043	-0.212	0.169	0.639	3.85E-06	0.958	0.809	0.002
1985	0.085	-0.159	0.245	0.639	3.85E-06	1.089	0.853	0.003
1986	-2.518	-0.172	-2.346	0.639	3.85E-06	0.081	0.842	1.684
1987	-0.333	-0.136	-0.197	0.639	3.85E-06	0.717	0.873	0.216
1988	0.085	-0.148	0.233	0.639	3.85E-06	1.089	0.863	0.002
1989	-0.094	-0.17	0.075	0.639	3.85E-06	0.91	0.844	0.029
1990	-0.285	-0.102	-0.183	0.639	3.85E-06	0.752	0.903	0.204
1991	-0.285	-0.074	-0.211	0.639	3.85E-06	0.752	0.929	0.229
1992	0.138	-0.069	0.207	0.639	3.85E-06	1.148	0.934	0
1993	0.129	-0.047	0.176	0.639	3.85E-06	1.138	0.954	0.002
1994	0.048	-0.051	0.1	0.639	3.85E-06	1.05	0.95	0.02
1995	-0.238	-0.066	-0.172	0.639	3.85E-06	0.788	0.936	0.195
1996	0.84	-0.082	0.922	0.639	3.85E-06	2.317	0.921	2.183
1997	0.374	-0.085	0.458	0.639	3.85E-06	1.453	0.919	0.166
1998	-0.38	-0.105	-0.274	0.639	3.85E-06	0.684	0.9	0.286
1999	-0.295	-0.127	-0.168	0.639	3.85E-06	0.744	0.88	0.191
2000	-0.068	-0.118	0.05	0.639	3.85E-06	0.934	0.888	0.041
2001	-0.516	-0.122	-0.394	0.639	3.85E-06	0.597	0.885	0.402
2002	-0.361	-0.123	-0.238	0.639	3.85E-06	0.697	0.884	0.253
2003	-0.386	-0.165	-0.222	0.639	3.85E-06	0.679	0.848	0.239
2004	-0.497	-0.168	-0.329	0.639	3.85E-06	0.608	0.846	0.339
2005	-0.312	-0.082	-0.23	0.639	3.85E-06	0.732	0.921	0.246
2006	0.238	-0.013	0.25	0.639	3.85E-06	1.268	0.987	0.004
2007	0.668	-0.04	0.708	0.639	3.85E-06	1.95	0.96	0.851
2008	-0.263	-0.073	-0.191	0.639	3.85E-06	0.768	0.93	0.211
2009	0.623	-0.102	0.724	0.639	3.85E-06	1.864	0.903	0.922
2010	-0.362	-0.168	-0.193	0.639	3.85E-06	0.696	0.845	0.213
2011	1.087	-0.08	1.167	0.639	3.85E-06	2.967	0.923	5.198

Result: Selectivity of Japanese Longline

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
0.071	0.543	0.608	0.811	1	0.947	0.921	0.858	0.668	0.448	0.526	0.677	0.771	0.858	0.729

Result: Fit to U.S. GOM Larval Index

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1977	1.002	0.541	0.461	0.639	9.53E-08	2.724	1.718	0.169
1978	1.555	0.377	1.178	0.639	9.53E-08	4.733	1.457	5.379
1981	-0.261	-0.287	0.025	0.639	9.53E-08	0.77	0.751	0.053
1982	0.348	-0.389	0.737	0.639	9.53E-08	1.417	0.678	0.981
1983	0.07	-0.438	0.508	0.639	9.53E-08	1.073	0.645	0.25
1984	-0.933	-0.455	-0.478	0.639	9.53E-08	0.393	0.634	0.484
1986	-0.832	-0.564	-0.268	0.639	9.53E-08	0.435	0.569	0.281
1987	-0.951	-0.597	-0.354	0.639	9.53E-08	0.386	0.55	0.363
1988	0.061	-0.601	0.663	0.639	9.53E-08	1.063	0.548	0.67
1989	-0.271	-0.631	0.359	0.639	9.53E-08	0.762	0.532	0.056
1990	-1.144	-0.685	-0.46	0.639	9.53E-08	0.318	0.504	0.467
1991	-0.949	-0.704	-0.245	0.639	9.53E-08	0.387	0.495	0.26
1992	-0.636	-0.755	0.12	0.639	9.53E-08	0.53	0.47	0.013
1993	-0.722	-0.789	0.067	0.639	9.53E-08	0.486	0.454	0.033
1994	-0.638	-0.824	0.186	0.639	9.53E-08	0.528	0.439	0.001
1995	-1.119	-0.807	-0.312	0.639	9.53E-08	0.327	0.446	0.323
1996	0.019	-0.816	0.835	0.639	9.53E-08	1.019	0.442	1.53
1997	-0.876	-0.816	-0.06	0.639	9.53E-08	0.416	0.442	0.107
1998	-2.087	-0.802	-1.285	0.639	9.53E-08	0.124	0.449	1.188
1999	-0.638	-0.774	0.136	0.639	9.53E-08	0.528	0.461	0.009
2000	-1.045	-0.732	-0.312	0.639	9.53E-08	0.352	0.481	0.323
2001	-0.884	-0.716	-0.167	0.639	9.53E-08	0.413	0.489	0.191
2002	-1.145	-0.72	-0.425	0.639	9.53E-08	0.318	0.487	0.432
2003	-0.243	-0.737	0.494	0.639	9.53E-08	0.784	0.479	0.224
2004	-0.543	-0.748	0.205	0.639	9.53E-08	0.581	0.473	0
2005	-1.443	-0.708	-0.735	0.639	9.53E-08	0.236	0.493	0.735
2006	-0.536	-0.683	0.147	0.639	9.53E-08	0.585	0.505	0.006
2007	-1.327	-0.619	-0.708	0.639	9.53E-08	0.265	0.538	0.709
2008	-0.89	-0.545	-0.345	0.639	9.53E-08	0.411	0.58	0.354
2009	-0.43	-0.508	0.078	0.639	9.53E-08	0.65	0.601	0.028
2010	-0.779	-0.461	-0.318	0.639	9.53E-08	0.459	0.631	0.328
2011	-0.169	-0.445	0.276	0.639	9.53E-08	0.844	0.641	0.011

Result: Selectivity of U.S. GOM Larval Index (Treated as an index of SSB)

Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
0.019	0.068	0.144	0.232	0.406	0.427	1	0.689

Result: Fit to U.S. GOM Pelagic Longline Index

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1987	1.18	-0.23	1.41	0.639	4.37E-05	3.255	0.795	10.847
1988	0.427	-0.252	0.679	0.639	4.37E-05	1.533	0.778	0.73
1989	0.892	-0.286	1.178	0.639	4.37E-05	2.44	0.751	5.388
1990	0.636	-0.326	0.962	0.639	4.37E-05	1.889	0.722	2.541
1991	1.181	-0.337	1.518	0.639	4.37E-05	3.256	0.714	14.639
1992	-0.227	-0.387	0.16	0.639	4.37E-05	0.797	0.679	0.004
1993	-0.795	-0.455	-0.339	0.639	4.37E-05	0.452	0.634	0.348
1994	-1.093	-0.447	-0.646	0.639	4.37E-05	0.335	0.639	0.65
1995	-1.171	-0.429	-0.742	0.639	4.37E-05	0.31	0.651	0.742
1996	-1.698	-0.404	-1.293	0.639	4.37E-05	0.183	0.668	1.194
1997	-1.104	-0.307	-0.797	0.639	4.37E-05	0.332	0.736	0.793
1998	-1.031	-0.251	-0.78	0.639	4.37E-05	0.357	0.778	0.777
1999	-0.49	-0.243	-0.248	0.639	4.37E-05	0.612	0.785	0.262
2000	-0.123	-0.302	0.179	0.639	4.37E-05	0.884	0.739	0.001
2001	-0.686	-0.251	-0.436	0.639	4.37E-05	0.503	0.778	0.443
2002	-0.752	-0.234	-0.518	0.639	4.37E-05	0.471	0.791	0.524
2003	-0.148	-0.297	0.149	0.639	4.37E-05	0.862	0.743	0.006
2004	-0.245	-0.337	0.092	0.639	4.37E-05	0.783	0.714	0.022
2005	-0.527	-0.291	-0.237	0.639	4.37E-05	0.59	0.748	0.252
2006	-0.882	-0.251	-0.631	0.639	4.37E-05	0.414	0.778	0.636
2007	-0.582	-0.294	-0.288	0.639	4.37E-05	0.559	0.745	0.3
2008	0.249	-0.2	0.449	0.639	4.37E-05	1.283	0.819	0.153
2009	0.018	-0.162	0.18	0.639	4.37E-05	1.018	0.85	0.001
2010	-0.127	-0.127	0	0.639	4.37E-05	0.881	0.881	0.068

Result Selectivity of U.S. GOM Pelagic Longline

Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
0.035	0.098	0.267	0.142	0.284	0.265	1	0.346

Result: Fit to Japanese Longline Gulf of Mexico Index

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1974	-0.033	0.269	-0.302	0.639	1.13E-05	0.968	1.309	0.313
1975	-0.627	0.201	-0.828	0.639	1.13E-05	0.534	1.223	0.822
1976	-0.406	0.133	-0.539	0.639	1.13E-05	0.666	1.142	0.545
1977	-0.091	-0.018	-0.073	0.639	1.13E-05	0.913	0.982	0.116
1978	-0.132	-0.208	0.075	0.639	1.13E-05	0.876	0.812	0.029
1979	0.252	-0.393	0.645	0.639	1.13E-05	1.287	0.675	0.608
1980	0.147	-0.615	0.762	0.639	1.13E-05	1.158	0.54	1.105
1981	-0.592	-0.853	0.261	0.639	1.13E-05	0.553	0.426	0.007

Result: Selectivity of Japanese Longline Gulf of Mexico

Age 9	Age 10	Age 11	Age 12	Age 13	Age 14	Age 15	Age 16
0.031	0.066	0.104	0.299	0.603	0.638	1	0.856

Result: Fit to Tagging Index

			Residuals	Standard	Q	Untransfrmd	Untransfrmd	Chi-square
Year	Observed	Predicted	(Obs-pred)	Deviation	Catchabil.	Observed	Predicted	Discrepancy
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1970	13.879	13.196	0.683	0.639	9.34E-01	1065132	538056.306	0.747
1971	13.817	13.007	0.81	0.639	9.34E-01	1001624	445449.224	1.375
1972	12.976	12.961	0.016	0.639	9.34E-01	431955	425287.219	0.059
1973	12.121	12.742	-0.622	0.639	9.34E-01	183616	341852.349	0.626
1974	12.741	13.241	-0.499	0.639	9.34E-01	341589	562799.883	0.506
1975	13.226	12.977	0.249	0.639	9.34E-01	554596	432562.631	0.004
1976	12.442	12.636	-0.194	0.639	9.34E-01	253265	307384.19	0.214
1977	12.458	12.395	0.063	0.639	9.34E-01	257385	241648.861	0.034
1978	11.704	12.285	-0.58	0.639	9.34E-01	121110	216372.245	0.586
1979	11.501	12.226	-0.725	0.639	9.34E-01	98815	204114.616	0.726
1980	12.168	12.097	0.071	0.639	9.34E-01	192541	179269.953	0.031
1981	12.731	12.002	0.728	0.639	9.34E-01	337995	163129.804	0.941

Result: Selectivity of Tagging Index (Fixed)

Age 1	Age 2	Age 3
1	1	1