REPORT OF THE 2016 ICCAT BLUEFIN DATA PREPARATORY MEETING

(Madrid, Spain – 25-29 July, 2016)

1. Opening, adoption of agenda and meeting arrangements

The meeting was held at the ICCAT Secretariat in Madrid from July 25 to 29, 2016. Dr. Clay Porch (USA), Coordinator, opened the meeting. Drs Gary Melvin (Canada) and Sylvain Bonhommeau (EU-France), Rapporteurs for the western Atlantic and eastern Atlantic and Mediterranean stocks, respectively, served as co-Chairmen. The Chairmen welcomed meeting participants ("the Group") and proceeded to review the Agenda which was adopted with minor changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents presented at the meeting is attached as **Appendix 3**. The following served as rapporteurs:

Sections	*Rapporteur*
Items 1and 10	M. Neves dos Santos
Item 2	S. Tensek, A. di Natale
Item 3	G. Diaz, D. Secor, H. Arrizabalaga and L. Kerr
Item 4	C. Palma and G. Diaz
Item 5	D. Álvarez-Berastegui, A. Kimoto, T.Rouyer, J. Walter
Item 6	J. Walter, D. Butterworth, C. Porch
Item 7	D. Butterworth and T. Carruthers
Item 8	C. Porch
Item 9	S. Bonhommeau, G. Melvin

The Coordinator noted that more than 40 documents and presentations had been submitted for review. Owing to the limited time available, it was agreed to limit each presentation to 10 minutes including discussions. In several cases discussions had to be deferred to one of several smaller working groups that were formed to focus on tasks related to items 3-7 of the agenda.

2. Review progress made by the GBYP and Phase 6 programme

During Phase 5, several partial reviews of the Programme activities were undertaken, as required by the Commission. The Cost-Benefit analysis of the GBYP tagging activities and aerial surveys were successfully carried out and the reports are available from the ICCAT GBYP web site, while the cost-benefit analysis of biological studies haven't been done due to the lack of tenders. GBYP Phase 5 officially terminated on February 2016 and was immediately followed by Phase 6. The full integrated analysis of all GBYP activities since the beginning of the Programme (ICCAT GBYP second review) was carried out at the beginning of the Phase 6, but the final report is still to be finalised and therefore is not publicly available. The ICCAT GBYP Coordination team undertook the analysis of ICCAT GBYP PSAT tags data, revision of trap data, review of old literature on bluefin tuna maturity, review and selection of best trade, market and auction data, study of bluefin tuna YOYs in the Mediterranean and the analysis of ICCAT conventional tags database (reports are available as SCRS documents).

Regarding data mining activities, additional data recovery activities were initiated in Phase 6 for collecting recent and historical data sets still missing from Task I and Task II data. A contract was awarded to the Stanford University for the recovery of 393 electronic tag datasets which will be available at the end of August. Other electronic data sets have been already provided to the SCRS bluefin tuna Group. For the purpose of data recovery in Mauritania, a short training course was carried out in July, within a local data mining activity.

The aerial survey was suspended in the Phase 6, while the PSAT tagging activities continued, followed by the limited complementary conventional tagging. 19 electronic tags were deployed in a Turkish purse seine, 15 in a Moroccan trap, 20 in a Sardinian trap and 24 in a Portuguese trap, while additional electronic tagging will be carried out in Irish waters and in the Strait of Messina. Field tag awareness campaign was straighten in this Phase by awarding a contract for producing two short promotional videos, while the tag recovery and rewarding activities are still ongoing. The first part of the close-kin genetic tagging feasibility study has been completed but the report is still to be approved and the decision on the second part is still pending.

The biological studies in Phase 6 are focused in sampling and analysis. Biological sampling was enhanced this year, due to the need for collection of additional adult samples from spawning areas for the purpose of preliminary close-kin feasibility study. Three contracts were provided for sampling adults, while the main contract for biological studies is still to be awarded. This year the biological studies will represent the continuation of the work from the previous phases (e.g. micro-constituents, otolith shape, genetic, age analyses, etc.) with the introduction of the analysis of microsatellite genetic markers. A larval workshop is scheduled for September.

MSE modelling development is ongoing, carried mainly by the external expert Dr. Tom Carruthers, whose contract was renewed. The GBYP Core Modelling MSE group meeting will be carried out in the later phase.

3. Review of historical and new information on biology and stock structure

Documents SCRS/2016/140 indicated that year 2015 was the warmest so far in the Mediterranean Sea and the possible effects on the bluefin tuna reproductive biology were proposed to SCRS by GBYP in the same year. Now, after collecting some detailed samples and data about the presence of YOY in different parts of the Mediterranean Sea, it is possible to notice a peculiar situation, showing different size-at-time by area in late summer-fall and early winter 2015/2016, possibly mirroring fractioned spawnings and different growth rates. These fish might result in future problems for age readings and ALK at least for the juveniles of bluefin tunas born in 2015. This document also provides the growth curves and equations for the various cohorts of bluefin tuna YOY which have been detected and that were born in 2015.

The Group briefly discussed if anomaly warm weather in the Mediterranean during 2015 would affect the eastern stock in a positive or negative way. In general, warmer waters can result in longer spawning seasons which tend to produce higher recruitments. However, it is hard to predict that this will be the result in all cases. It also inquired how these high temperatures can affect the chemical signals in the otolith. It was hypothesized that warmer waters in the Mediterranean Sea can produce a signal similar to that in the Gulf of Mexico. However, it was indicated that the opposite might be true with higher temperatures in the Mediterranean resulting in otolith signals that even more different than that from the Gulf of Mexico. The Group observed that the document described that three cohorts were spawn during the spawning season, but that at some point their sizes would overlap and it would not be possible to distinguish one cohort from the others. It was indicated that daily otolith rings could be used to distinguish the cohorts.

Document SCRS/2016/141 presented a brief review of some of the most significant ancient studies on sexual maturity and reproductive biology of eastern Atlantic bluefin tuna. Special attention was given to the works of Rodriguez-Roda (1964, 1967) and Frade (1950, 1962), and in particular on the study of the fish size at first maturity. All these studies are well-known, but they are quite often forgotten in recent papers on bluefin tuna biology. Due to the recurrent discussions about the sexual maturity of eastern bluefin tuna, a summary of their findings can be useful.

The Group once again agreed that for stock assessment purposes it is important to know what fraction of fish at each age are mature and are contributing to spawning. The Group noted that in the document, samples from fish around 110 cm FL were few even though the fish sampled at this size were 100% mature. Since most fish in the samples were 135 cm FL and larger, the Group discussed that this might indicate that not all 110 cm FL fish in the population are mature and only a fraction of these fish are spawning.

Document SCRS/2016/146 reviewed sexual maturity and reproduction for Atlantic bluefin tuna in the Mediterranean Sea and western North Atlantic against the historic research record and current management assumptions. The document highlight the need to update and revise ICCAT scientific assumptions for putative western Atlantic bluefin tuna in the context of emerging understanding established with histological and new endocrine techniques that establish similarity to maturity and reproduction in the Mediterranean Sea. With confirmation of Atlantic spawning and extended spawning period established by larvae collected across the Slope Sea in the NW Atlantic, expanded, state-of-the-art reproductive sampling of bluefin tuna in the pelagic realm is needed, in conjunction with broader larval sampling, in order to obtain spatio-temporal and oceanographic attributes of spawning areas as well as their variability.

Document SCRS/2016/151 indicated that the fisheries of Atlantic bluefin tuna, *Thunnus thynnus* (L.) (ABFT) juveniles began to develop at the end of the 1940s (Bay of Biscay), middle of the 1950s (off the coast of Morocco) and in 1958 off New England (USA). The results of an analysis of the juvenile ABFT population of the eastern Atlantic part between 1949 and 1962 reveal that under different scenarios the high fishing mortality exerted on the juvenile fish groups (<5 years) in the period studied may have been one of the main factors behind the decline of the north eastern Atlantic fisheries of spawners from 1963; juvenile catches of 6,879,967 ABFT may have given rise to the limited recruitment from juvenile age to spawning stocks. The analysis has also been made for the periods 1970-2006 and the present (2009). In the first of these two cases fishing mortality (F) fell as a result of a fall in the catch of juveniles, mainly the fishery of Morocco. Nevertheless, during these years over 4 million specimens of 1 year were caught illegally in the Atlantic part of the eastern stock. The fall in F is now even greater due to the practically entire disappearance of the juvenile fisheries as a result of the implementation of the Pluriannual Recovery Plan (PRP) of the *International Commission for the Conservation of Atlantic Tunas* (ICCAT), which began in the fisheries of the eastern stock in 2007.

Document SCRS/2016/154 explained that the recently adopted models by ICCAT Standing Committee on Research and Statistics (SCRS) for the Atlantic bluefin tuna (ABFT), *Thunnus thynnus* (L.) (RW= 0.0000159137 SFL3.020584, *WEST*; and RW= 0.0000315551 SFL 2.898454, *EAST*), together with the models used to date (RW= 0.0000152 SFL3.0531, for western stock; and RW= 0.000019607 SFL 3.0092, for eastern stock) and an alternative model for the eastern stock (RW= 0.0000188 SFL 3.01247), are analyzed in using bi–variant samples (SFL (cm), RW (kg)) of 698 pairs of data (K= 2.02 ± 0.23 SD, western stock) and 474 pairs of data (K= 2.03 ± 0.15 SD, eastern stock) with the aim of validating them and establishing which model best fits the reality represented by the samples and, therefore, will have the greatest descriptive and predictive power. The result of the analysis indicates that the adopted models WEST and EAST currently used clearly underestimates the weight of spawning ABFT, while the alternative model presented in this paper best explains the data of the samples. The result of the classical statistical analysis is confirmed by means of the quantile regression technique, selecting the quantiles 5%, 25%, 50%, 75% and 95%. Other biological and fisheries indicators also conclude that the models WEST and EAST gradually underestimates the weight of ABFT spawners (of 2-3 m) by 8-14%; the average value of K (1.78 and 1.82) obtained for spawners (> 140 cm), using the adopted models, represents ABFT in low fattening condition; and the evolution of K throughout the year, by using the monthly L-W adopted models, does not represent the significant increase in weight that ABFT experiences in nature between August and December.

A presentation by D. Richardson on a recent publication (Richardson *et al.* 2016) indicated that in 2013 opportunistic plankton sampling collected 67 bluefin tuna larvae in the Slope Sea between the Gulf Stream and the U.S. northeast continental shelf. The majority of these larvae were small (<5 mm) and drifting buoy tracks confirmed that these larvae could not have been transported into the region from the Gulf of Mexico. Electronic tagging data and published reproductive studies point to size-structured spawning migrations in western Atlantic bluefin tuna, and support a younger age-at-maturity. Also notable is that published multi-year tracks of electronically tagged bluefin tuna that show movement from the Slope Sea in one year to the Gulf of Mexico or the Mediterranean Sea in the following year.

SCRS/P/2016/037 presented an oceanographic index of bluefin tuna spawning habitat in the Gulf of Mexico (Domingues *et al.* 2016). The main findings from this study were that the BFT_Index successfully captures the spatial and temporal variability in the occurrence of bluefin tuna larvae. Areas with favorable environmental conditions for larvae in the GOM exhibit year-to-year spatial and temporal variability linked with mesoscale ocean features and sea surface temperature. Comparison of the BFT_Index- with recruitment of age-0 fish estimated from the 2014 stock assessment indicates that changes in environmental conditions reflect a relevant component (~58%) of the recruitment variability. It may be possible that this index could be considered as a proxy for recruitment deviations from a spawner-recruit curve. In addition the spatial and temporal habitat predictions will be useful in designing larval surveys and evaluating trends in habitat over time.

3.1 Review life history assumptions such as fecundity, maturity, mortality schedules

Fecundity

Information was presented to the Group indicating than the length of individual E-BFT spawning events are longer (>30 days) (Gordoa *et al*., 2015) than previously thought. Furthermore, it was indicated that females were observed spawning as late as October even when their ovaries were already partially absorbed (Di Natale *et al.* 2016). More details on this observation are needed because this contradicts historical and recent literature on eastern Atlantic bluefin tuna reproduction. With regard to fecundity, there is evidence in the scientific literature that batch fecundity per gram of body weight is fairly constant regardless of fish size (e.g., Corriero *et al*., 2005; Knapp *et al*., 2014). However, the question of the viability and survival of eggs and larvae from younger females in the wild compared to those produced by the older female spawners remains unanswered. However, it was indicated to the Group that in captivity, the quality of eggs and larvae seems to be influenced by the quality of female nutrition more than by size (Izquiero *et al*. 2001).

Age of Maturity

It was discussed by the Group that significant progress has been made in studying and establishing age of maturity for W-BFT. It was indicated to the Group that there is scientific evidence that W-BFT mature at 3-5 yr old (Heinisch *et al.*, 2014) similar to E-BFT, rather than what is currently assumed for the stock assessment (age 9). It is known that fish of that young age are uncommon in the Gulf of Mexico (GOM) at any time of the year. The Group acknowledged the new hypothesis that indicates that younger BFT may spawn in the area known as the Slope Sea where bluefin tuna larvae were found in 2013 (Richardson *et al*., 2016). There was a general agreement within the Group that this is a promising hypothesis that still needs to be tested. It was pointed out that the newly proposed age of maturity for the western stock is in line with the age of maturity for the eastern stock. The current discrepancy between the ages of maturity of each stock has been difficult to justify biologically, particularly given that both stocks have almost identical growth curves. However, the Group acknowledged that some basic information necessary for stock assessment regarding the newly proposed age of maturity is currently lacking, such as the relative contribution of these younger spawners to the total spawning. There is also no information available at this time with respect to the proportion of fish that are mature at each age, whether spawning in the Slope Sea takes place every year, and the stock origin of the fish spawning in this area (or even if the fish spawning in this area constitute a separate stock). The Group recalled one of the recommendations from the 2013 bluefin tuna data preparatory meeting held in Tenerife (Anon. 2014b) regarding the development of a maturity o-give for the western stock.

The Group agreed to develop two alternative vectors for the proportion of fish contributing to the spawning output of the population as a function of age. These vectors were to be used in the operating model of the MSE as describing the plausible range of these relationships and should be used for both stocks. One of the vectors (option 1) was developed by assuming that maturity alone determines contribution to the spawing stock. The other vector (option 2) was calculated by using the results of the southern bluefin tuna close-kin studies and translating them to ABFT (Table maturity vectors, **Appendix 4**). The Group also agreed to define the quarters were spawning was possible for each of the areas in the operating model. The definitions were to be done exclusively by considering SST (Table spawning areas, **Appendix 4**). Both calculations on vectors of the proportion of fish spawning and the definition of possible spawning areas were conducted by a few members of the working group. Although the methodology used in both cases was not thoroughly reviewed by the whole working group, it was accepted that such values would be transmitted to the MSE Modelling Working Group.

The quarters and areas with probability of spawning activity were classified in two categories (yes and no) using the criteria of average value quarter SST >20ºC assuming 20ºC is the minimum temperature for the larvae to survive (SCRS/P/2016/043). Average temperatures per quarter were estimated from monthly SST NOAA NASA AVHRR Oceans Path-finder on a grid of 5x5º cells. Areas and quarters with positive probability of spawning activity might be overestimated for some areas due to the large latitudinal range some of the geographical areas represent (e.g. Western Atlantic).

Natural Mortality

The Group recalled that during the meeting in Tenerife it was proposed to replace the currently assumed natural mortality for each stock with a Lorenzen mortality function ($M=3.0.W^{-0.288}$) rescaled so that the average mortality on the age classes that are available to the fishery (ages 4+) equals the value inferred from the maximum age using the relationship on Then *et al*. (2014). As such, the Group reiterates that recommendation. For the purpose of estimating the Lorenzen mortality function, the Group recommends to use a maximum age of 35 yr for both the western and eastern stocks. This assumption is based on the maximum age observed in the Canadian bluefin tuna age-length observations, the growth curves currently used for each stock, and the observed maximum lengths of fish landed in the fisheries (on average 300 cm FL). Cort *et al.* (2015) reported a bluefin tuna of 725 kg and 320 cm FL, but the age of this fish was not estimated.

Stock-Recruitment

Recent modeling exercises have attempted to incorporate mixing rates into the assessments for eastern and western stocks of bluefin tuna (SCRS/P/2016/038). The Group agreed that while there is high uncertainty in the estimates for the most recent years of both SSB and recruitment, should this be the beginning of an increasing trend in future assessments may prove informative in elucidating the spawner recruit relationship for WBFT.

3.2 Review stock structure and mixing rate information

The terms of reference addressed by the Mixing Group are directly applicable to SCRS efforts to work with Dr. Tom Carruthers and others to develop an operating model – MSE framework to address scenarios of stock structure, life history assumptions, and seasonal movements on population dynamics and reference points. These terms of reference also apply to likely stock assessment activities by SCRS and a parallel effort to evaluate operating and assessment models by Dr. Lisa Kerr and colleagues.

New information on stock mixing

In 2013 opportunistic plankton sampling collected 67 bluefin tuna larvae in the Slope Sea between the Gulf Stream and the U.S. northeast continental shelf (Richardson *et al.*, 2016). The majority of these larvae were small (<5 mm) and drifting buoy tracks confirmed that these larvae could not have been transported into the region from the Gulf of Mexico. Electronic tagging data and published reproductive studies point to size-structured spawning migrations in western Atlantic bluefin tuna, and support a younger age-at-maturity. Also notable is that published multi-year tracks of electronically tagged bluefin tuna that show movement from the Slope Sea in one year to the Gulf of Mexico in the following year.

Applications centered on otolith stable isotope analysis were presented that focused on mixing in the western stock. Siskey *et al.* (2016) conducted a study on decadal trends in mixing levels observed in US fisheries, analyzing otoliths archived by NMFS. They observed a substantially higher contribution of Mediterranean-origin fish in the 1990s (48% eastern stock contribution) than in the 1970s (0% contribution) and the most recent 2009-2014 sample (4% contribution). They attributed higher mixing in the 1990s to a depleted status in the western stock. In contrast to the recent low mixing levels in US fisheries observed by Siskey *et al.* (2016) for the period 2009-2014, SCRS/2016/130 reported a high level of mixing in 2015. The 2015 sample of US fisheries was heavily biased towards the recreational fleet, with >80% < 120 cm CFL. The authors suggested that this apparent shift in mixing between the period 2009-2014 and 2015 may have been caused by contributions of Mediterranean-origin juveniles emanating from a strong year-class.

Document SCRS/2016/128 presented a comparative analysis of individual origin assignments for bluefin tuna sampled within the GBYP programme. For that purpose, an integrated stock identification database has been established with individuals assigned to origin using different methods (namely otolith stable isotopes, genetics and otolith shape analysis) over the past years. Analysis of the integrated database revealed that overall rates of agreement between methods were reasonably good given the compounding influence of classification error associated with each method. Rates of agreement were lowest for fish that had potentially performed transatlantic migrations, e.g. fish collected in the east that was classified to be of western origin (according to at least one method), or the reverse. This may reflect the influence of environmental history on phenotypic markers (otolith shape and chemistry). Rates of agreement between methods also increased when more restricted classification criteria were used (e.g. when the individual probabilities of belonging to a given stock was higher than 0.7, compared to 0.5).

Subsequently, SCRS/P/2016/032 presented the development of a genetic traceability panel to assign bluefin tuna to their birth place. For that aim, the authors have gathered larvae and young of the year from the Mediterranean, larvae from the Gulf of Mexico, and young of the year from Cape Hatteras. Applying the Restriction Site Associated DNA sequencing (RAD-seq) method to 204 of the samples, they have discovered and genotyped more than 10k SNPs and used them to determine population structure. Their results show clear genetic differentiation among the Gulf of Mexico and the Mediterranean, and suggest separation between the Gulf of Mexico and Cape Hatteras, meaning that the latter cannot be used as reference for the Gulf of Mexico spawning component. Genetic information on the Cape Hatteras samples was very preliminary because it was based on a small sample of young-of-the-year juveniles, which were taken on only a single day. Respectively, the 144 and 38 SNPs that best differentiate between the Northwest Atlantic and the Mediterranean and between the Gulf of Mexico and the Mediterranean were selected and genotyped in 152 new samples. With a reduced panel of 40 SNPs, 93% and 60% correct assignments for Mediterranean and Gulf of Mexico samples respectively were obtained. Although this panel is the best performing to date, it can still be improved, particularly increasing the sample size of the Gulf of Mexico baseline.

Stock composition information can be applied at the data preparation stage of the stock assessment process to avoid utilizing mixed-stock data (e.g., CPUE series) to stock dynamics. SCRS/P/2016/038 presented a revised stock assessment approach for western origin bluefin tuna in which input data (catch, catch-at-age, catch-per-unit-effort) from the most recent ICCAT stock assessment of western Atlantic bluefin tuna fisheries was revised based on previous estimates of stock composition (Busawon *et al*., 2013; Fraile *et al.*, 2014; Rooker *et al*., 2014; Secor *et al*., 2015, Siskey *et al*., 2016). The assessment of western Atlantic fisheries was compared to the assessment of western-origin fish to demonstrate the sensitivity of results to stock mixing as well as to demonstrate a practical approach to operational assessments that account for stock mixing. Estimates of stock size and fishing mortality from the VPA of western-origin Atlantic bluefin were generally similar to the ICCAT (2014) estimates based on western Atlantic mixed-stock fisheries. However, estimates of SSB in the western origin assessment were lower in 1970s and SSB and recruitment were greater in recent years (since mid-2000s). Fishing mortality and recruitment were also lower in the 1980-1990s in the western origin assessment. These results are preliminary and work is ongoing to improve upon the approach.

3.2.1 Review status of ICCAT electronic tagging data base and the response to the letter from the SCRS Chair

The Group discussed the response to the request for electronic tagging data. Many cooperators responded positively to the request, and to date, summarized tracks from 770 individual fish have been submitted (**Table 1**). A review of the tagging (conventional and electronic tags) database was presented in SCRS/2016/135 (722 tracks reported within that document). The majority of tags have been released in the West Atlantic and Gulf of St. Lawrence, accounting for over half of the available data (**Table 2**). Four regions had zero tag releases, the North Central Atlantic, South Central Atlantic, northeast Atlantic, and Caribbean Sea. Of the 770 individuals, 242 were released within or entered the Mediterranean Sea, and 85 were released within or entered the Gulf of Mexico, and therefore could potentially have stock id assigned (**Table 3**). The Group discussed the need to review the list of potential investigators and send a second request to those that have not responded. The database has been posted on the ownCloud and is available to the SCRS.

3.2.2 Review/compile inventory of composition data (genetics, microconstituent) by fleet and area and year

The following were recommended related to the provision and structure of a stock structure inventory:

- Data will be made available to GBYP for archival and data amendment purposes. Records will be classified regionally according to the same 11 geographic boxes specified in the electronic tagging data set (Lauretta *et al.* 2016b) and made available to SCRS and associated scientists and stakeholders.
- To the extent possible, data providers agreed on the format constructed within the GBYP programme.
- The Group agreed that individual assignment data was required rather than strata-aggregated mixing levels. Individual assignment algorithms vary among data providers but the Group decided that this likely would not bias the intended stock mixing modeling efforts. Still, future research was recommended that should compare different individual and Group assignment methods. As analysis of stock mixing will become increasingly common in bluefin tuna assessments, the Group recommends that the Random Forest classification procedure (R code) developed by Dr. Alex Hanke should be nominated for inclusion in SCRS software tool kit.
- Where multiple methods were employed to assign population of origin for the same individual, and in cases of disagreement, the Group decided to respectively select the classification determined by: 1) otolith stable isotope information first; 2) genetics; and, then 3) otolith shape. This was justified on the basis that the stable isotope work is peer reviewed, at an operational stage, and 90% of the individuals on the compiled database (with 5495 individuals) have stable isotope information. The genetic work includes two different approaches that are not peer reviewed yet, and around 15% of the individuals have genetic origin information. Finally, otolith shape can be influenced not only by origin but also life history, and less than 3% of the individuals have this information.
- It was advised that age-0 population assignments should be dropped from any analysis as these serve a different purpose than assessing mixed stocks.

Individual assignments will require acceptance of error risk. Therefore categorical stock designations (i.e., east or west) will be made by the analyst. This is accomplished by provision of probability of eastern stock identity provided in the data set. There is some precedent and justification for acceptance of a 70% assignment probability (Fraile *et al*., 2014).

It was noted that there is a certain level of uncertainty in the estimates of movement matrices and mixing proportions. This should be reflected in a plausible range of OMs. In addition, due to a nature of highly migratory species, mixing proportions might change across years, and therefore stochastic mixing should be incorporated into the OMs. Since the population size differs between the western and eastern populations and stochastic mixing may increase a chance of higher exploitation of western stock, the extent of stochasticity could become one of drivers in management performance. Therefore, the Group recommended the OMs to cover these sorts of uncertainty/stochasticity.

3.2.3 Determine preliminary stock definitions

The Group considered past population structures developed at the 2013 SCRS Biological Parameters meeting (Anon. 2014b) and new information pertinent to Mediterranean subpopulation structure (H. Arrizabalaga in review). Discussions centered on feasible population structures that could be assessed by the operating model – MSE framework and centered on (1) new evidence of spawning in the NW Atlantic Slope Sea (Richardson *et al*., 2016); and (2) accumulated evidence on migration behaviours of adults originating from spawning regions within the Mediterranean Sea (Arrizabalaga *et al*., in review).

Slope Sea Spawning

Genetic investigation of stock of origin will occur for larvae collected in the Slope Sea from June-July 2016 and the limited number of ethanol preserved larvae collected in 2013. The collection and processing of the 2016 plankton samples is ongoing at this time (Richardson *pers. com.*).

Until results confirm otherwise, the Group provided guidance that spawners in the Slope Sea should be considered as part of a broader western Atlantic population (Gulf of Mexico, Greater Antilles, plus the Slope Sea). The Group recognized that the Slope Sea is in an area proximate to high levels of historical mixing and spawners within that region could include Mediterranean population individuals. An alternative concept is that spawning in the Slope Sea represents a separate population independent of the Gulf of Mexico and Mediterranean populations. It was noted that additional population structure could explain the inability of genetic approaches (e.g. SCRS/P/2016/32) to assign a substantial fraction of mixed stock samples to either the Gulf of Mexico or Mediterranean populations. Either of these concepts (population mixing or separate population), if proven, could have very large consequences in how populations are modeled, assessed and evaluated against reference points. At this time however, when new discoveries about Slope Sea spawning are imminent, the Group advises modeling Slope Sea recruits as part of the broader western Atlantic population.

Mediterranean subpopulation and Contingent Structure

Arrizabalaga *et al.* (in review) provided a synthesis of current knowledge regarding potential population structures within the Mediterranean. In essence, the new knowledge accumulated since the last meeting in Tenerife (Anon. 2014b) uncovered links between the western, central and eastern Mediterranean spawning grounds and the Atlantic Ocean. In essence, uncertainty remains high regarding the percentage of resident/migratory fish in each potential subpopulation or contingent. There is a need to reconcile results from different genetic studies, but even in the absence of genetic differences, if strong behavioural differences exist between fish spawning in different spawning grounds, there might be a need to consider this substructure in the management process. Current knowledge and research efforts provide limited opportunity to resolve the contingent hypotheses, but long term e-tag information as well as close-kin genetics would be helpful.

3.3 Review/develop movement matrices (probability of occurrence in a region, amongst 8 box model regions, by stock, month of the year, and size class)

Stock mixing influences on bluefin tuna assessments have been evaluated through the development of movement matrices. Butterworth and Punt (1994) and NRC (1994) studied how inclusion of mixing could affect the results of stock assessments for bluefin tuna using a discrete time box-transfer model. Porch *et al.* (2001) conducted sensitivity analysis of VPA results to stock mixing using a tag-integrated model of bluefin tuna (VPA 2-box model). Taylor *et al.* (2011) developed movement estimates using both bulk transfer and gravity based estimates as alternative methods to inform a Multi-stock Age Structured Tag Integrated Model (MAST). These estimates were based on a combination of electronic tagging, conventional tagging, otolith chemistry, and CPUE data. The bulk transfer method estimates all off-diagonal matrix cells (i.e., transfer coefficients from one area to another). This approach can be more robust, however, due to the number of parameters this method can make model convergence difficult. The gravity method estimates an ‘attraction’ coefficient for each area to derive residence, and movement is derived from relative attraction of other areas in that season. This approach reduces the number of parameters to estimate, but estimates may not be as realistic due to this simplification. Lauretta *et al.* (2015) incorporated both gravity and bulk transfer approaches to estimate movement matrices to inform an operating model with stock mixing. Galuardi *et al.* (2015) (R package “sattagsim”) and SCRS/P/2016/032 used advection diffusion population simulations to combine various sources of electronic tagging data to calculate the underlying seasonal movement probability matrix (i.e., the full Markov matrix of movements from-to all areas). This approach estimates movement outside of the assessment model, avoiding interactive effects of selectivity, fishing mortality and other assumptions. There are a number of possible uses for these estimates in operational modelling to support

MSE, and a related R package has been developed and is available. The simplest approach would be to assume the derived movement matrices are known exactly and 'hard-wire' these into the operating model and therefore avoid simultaneous estimation of movement in the operating model. This would greatly simplify estimation however it may lead to a model predicted spatial distribution of individuals that cannot be reconciled with other fishery information (for example the prediction of few fish in a particular area and season in which there are substantial catches of fish). An alternative, intermediate option would be to use the method to derive a prior on movement probabilities. This would provide both the benefits of a better defined estimation problem whilst allowing for flexibility in movement modeling in light of other fishery observations. Estimated movement matrices also have other potential uses such as probabilistic assignment of stock of origin to tracks of unknown origin and the prediction of seasonal expected distribution of individuals from one or more stocks. Future applications of movement matrices will continue to heavily rely on acquisition and compilation of electronic tagging tracks (see Section 3.2.1).

3.4 Review progress on age-length keys

Five documents were presented in relation to direct ageing, age-length keys and growth.

Document SCRS/2016/134 presented an updated comparison of age estimates from otoliths and spines from the same specimen, with the intention to analyze whether it is possible to use both structures in obtaining age-length keys for this species. The agreement between otolith and spine age estimates was good for bluefin tuna younger than 14 years old with less than one year of difference between averages for each age. Tests of symmetry showed asymmetrical distributions of ages. However no significant differences were found between the growth parameters estimated from both paired hard parts. The authors suggested using readings from both structures for constructing age-length keys for bluefin tuna younger than 14 years.

A question was raised about the influence of nucleus vascularization of fin spines in the age comparison; the authors confirmed that a correction for this had been applied. The use of a X^2 statistic test to determine at which point age symmetry is no longer maintained was also suggested.

Document SCRS/2016/133 analyzed the available direct ageing information in the last decade from Atlantic bluefin tuna caught in the eastern management area. To investigate differences among ALKs, a standard von Bertalanffy growth function (VB) was fit to length at age data for each stratum. Poor convergence of VB fitting to the asymptotic length due to the scarcity of old specimens was found for all available ALKs. After these analyses some records were identified as outliers (arising from reading methodological issues) and removed from the data base.

Document SCRS/2016/143 analyzed all data existing in the ICCAT bluefin tuna conventional tag data base, for extracting the data that could be used to detect growth in the wild with high confidence. The analysis revealed that very few data can be used whenever considering straight fork length and round weight without first applying a conversion factor. Questions were raised about the purpose of this paper because this data base was examined thoroughly in Ailloud *et al.* 2014 and found to have high quality information useful for estimating growth parameters after the data were subjected to stringent data quality control procedures; furthermore, the database has been used for growth estimations in conjunction with otolith data (SCRS/2016/147).

Document SCRS/2016/147 uses the improvements in otolith age determination together with advances in modeling of tag-recapture data to provide an update of the western Atlantic bluefin tuna growth curve. A much larger sample of otoliths has been aged (n=3,779) since parameters were last estimated (n=146) and ageing corrections have been made to avoid bias. For tagging data, new maximum likelihood approaches now render growth parameters directly comparable when they are estimated from otolith and tagging data. Growth parameters estimates were derived from an integrated analysis of both sources of data using the "Aires-da-Silva-Maunder-Schaefer-Fuller with correlation" (AMSFc) framework (Francis *et al*., 2016). Two different cases of the Schnute (1981) growth model were considered: the Richards model and the von Bertalanffy model. Results suggest that the Richards curve provides a better fit. Both curves follow a similar trajectory until age 16, after which they diverge from one another. The Richards model supports a lower mean asymptotic length ($L\infty$= 263.77cm FL) than the model currently used in the stock assessment ($L\infty$= 314.9cm FL). Implications of this change to the stock assessment process were discussed by authors. Discussion after the presentation acknowledged that the new model had provided a valuable contribution and requested a reestimation without the age 1 and age 2 observations because these might be biased through under-selection of slower growing individuals under length-specific selectivity.

3.4.1 Evaluate performance of various ALK approaches and cohort slicing

A presentation in relation to the use of hybrid age-length keys for improving age composition estimates dealt with how to accommodate the sparseness of aged samples in some years (SCRS/P/2016/049). In years with no aged fish in a length interval, the suggestion is to use cohort slicing; in years with adequate data for creating a key it is suggested to use the key. The "hybrid" approach applies to the case where there are fewer than 20 age readings in a length interval. In this case, it is suggested to average the result from cohort slicing and from the age-length key with the weight w for the key being w = n/20 for n < 20 and w = 1 for n = 20 or more; here n is the number of fish aged in the length interval.

A small working group was tasked with evaluating various ALK approaches and cohort slicing in an objective way. The report is provided in **Appendix 5**.

3.4.2 Develop preliminary age-length keys for each stock

A small working group was tasked with developing a preliminary ALK for each stock and the details are given in **Appendix 5**.

3.4.3 Review potential for developing age-stock-length keys

A small working group considered the potential for developing age-stock-length keys and the details are given in **Appendix 5**.

4. Review of Task I nominal catch

This section describes the current status of Task I (T1NC: nominal catches) and Task II (T2CE: catch and effort; T2SZ: actual size; T2CS: catch-at-size report by CPCs) statistics, aiming its validation and approval by the Group. This revision takes into account the improvements made with the incorporation of new information available (GBYP historical recoveries, size samples from farmed tuna, size samples from stereoscopic cameras, etc.) , and, it also focus on the improvements required for the next bluefin tuna stock assessment (planned for 2017).

4.1 Review Task I statistics to be used for the 2016 update projections

The Secretariat presented to the Group the current (up-to-date) T1NC statistics for the eastern (**Table 4** and **Figure 1**) and western stocks (**Table 5** and **Figure 2**). Catches from the last three years (2012 to 2014) are preliminary, and, 2015 still incomplete. A preliminary estimation of 2015 catches was made (for the 2016 update projections) using preliminary catches provided during the meeting by the National scientists (two stocks) and also using the BCD (Bluefin tuna catch documentation scheme) catches for the eastern stock. No changes were made to T1NC catches prior to 2013 since the SCRS meeting of 2015.

As requested by the Group in 2015, the Secretariat presented a comparison between T1NC and BCD annual catches. **Table 6** (and **Figure 3)** summarises the current BCD information (number, total weight and total number of fish) available in ICCAT between 2008 and 2016 by stock. From a total of 18942 BCDs issued since 2008, around 449 (about 2%, representing 890 t and 18837 fish) cannot be allocated to a stock (geographically undefined). In addition, several other types of omissions/inconsistencies/errors were identified (omissions in the number of fish caught and/or weight of the catch, no date of the catch, undefined gear, etc.) which do not allow to utilize their respective catches in any case. Details of these inconsistencies are presented in **Table 7** by flag, year, and stock. Without considering these problems, overall T1NC and BCD catches between 2008 and 2015 are very similar in the eastern stock (**Table 8**). The BCD information for the western stock is scarce (BCD system was developed for BFT-E), and thus cannot be compared against T1NC. There are however, some minor exceptions (mostly gaps in T1NC and very few cases with under estimations in T1NC). The Group agreed that the BCD information is a valid instrument to validate and get provisional T1NC catches (as it was here made for 2015 catches) for the eastern stock. In some cases, it can also be used to complete the T1NC gaps. However, the inconsistencies found in nearly 450 BCDs need to be solved before trying to use BCDs to fill the gaps in T1NC. The unclassified gear problem (gear codes: SURF + SPOR + UNCL) of T1NC, identified several years ago in both stocks, is still problematic (**Figure 4)** and no progress has been made to solve it. In the 50s and 60s, more than 25% of the entire catches lacks a gear association in both stocks. The Mediterranean region (eastern stock) is the worst case and the same problem (nearly 25% of Task I without gear) also occurred in the 80s. The Group established a work plan (**Table 14**) to, among other objectives, reduce the unknown gear catches to a minimum.

This task must be accomplished before the 2017 data preparatory meeting.

For 2017, other changes to T1NC were adopted by the Group. The historical Trap catch series of EU-Italy, Eu-Portugal, EU-Spain, and Morocco, recovered/revised under the GBYP programme (SCRS/2016/139), were finally approved by the Group. The Secretariat will send these catch series to each one of the above mentioned CPCs for a formal adoption.

4.2 Review CPC submissions of metadata describing the quality of the submitted statistics

The ICCAT catalogues of Task I (T1NC quantities) and corresponding Task II (T2CE and T2SZ/CS) stored in the ICCAT-DB system (i.e.: reported all over the years by the ICCAT CPCs) are presented in **Table 9** (BFT-E Atlantic region), **Table 10** (BFT-E Mediterranean sea) and, **Table 11** (BFT-W). The catalogues include the largest portion of the GBYP data recoveries, the largest amount of the stereoscopic camera samples, and the (first estimation) of the PS wild equivalent (discounted the growth in size during the fattening period) samples of the bluefin tuna harvested on the farms (2005 to 2013). Some Task II (both T2CE and T2SZ) datasets reported during the last two weeks have yet to be integrated into the ICCAT-DB system.

4.3 Review progress by CPCs on their submissions of Task II size data to include the actual size samples used to estimate the catch at size and using the new weight/length conversions

In relation to the Task II size frequencies (T2SZ) harmonization ongoing task, very little progress has been made during the last year. As shown in **Table 12**, T2SZ maintains globally (all flags and fisheries) reasonable levels of structural heterogeneity and poor resolution in time (high amounts of datasets/fish by year and quarter), many types of geographical stratification (grids of 1x1, 5x5, 5x10, 10x10, 10x20, sampling areas), several frequency types (FL, SFL, CFL, LD1, WGT, etc.) and various size intervals (1, 2, 5, and 10 cm/kg). Similarly, the T2CS information (**Table 13**) with similar levels of structural heterogeneity has not improved in the last year. The complete revision presented by Japan (SCRS/2016/123) of T2SZ and T2CS (1973 to 2011) significantly contributes to Task II harmonization (LL component).

4.4 Review and make final revisions to Task II by validating and integrating the catch at size statistics with new information from farms, harvesting and stereoscopic cameras, and other sources of information

The Secretariat presented to the Group the preliminary version of the "fully" revised catch-at-size (CAS, 1950-2013) prepared, as planned, for the 2014 stock assessment. This preliminary estimation already includes a large portion of the new ICCAT GBYP size samples recovered, and, the wild equivalent PS samples derived (using the "old" W/L relationships) from the farmed tuna samples. This preliminary CAS version could be used as the basis for the development of a final fully revised CAS. A joint effort (CPC scientists, Secretariat, ICCAT GBYP) needs to be made to achieve this goal. The work plan presented in **Table 14** was created specifically for that purpose.

5. Evaluate indices available for use in next assessment (including the index criteria table)

5. 1 Review currently used indices and updates for 2016 species group meeting

For eastern bluefin tuna, two updated series were presented to the Group. As the joint index with the Spanish traps stopped in 2013, the series for the Moroccan Atlantic traps for the period 1986-2015 was presented (SCRS/2016/136). The standardized index displayed a substantial increase in 2012 and remained at a high level since then. The data included above-quota released fish and improvements from the standardization were noted, but it was suggested to account for the effect of the quota-based management in the CPUE standardization. It was noted that outside-quota fish was estimated by the trap divers and that the geographical coverage was concentrated. The updated CPUE series of the Japanese longline fishery in the Northeast Atlantic for 2016 remains at a high level since 2010, supported by the 2003 and following year classes (SCRS/2016/122). The Working Group recognized that the geographical concentration of their operations was the result of the short fishing seasons and the high catch rates and the current quota. The Spanish baitboat index in the Bay of Biscay (Santiago *et al.* 2016) could not be updated due to lack of fishing activity during the last recent years. An acoustic survey (SCRS/2016/137) started in 2015 and might provide additional information about local abundance trends in the future, but was considered to be preliminary for the current assessment.

For western bluefin tuna, the updated index from the Japanese longline fishery to 2016 fishing year (SCRS/2016/122) was presented. The longline effort in the Northwest Atlantic in recent years has concentrated on waters off of Canada during November to February, and has observed nearly 100% positive occurrence of bluefin tuna in November 2015. The relatively high longline CPUEs both in the West and Northeast Atlantic have been supported mainly by the strong 2003-year class and the following year classes. The operations in September and October have not been included in this index, however operations targeting not only bluefin tuna in those months were observed in the recent years. It was noted that careful considerations would be needed for the use of Japanese CPUE series in the stock assessments.

5.2 Review of new indices of potential use in 2017 assessment

Three CPUE indices and four fishery-independent indices were presented for eastern bluefin tuna. The updated series from the Algarve trap operating off the southern coast of Portugal (Algarve) indicated an upward trend generally consistent with other fisheries indicators (SCRS/2016/118). However, concerns were raised about the possibility to standardize it to account for quota implementation and due to the lack of monthly data.

Two series of CPUE indices from purse seiners were presented. The fundamental difficulty to quantify effort proportional to fishing mortality rate for purse seiners was underlined. In purse seine fisheries, it was noted that recent research on purse seine standardization has been taken up. The updated nominal CPUE (catch per day) from the Balfegó purse seiners (2000-2016) was noted to display a good correlation with Japanese indices (SCRS/2016/132). GLM analysis show that only the year effect was significant. An updated CPUE series for Tunisian purse seiners in the central Mediterranean from 2009 to 2015 was presented (SCRS/2016/148).

The French aerial surveys for juvenile bluefin tuna in the Northwest Mediterranean Sea, from 2000 to 2015, displayed a general increase in abundance and changes in spatial distribution between the early 2000s and the 2009-2015 period (SCRS/2016/153). Diagnostics from sensitivity analyses from previous assessments were found satisfactory. It was noted that this index referred to a density of schools and not to individual fish abundance and that improvements could be expected by accounting for changes in detectability related to environmentally-driven factors including movement of the fish. The ICCAT GBYP aerial surveys of spawners currently covers four years (Di Natale and Tensek 2016). Concerns related to inter-calibration of the survey and transect density between areas were raised.

A potential larval survival index based on empirical data from rearing experiments of eggs and larvae was presented (SCRS/P/2016/043). The index, covering years 2000 to 2015, identified good larval survival in 2003 around the Balearic Islands, matching the high recruitments already reported by ICCAT, whereas poor conditions were estimated for 2013. The interest of this index was underlined but further developments were suggested so that it could be considered for inclusion in some way in a future stock assessment. Due to the differences between how assessment models will need to incorporate environmental factors, the most appropriate treatments of environmental covariates will be a recommendation to the Method Working Group.

The update of the larval survey in the western Mediterranean (Balearic Islands) up to 2014 was presented (SCRS/P/2016/041). Three different larval indices were computed. The three models showed an increase trend along the last years and were found to correlate with SSB. Larval abundance model considering variables related to the quality of larval habitat performed significantly better. It was noted that the characteristics of the survey changed over time and that methods for standardization were applied to the time series. It was suggested to investigate the reasons underlying the high value obtained in 2014.

For western bluefin tuna, two new potential indices of abundance were presented. The acoustic survey in the Gulf of St. Lawrence (SCRS/P/2016/34) was compared with the Gulf of St. Lawrence rod and reel index and showed similar trends, but with lower inter-annual variation observed in the acoustic survey. It was mentioned that the first two years of the series might have to be truncated due to potential bias from zeroes in the data. The acoustic index was not standardized, and it was noted that a change in survey vessel occurred after 2015, which may have resulted in a change in detection of bluefin. The Group noted that the acoustic survey might be a good candidate to test harvest control rules due to the low inter-annual variation. The larval recruitment index for the GOM based on Gulf of Mexico oceanographic index provided estimates of annual variation in spawning habitat suitability (SCRS/P/2016/37), and was shown to capture spatio-temporal variability in larvae occurrences habitat. Areas with favourable environmental conditions for larvae in the GOM exhibit year to year spatial and temporal variability linked with mesoscale oceanic features and sea surface temperature. The year-to-year variability in the index was driven primarily by sea surface temperature. It was suggested that the modality of best approach for inclusion in the stock assessment of indices based on environmental data should be investigated by the method Methods Working Group.

5.3 Review of progress towards combined CPUE indices

The small working group was settled to explore the feasibility of combining the non-aggregated longline catch and effort data from Canada, Japan, Mexico and United States in the West Atlantic. The conclusion of the workshop was that spatial overlap was observed when aggregate data was evaluated, and this provided encouragement to the small group to proceed with combining set by set data (Report on workshop to be presented to SCRS at Species Group). No decision on using the pooled data for a combined index will be made until after the data diagnostics and standardization details are reviewed sometime this fall. If it appears that a combined index can be derived, a second meeting of the Group will be proposed in the early 2017 to develop appropriate modeling approaches and diagnostics to evaluate the performance of combined fleet indices.

The general characteristics of all available indices were assessed through a list of criteria suggested by the methods Working Group (**Tables 15 and 16**). The tables were first filled for each index by each scientist in charge of the index. The Group then discussed and modified each entry. The Group agreed to discontinue assigning numerical scores to the entries and suggested several other changes. The two rows related to biological plausibility were replaced with a single row (discussed below). A row for “Other comments” was added and the row describing the continuity of CPUE was augmented with the number of years represented and the span of years covered by the index (e.g., 12 of 15 years). For the fisheries independent indices, the “Catch Fraction” criterion was changed to “Proportion of the stock covered”.

It was noted that the continuity of potential indices to be included in the stock assessment should be ensured to a certain extent for the following years. The availability of uncertainty quantification associated to each index was also underlined to consider their inclusion in the assessment model. The Group agreed to show all available indices. The Group did not make any selections of indices for the next stock assessment in 2017. The tables will be revised in the next data preparation meeting, when the selection of indices will also be done.

During the meeting, results from analyses of the interannual variability of the index and the deviation from assumed production model dynamics were reviewed (SCRS/2012/039). This exercise is a diagnostic that can flag indices with very or very low interannual variation in an index, outlier values or systematic trends that could be indicative of unaccounted for process error. The exercise is most useful for evaluating indices that would reflect or be used in production models (e.g. SSB, total biomass indices) it nonetheless can flag peculiar index behavior in age-specific indices that would be expected to vary with the variability in year class strength. To make this analysis requires making an assumption about the intrinsic rate of population increase (r). Values were taken from Fromentin *et al.* 2010 and were, for WBFT = 0.84, and for east bluefin tuna = 1.54 (John adds a sentence to that – Sylvain’s comment). This process also requires an assumption of the rate of initial biomass level relative to K at the start of the index time frame (assumed to be 0.5 for each index), the maximum rate of annual decline in biomass (assumed to be 0.5, or 50% of the population can be removed in a year). Overall most of the indices showed high interannual CVs with some above 1. One purse seine index showed very little variability indicative of potential hyperstability. About half of indices showed substantial deviations from assumed production model dynamics (>50% outside plausible bounds) (**Figures 5 and 6**). Lastly many indices showed positive deviations in the most recent years, a time frame when regulatory impacts have substantially impacted all fishery-dependent indices. Taken qualitatively, this suggests either that the assumed surplus production model framework is not appropriate or that the indices may not reflect population dynamics model assumptions very well.

6. Review of assessment methods

6.1 Review current models and proposed enhancements

SCRS/P/2016/38 presented progress towards incorporating stock mixing into the VPA assessment of Atlantic bluefin tuna through the use of otolith-derived stock composition information to revise data inputs.

6.2 Review new models under consideration for 2017 assessment

SCRS/2016/152 provided a description of the Statistical Catch at Length (SCAL) assessment methodology, covering both the formulation of the population dynamics and the penalised log likelihood used for fitting to data. Parameter value inputs for recent applications to East Atlantic and Mediterranean as well as to West Atlantic bluefin tuna were provided, together with the data used on those occasions. The approach as presented is applicable only to separate West or East and Mediterranean stocks, and is not able to explicitly address a situation where these two stocks mix. This submission was intended to serve as an initial step in the process of this methodology being considered for possible use in the 2017 assessment update process.

6.3 Review status of the ICCAT Stock Assessment Software Catalogue

Under the SCRS Strategic Plan for 2015-2020 it was agreed to consolidate the Stock Assessment Software Catalogue and to ensure the best use of stock assessment models that should be fully documented.

To do this three strategies were agreed in the Strategic Plan:

1.3.1 Update the current stock assessment software catalogue, by removing outdated software and updating the software versions that are currently being used.
1.3.2 Ensure that all software used in the most recent assessments are matched up with the versions in the catalogue.
1.3.3 Ensure that software is well documented and have an accompanying user's manual and code.

The measurable target for the Software Catalogue under the Strategic Plan is to reactivate the Working Group on the Stock Assessment Software Catalogue and review the protocols of inclusion and updating the software used for stock assessments, while maintain a historic repository of version control. A review of current protocols was completed in 2015 with the participation of the Species Group rapporteurs, the main change is to recommend that a version control system is used to track changes in the software. See: github.com/ICCAT/software/wiki/1.-Introduction

7. GPYP Core Modelling MSE Group

7.1 Review of activities relative to MSE/MP development

Dr. T. Carruthers gave presentations on issues arising from the preliminary conditioning of operating models for Atlantic bluefin tuna (SCRS/2016/145), including outstanding data needs, and the progress on simulation testing (SCRS/2016/144).

7.2 Review, discuss and complete the technical specifications for the MSE/MP

The proposed fleet structure definitions for the operating model and tentative specifications for assessment models are outlined below. We note that for stock assessment models there may need to be some flexibility in these specifications pending examining initial model run diagnostics, particularly as non-spatial models may need to incorporate some flexibility by allowing selectivity to model spatial changes in a fleet.

- Longline (2 fleets): Japan_longline, Other_longline
- Baitboat (2 fleets): BBPre2009, BB2009onwards
- Purse Seine (5 fleets): PSMedRecent_2009onwards, PSMedLarge_Pre2009, PSMedSmall_Pre2009, PSWestern_Pre1987, PSWestern_1987onwards. The precise separation of small *versus* large purse seines fleets in the Mediterranean will be defined according to quarter and flag.
- Trap (2): TPPre2009, TP2009onwards
- Rod and reel (2); RRCan, RRUS, only use complete data from 1988 on due to missing data from some fleets prior to this year.
- All other fleets (1)

This totals 14 fleets. Many fleets were split at 2009 due to the impacts of Resolution 08-05 that affected fleet operations.

7.3 Recommend Task I and Task II statistics, abundance indices and other information to be used for the MSE/MP

The draft document entitled *Specifications for MSE Trials for Bluefin Tuna in the North Atlantic*, developed during the Monterey meeting (Anon. 2016), included a number of items specifically referred to this Data Preparation meeting for final decision. Those decisions are set out below, with the table references being to that document unless otherwise indicated.

- Table 2.1 (Overview of available data which may be used): The ICCAT CATDIS dataset and the ICCAT bluefin size frequency data set are the sources of catch and catch composition observations, respectively. These data are now available at a sufficiently fine scale to allow for modification of fleet definitions and spatio-temporal strata for the operating models to be used for the MSE.
- Tables 2.2 and 2.3 (PSAT and otolith microchemistry data): The stock of origin data (otolith microchemistry) and electronic tagging (PSAT) data had both been compiled into single datasets. These are now available in their raw form, providing flexibility over how they may be aggregated and interpreted. Data of this nature which are provided to ICCAT only after the final day of this meeting will not be included among those to be used in conditioning the operating models.
- Fleet selection (Section 3 part *III*): Fleets are defined as fishing activities for which size selectivity can be assumed to be constant over time and space. Based on historical changes in fishing, observations of size data and the estimated selectivities from a previous stock assessment model, the group identified 14 discrete fleets (see Section 7.2 above). These were structured using fishing season, year, area, flag and gear group codes.
- Indices to use in projections (Section 7 part *I*): The predictions of the conditioned operating models can be compared with relative abundance indices to characterize the statistical properties of these data (e.g. imprecision, autocorrelation, constant of proportionality). In the absence of a combined index derived from Canadian, U.S. and Japanese longline catch rate data in the west, the meeting agreed to replace this option with two alternative options: the Japanese longline index and the combined US-Canada longline index (Lauretta *et al.* 2016a).
- Parameter values (Table 8.2): The von Bertalanffy growth curve will be replaced by a Richards curve (see section 3 of the report of this meeting). The same age-based mortality curve will be used for both stocks. This is a Lorenzen type curve in which natural mortality rate is inversely related to weight. $M=3W^{-0.288}$ (see details given in section 3.1 of the report of this meeting). Two scenarios for maturity-at-age were developed during the meeting, which could be applied to either stock to form a crossed design (younger/older maturity schedule in the west by younger/older maturity schedule in the east) (see details given in section 3 and appendic 3.1 of the report of this meeting).

8. Other matters

8.1. Biometrics for farmed fish

The Commission requested information on the appropriate length-weight relationships to be used in the calculation of weight of fish when they are put in the farms. Two papers were presented and are described below. However, the Group decided that the response to the Commission should be developed at the September Species Group meeting.

The SCRS/2016/131 examines the suitability of using the most recent length-weight relationship adopted by ICCAT for the eastern stock to calculate weights from lengths measured by stereo cameras. The estimated weights were compared with those obtained from direct observations from purse seiners' catches in the Balearic grounds. Observations come from fish that died during fishing operations or were damaged and had to be killed during the fishing season from 2010 to 2015. The results showed that estimations with the annual L-W relationship overestimate the catch (quota) around 4% and the relationship for the month of June around 6%. Therefore, a good and representative model for the stock might not be the same for each fishery. The authors consider it advisable that the L-W metrics for stereo cameras should be adjusted for each region.

The document SCRS/2016/149 reharding morphometric relationships of fattening bluefin tuna (*Thunnus thynnus*) caught in the central Mediterranean in 2013 and 2014, analysed the length–length (LLR) and length–weight (LWR) relationships of fattened bluefin tuna, caught in the central Mediterranean Sea and farmed in the region of Mahdia (Tunisian eastern coasts). Fulton's condition factor (K) was also estimated. A total of 1,653 and 713 specimens from the catches of 2013 and 2014 were sampled, respectively. The LLRs, the LWRs and the condition factor K showed significant differences between fattened fishes of the two years. These differences seem related to the duration of the fattening process.

8.2. Observer coverage

Document SCRS/2016/124 presents a short summary of Japanese scientific observer data collected on their longline vessels in 2014 and 2015 fishing year (FY) in the entire Atlantic Ocean were presented with the observer coverage. In 2015 FY, 17 observer trips were conducted and 710 operations were monitored, while the observers monitored 1,363 operations in 30 trips in 2014 FY. Details of trips, animal records, and the coverage level based on the number of operating days are available in the document. In each FY, more than 35,000 individuals were recorded. Japan's observer programmes covered 8.7% fishing activities in the entire Atlantic Ocean in 2015 calendar year, and also monitored 30.4% of the operations for eastern Atlantic bluefin tuna in 2015 FY.

9. Recommendations

9.1 Statistics

See above item 4.4 for details on a work plan (see also **Table 14**) aiming the provision of a “fully” revised catch-at-size (CAS, 1950-2013) data set.

9.2 Research

Without financial implications

- Continued sampling and analysis of otoliths and genetic tissues for stock composition analysis, particularly sampling that is representative of principal fishing fleets, size and age classes, and regions. Individual stock assignments should be coupled with age estimates and provided to the GBYP database on stock composition.
- Evaluate bias in stock assignment procedures owing to empirical approaches and assignment algorithms. Continue exploration of the influence of incorporating mixing and population structures into assessment and simulation (operating model) frameworks.
- Evaluate population origin for larvae collected in the Slope Sea.
- Evaluate potential for spawning in regions within and outside (i.e., the Azores; Morocco and Canary Islands) of the Mediterranean Sea.
- the Group should use the available and latest models that predict habitat/seasons of spawning bluefin together with observations of co-occurrence of bluefin in those areas/times to define areas of highest priorities for new larval surveys.
- The ICCAT GBYP larval workshop should have as an objective to evaluate the resources required to provide larval indices with coefficients of variation that are smaller to those currently obtained in existing larval indices.

With financial implications

- Next iteration of the feasibility of close-kin analysis should consider that the estimation of the proportion of each age group which contributes to spawning is one of the highest priorities as a possible objective for a future close-kin analysis.
- A last call needs to be issued for available electronic tagging data providing a firm threshold date for data receipt.
- Continue to deploy archival tags, particularly for juveniles and acquire archival tag tracks in the Mediterranean Sea to support inferences on initial size at spawning and population structure.
- Longline cruise to obtain linked samples for reproductive analyses, otolith microchemistry and genetic analyses.
- Obtain samples of Atlantic bluefin tuna from the South Atlantic for population assignment purposes.

Research on the Slope Sea, which includes:

- An ichthyoplankton survey that is designed to allow for rigorous comparisons of the relative magnitude of spawning in the Slope Sea and Gulf of Mexico.
- Further work to evaluate the spatial extent of nursery (YOY and age-1) areas for bluefin tuna spawned in the Gulf of Mexico and Slope Sea. Analyses of existing western Atlantic YOY samples determine whether a spawning ground can be assigned.

9.3 Other

Given that the convergence of relatively long term environmental time series and more advanced modeling tools to incorporate environmental covariates, it is necessary to consider how environmental indices should be used in stock assessments. The Group recommends that the ICCAT Stock Assessment Methods Working Group consider a set of criteria similar to the CPUE report card for evaluating the suitability of environmental indicators for explicit inclusion in assessment models. This may include consideration such as the mechanistic link between the process and the biology, the model parameters that the covariate may influence and whether appropriate diagnostic and methodological performance of the covariate has been conducted.

10. Adoption of the report and closure

Due to the limited time, some of the analyses conducted in support of various agenda items were only partially reviewed in plenary prior to the close of the meeting. These analyses are included as appendices (4 and 5) to this report with the appropriate annotation. The remainder of the report was adopted during the meeting. The meeting was adjourned.

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Table 1. Cooperators that have provided electronic track data for Atlantic bluefin tuna.

Investigator	# Tags
AZTI Tecnalia (AZTI)	20
Grande Bluefin Year Programme (GBYP)	134
Department of Fisheries Oceans (DFO)	48
DFO - Acadia National Park (Acadia)	37
DFO - Duke University (Duke)	15
Instituto Espanol de Oceanographica (IEO)	13
Large Pelagics Research Center (LPRC)	316
National Oceanic Atmospheric Administration (NOAA)	31
Natural Resource Damage Assessment (NRDA)	24
Universidad de Cadiz (UCA)	46
WWF	86

Table 2. Number of tags released per stock area.

Release_Area	# tags
GOM	31
CAR	0
GSL	121
W_ATL	319
NC_ATL	0
SC_ATL	0
NE_ATL	0
SE_ATL	93
E_ATL	37
W_MED	132
E_MED	37

Table 3. Number of individuals that were released within or entered a stock spawning area.

Spawn entry	# tags
MED-EAST	242
UNKNOWN	443
GOM-WEST	85

Table 4. Current Task I BFT-E estimated catches (t) by area, gear and flag, between 1970 and 2015.

			1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	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	2012	2013	2014	2015
BFT-E	TOTAL		10686	10958	10692	10969	19178	21461	22357	18980	14867	12323	13935	13778	22426	21745	24442	22063	19260	18228	24129	21074	23257	26440	31851	34161	46748	47288	50821	50476	40464	32430	33789	34616	33775	31175	31392	35862	30708	34533	23862	19765	11155	9774	10934	13244	13250	15673
	ATE		5972	4761	4733	4862	6108	10180	5275	7153	6020	4855	3892	3253	6699	8105	7396	4806	4687	4453	6951	5434	6040	6556	7619	9251	6931	9646	12674	16856	11739	9596	10547	10086	10347	7362	7410	9036	7535	8037	7645	6684	4313	3984	3834	4163	3918	4742
	MED		4714	6197	5958	6107	13070	11280	17082	11827	8848	7467	10043	10525	15727	13640	17046	17257	14572	13775	17178	15640	17218	19884	24232	24910	39818	37642	38147	33619	28725	22834	23242	24530	23428	23813	23983	26826	23173	26495	16217	13080	6842	5790	7100	9081	9333	10931
Landings	ATE	Bait boat	3017	3055	3032	3316	2385	3193	1868	3055	4126	2216	1707	1479	987	3127	2949	2364	2253	2129	2682	2685	1993	1648	1418	3884	2284	3093	5369	7215	3139	1554	2032	2275	2567	1371	1790	2018	1116	2032	1794	1260	646	636	283	243	95	10
		Longline	274	254	261	91	2243	2923	2048	1806	733	748	1002	575	2705	2626	1541	551	967	924	1169	962	1496	3197	3817	2717	2176	4388	4788	4534	4300	4020	3736	3303	2896	2750	2074	2713	2448	1706	2491	1960	1194	1157	1166	1193	1220	1478
		Other surf.	19	106	107	16	1	4	9	5	3	2	2	4	30	134	262	175	133	357	475	307	262	143	557	995	627	555	273	135	395	404	510	712	701	560	402	1014	1047	502	187	298	143	36	49	141	210	221
		Purse seine	876	683	961	933	1459	3612	860	1426	257	266	437	266	655	262	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	0	0	2	0	
		Sport (HL+RR)	0	0	0	0	0	0	0	300	450	1023	38	70	12	0	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	23	19	25	21	16	128
		Traps	1786	663	372	505	20	448	490	561	450	600	706	859	2309	1956	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	2307	2137	2311	2564	2376	2905
	MED	Bait boat	0	0	0	0	0	0	0	0	0	0	0	100	53	0	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	38	0	0	2	11	0	
		Longline	69	129	236	520	2408	1400	1243	639	179	222	253	342	1550	980	1196	1228	678	799	1227	1121	1026	2869	2599	2342	7048	8475	8171	5672	3131	2463	3317	3750	2614	2476	2564	3101	2202	2656	2254	1344	875	869	587	605	586	538
		Other surf.	758	516	73	122	81	122	251	281	202	239	253	380	542	684	1752	3265	3556	2773	2876	3298	1216	1409	1894	1615	3226	1044	1200	1040	1882	2978	1069	1101	994	2539	1107	484	307	699	1022	0	275	223	26	72	81	80
		Purse seine	2393	3904	4084	4324	8119	8065	13970	9563	7299	6103	8541	8529	12131	10484	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	5057	4293	6172	7974	8184	9853
		Sport (HL+RR)	100	100	100	100	100	114	100	188	160	153	60	22	87	194	275	507	322	433	844	460	1559	742	952	1238	2257	3556	2149	2340	1336	1627	1922	1327	1647	1401	1351	646	515	95	149	160	353	226	177	189	239	259
		Traps	1394	1548	1465	1041	2362	1579	1518	1156	1008	750	936	1152	1364	1298	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	125	222	232	192
Discards	MED	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	12	9	11	2
Landings	ATE	Cape Verde	0	0	0	0	0	0	0	0	0	0	0	0	0	10	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	0	0	0	
		China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	36	38	37	43
		Chinese Taipei	46	12	2	1	12	5	3	2	0	3	5	6	16	2	3	16	197	20	0	109	0	0	0	6	20	4	61	226	350	222	144	304	158	0	0	10	4	0	0	0	0	0	0	0	0	
		EU.Denmark	1	2	1	3	1	2	1	3	0	1	2	1	0	0	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	0	0	0	0	
		EU.España	3785	2975	2542	3280	1685	2649	2067	3088	4247	3629	2161	2172	2854	4540	4805	3627	2876	2477	4567	3567	3557	2272	2319	4962	3137	3819	6186	9519	4163	3328	3493	3633	4089	2138	2801	3102	2033	3276	2938	2409	1483	1483	1329	1553	1282	1556
		EU.France	732	680	740	551	522	692	267	592	723	275	260	153	150	400	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	148	223	212	302
		EU.Germany	14	1	6	2	0	0	0	0	1	1	0	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	0	0	0	0	0	0	0	0	0	
		EU.Greece	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	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	10	13	19	14
		EU.Poland	0	100	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	191	303	24	14	56	35	24	17	41	174	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	223	235	243	263
		EU.Sweden	4	3	0	0	0	2	8	2	2	0	0	1	0	1	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	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	1	0	1	1	12	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	
		Faroe Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Guinea Ecuatorial	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
		Guinée Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	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	0	0	0	0	2	27	0	0	1	0	0	0	0	0	0	0	0	2	5	4	30	
		Japan	21	157	240	44	2195	2900	1973	1594	577	630	880	515	2573	2609	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	1093	1129	1134	1386
		Korea Rep.	0	0	19	43	36	15	3	2	0	1	0	0	0	3	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	0	0	0	0	
		Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Maroc	692	93	653	513	597	2624	331	884	36	206	161	177	993	365	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	990	960	959	1176
		NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Norway	677	738	430	421	869	988	529	764	221	60	282	161	50	1	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	0	0	0	0	
		Panama	0	0	0	3	0	0	69	208	156	14	117	48	12	0	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	0	0	0	0	
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	
		Seychelles	0	0	0	0	0	0	0	0	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	0	0	0	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	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	0	0	0	0	
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	9	34	40
		Algerie	100	100	1	0	33	66	49	40	20	150	190	220	250	252	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	0	69	244	244	370
		China PR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	
		EU.Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1418	1076	1058	1410	1220	1360	1105	906	970	930	903	977	1139	828	1017	1022	825	834	619	389	371	369	384	385	456
		EU.Cyprus	0	0	0	0	0	0	0	0	0	0	10	10	10	10	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	18	17	17	22
		EU.España	349	182	212	420	203	120	253	158	165	115	133	354	989	812	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	942	942	1064	948	1164	1217
		EU.France	1100	2200	1100	1400	1800	1600	3800	3182	1597	1578	1701	2350	4878	3660	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	791	2191	2207	2293
		EU.Greece	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	176	178	161	195
		EU.Italy	2264	2480	3718	3167	6839	7083	10369	6263	4983	4020	6272	6017	6658	5865	7140	7199	7576	4607	4207	4320	4117	3787	5006	5329	6882	7062	10006	9548	4441	3283	3847	4383	4628	4981	4697	4853	4708	4638	2247	2749	1060	1783	1788	1938	1946	2273
		EU.Malta	20	2	4	56	35	76	34	77	28	34	28	42	61	41	35	75	53	47	30	38	85	113	81	259	580	590	402	396	409	449	378	224	244	258	264	350	270	334	296	263	136	142	137	155	160	180
		EU.Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Egypt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64	77	77	155
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	1	
		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	0	0	0	0	0	0	
		Israel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	0	0	112	246	2195	1260	968	520	61	99	119	100	961	677	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	0	0	0	0	
		Korea Rep.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	77	80	81	
		Libya	500	600	449	475	1469	780	799	336	677	424	398	271	310	270	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	756	929	933	1153
		Maroc	0	79	37	1	9	40	1	7	0	2	0	2	0	1	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	223	309	310	322
		NEI (Flag related)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		NEI (MED)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	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	0	0	0	0	
		NEI (combined)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Panama	0	0	0	0	0	0	0	4	0	0	0	0	0	0	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	0	0	0	0	
		Serbia & Montenegro	0	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	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Syria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	50	41	0	34	0	0	0	0	40
		Tunisie	153	206	57	52	136	83	66	131	141	262	228	218	298	293	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	1017	1057	1047	1248
		Turkey	138	22	68	66	34	17	181	177	127	27	391	565	825	537	869	41	69	972	1343	1707	2059	2459	2817	3084	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	519	536	551	555	957
		Yugoslavia Fed.	90	326	200	224	317	155	562	932	1049	756	573	376	486	1222	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	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU.Croatia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	5	5	2	2
		EU.España	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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
		Libya	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	4	0	
		Tunisie	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	
		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	

Table 5. Current Task I BFT-W estimated catches (t) by area, gear and flag, between 1970 and 2015.

			1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	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	2012	2013	2014	2015
BFT-W	TOTAL		5466	6591	3948	3871	5393	5072	5883	6695	5765	6255	5802	5770	1442	2542	2280	2669	2316	2503	2896	2759	2780	2920	2282	2367	2113	2425	2514	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1876	2007	1754	1482	1626	1840
Landings	ATW	Longline	268	1390	339	1127	946	1562	3066	3753	3247	3713	3983	3898	374	829	823	1229	758	1138	1371	698	739	894	674	695	539	468	547	382	764	914	858	610	729	186	644	425	565	420	606	366	529	743	478	470	497	482
		Other surf.	83	182	186	115	256	24	311	194	163	174	121	113	309	514	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	126	148	117	121	119	938
		Purse seine	4288	3769	2011	1656	960	2320	1582	1502	1230	1381	758	910	232	384	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	0	2	29	38	
		Sport (HL+RR)	644	1144	1354	816	2955	1022	752	874	904	956	893	808	459	808	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	917	692	810	391
		Traps	183	106	58	157	276	144	172	372	221	31	47	41	68	7	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	17	11	20	6
Discards	ATW	Longline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	202	224	145	139	2
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	21
		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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	4	
		Sport (HL+RR)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	
Landings	ATW	Argentina	0	2	0	2	0	0	0	0	0	0	0	0	0	0	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	19	0	0	0	0	
		Brazil	0	0	0	0	0	0	0	0	14	10	2	3	1	1	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	0	1	0	0	
		Canada	1442	1082	477	1018	768	641	846	972	670	245	324	425	291	433	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	477	480	463	531
		Chinese Taipei	2	13	7	2	20	1	0	1	1	49	15	7	11	2	0	3	3	4	0	20	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	200	0	0	0	0	40	0	1	2	0	1	0	0	0	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	0	0	0	0	
		EU.Poland	0	0	0	0	3	0	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	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	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	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	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	0	0	0	9
		ICCAT (RMA)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	66	1375	321	1097	905	1513	2902	3658	3144	3621	3936	3771	292	711	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	289	317	302	347
		Korea Rep.	0	0	11	23	20	8	7	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	1	52	0	0	0	0	0	0	0	0	
		Mexico	0	0	23	29	39	24	37	14	28	22	10	20	14	0	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	51	23	51	53
		NEI (ETRO)	0	0	0	0	0	0	0	0	0	0	0	0	14	1	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	0	0	0	0	
		NEI (Flag related)	0	0	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	0	429	270	49	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	2	0	0	157	92	58	10	9	14	12	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	
		Trinidad and Tobago	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		U.S.A.	3756	4119	3109	1698	3638	2845	1931	1956	1848	2297	1505	1530	807	1394	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	713	502	667	877
		UK.Bermuda	0	0	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	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0
		UK.British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		UK.Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Discards	ATW	Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	17	0	0	3
		Japan	0	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
		U.S.A.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	166	206	159	143	20

Table 6. BCD inventory (as of 2016-07-19) by year (of catch) and stock (number of BCDs, total weight, total number). BCD related to 2016 is incomplete (preliminary, shaded in yellow). Unknown stock (UNK) in red indicates a possible incorrect fishing area.

	Number of BCDs			Total weight (t)			Total number		
Year of catch	BFT-E	BFT-W	UNK	BFT-E	BFT-W	UNK	BFT-E	BFT-W	UNK
2008	1326	80	10	19109	337	84	336526	26605	1287
2009	2238	176	332	13788	40	599	209532	191	14092
2010	3419	239	58	7792	77	160	134313	377	2663
2011	2741	428	11	7278	111	1	126535	695	34
2012	1810	78	13	9214	57	29	130469	284	539
2013	1782	260	2	11156	88	1	133801	468	9
2014	2126	149	9	11543	76	4	131441	435	55
2015	1357	66	5	13383	41	9	153340	234	124
2016	189		4	950		2	6131		13
?	20	9	5	26	2	1	519	9	21
TOTAL	17008	1485	449	94238	830	889	1362607	29298	18837

Table 7. Total catches (in number and weight (t)) obtained from the BCD system (as of 2016-07-19) held in ICCAT. Red figures could indicate an error or a major missing element (area, dates, gears, etc.)

			Σ(W[t]) by Year of catch									Σ(N) by Year of catch								
Stock	Fishing Flag	Errors/incompleteness	?	2008	2009	2010	2011	2012	2013	2014	2015	?	2008	2009	2010	2011	2012	2013	2014	2015
BFT-E	Albania	OK			50					34	40			485					320	303
	Algerie	OK		973				69	244	244	370		12593				1300	1851	3041	5085
	China PR	OK		68	42		36	36	38	38	43		652	285		246	215	229	197	245
	Egypt	OK					65	64	77	77	155					1845	706	1006	520	1203
	EU.Croatia	OK		941	613	383	371	373	346	385	468		80697	44836	36239	37369	33859	33891	35296	43431
	EU.Cyprus	OK		158	1	2	9	17	16	17	22		1633	6	23	194	300	118	318	384
	EU.España	OK		5164	1878	1647	1847	2161	2238	2256	2657		62925	16520	16240	20247	14286	16321	14603	17272
	EU.France	Incomplete (N.FISH and/or W.FISH)			2														1	
		NO DateCatch	2									72								
		OK		2078	2346	1412	685	676	1940	2083	2293		23797	31115	17703	10041	6300	18059	18135	17152
	EU.Greece	OK		207	253	172	165	162	107				1668	4529	3191	2292	2727	981		
	EU.Italy	Incomplete (N.FISH and/or W.FISH)												11	20					
		NO DateCatch	24									447								
		OK		1989	2425	283	1093	1743	1895	1854	2050		43211	41218	5012	17497	30009	21970	18682	18890
	EU.Malta	Incomplete (N.FISH and/or W.FISH)													16					
		OK		296	192	113	130	116	135	144	174		2186	1441	1165	1731	810	1121	1168	1490
	EU.Portugal	OK			61	110	180	216	236	242	262			482	824	1192	1372	1513	1295	1388
	Iceland	OK		50			2	4	4	28			460			12	26	17	148	
	Korea Rep.	OK		335	102			77	80	81			2165	3043			521	816	572	
	Libya	OK		1154	1060	645		763	933	933	1153		17786	13827	8237		7135	8720	9147	12042
	Maroc	OK		2316	2274	1539	1238	1187	1265	1267	1452		16200	12745	9028	6671	6312	6635	7560	7255
	Norway	OK								0									1	
	Syria	OK				34	81				40				995	2200				357
	Tunisie	OK		2475	1830	1044	851	1017	1057	1307	1248		48814	29557	26179	15673	17729	13256	13757	12815
	Turkey	OK		905	661	408	525	535	545	554	957		21739	9432	9441	9325	6862	7297	6680	14028
BFT-W	Canada	NO DateCatch	2									9								
		OK		19	31	65	98	14	70	32	26		105	153	326	642	96	382	236	163
	FR.St Pierre et Miquelon	Invalid Area					0									1				
	Mexico	OK		318	9	13	12	42	18	44	15		26500	38	51	52	187	83	199	69
	UK.Bermuda	OK						0	1		0						1	3		2
UNK	EU.España	Invalid Area		84				21					1287				478			
	EU.France	Invalid Area			452	154				2				11578	2532				23	
		NO Area/Gear			22	1								499	46					
		NO DateCatch/Area	0									5								
	EU.Italy	Incomplete (N.FISH and/or W.FISH)																		
		Invalid Area				4	0	0							63	1	1			
		NO Area/Gear			124	1	1							2000	11	14				
		NO DateCatch/Area	0									10								
		NO DateCatch/Area/Gear	0									6								
	EU.Malta	NO Area/Gear				1	0			0	1				11	1			1	10
	EU.Portugal	Invalid Area			1			8	0		0			15			58	2		1
	Turkey	NO Area/Gear					1	0	0	2	7					18	2	7	31	113
TOTAL			29	19529	14428	8029	7390	9300	11245	11623	13433	549	364418	223815	137353	127264	131292	134278	131931	153698

Table 8. Catch (t) comparison between Task I and BCD’s by Flag and year (2008 to 2015) in BFT-E stock. Only those BCD catches without any identified error were considered.

	Task I (t)								BCDs (t)								Task I – BCDs (t)							
Flag	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Albania		50		0		9	34	40		50					34	40	0	0	0	0	0	9	0	0
Algerie	1311				69	244	244	370	973				69	244	244	370	338	0	0	0	0	0	0	0
China PR	119	42	38	36	36	38	37	43	68	42		36	36	38	38	43	51	0	38	0	0	0	-1	0
Egypt					64	77	77	155				65	64	77	77	155	0	0	0	-65	-1	0	0	0
EU.Croatia	834	619	389	375	374	389	387	458	941	613	383	371	373	346	385	468	-107	6	6	4	1	43	2	-10
EU.Cyprus	132	2	3	10	18	17	17	22	158	1	2	9	17	16	17	22	-25	2	1	1	1	1	0	0
EU.España	5402	4178	2426	2426	2393	2502	2446	2782	5164	1878	1647	1847	2161	2238	2256	2657	238	2299	778	578	232	264	190	125
EU.France	2923	3454	1982	939	938	2414	2419	2595	2078	2346	1412	685	676	1940	2083	2293	845	1108	571	255	262	474	336	302
EU.Greece	350	373	224	172	176	178	161	195	207	253	172	165	162	107			143	121	52	7	15	71	161	195
EU.Ireland	1	1	2	4	10	13	19	14									1	1	2	4	10	13	19	14
EU.Italy	2247	2749	1060	1783	1788	1938	1946	2273	1989	2425	283	1093	1743	1895	1854	2050	257	324	776	689	44	43	92	223
EU.Malta	296	263	136	142	137	155	160	180	296	192	113	130	116	135	144	174	0	71	22	12	21	20	16	6
EU.Portugal	36	53	58	180	223	235	243	263		61	110	180	216	236	242	262	36	-8	-53	0	8	-1	2	1
EU.United Kingdom	0	1															0	1	0	0	0	0	0	0
Guinea Ecuatorial								1									0	0	0	0	0	0	0	1
Iceland	50			2	5	4	30		50			2	4	4	28		0	0	0	0	1	0	2	0
Japan	2431	1922	1155	1089	1093	1129	1134	1386									2431	1922	1155	1089	1093	1129	1134	1386
Korea Rep.	335	102			77	80	81		335	102			77	80	81		0	0	0	0	0	0	0	0
Libya	1318	1082	645	0	763	933	933	1153	1154	1060	645		763	933	933	1153	164	22	0	0	0	0	0	0
Maroc	2478	2278	1553	1237	1213	1270	1269	1498	2316	2274	1539	1238	1187	1265	1267	1452	162	4	14	-1	26	5	2	46
Norway	0					0	0								0		0	0	0	0	0	0	0	0
Senegal						6	0										0	0	0	0	0	6	0	0
Syria	41		34		0	0	0	40			34	81				40	41	0	0	-81	0	0	0	0
Tunisie	2679	1932	1042	852	1017	1057	1057	1248	2475	1830	1044	851	1017	1057	1307	1248	204	102	-1	0	1	0	-250	0
Turkey	879	665	409	528	536	551	555	957	905	661	408	525	535	545	554	957	-26	4	1	3	1	6	1	0
ICCAT (RMA)					5	5	1		n/a								n/a							
TOTAL	23862	19765	11155	9774	10934	13244	13250	14687	19109	13787	7792	7278	9214	11156	11543	13383								

Table 9. ICCAT catalogue of **BFT-E (ATE)** on statistics (Task-I and Task-II) by major fishery (flag/gear combinations ranked by order of importance) and year (1990 to 2015). Only the most important fisheries (representing +90% of Task-I total catch) are shown. For each data series, Task I (DSet= "t1", in tonnes) is visualised against its equivalent Task II availability (DSet= "t2") scheme. The Task-II colour scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"= CAS exists) that represents the Task-II data availability in the ICCAT-DB. See the legend for the colour scheme pattern definitions.

BFT-E (ATE)	T1 Total	6040	6556	7619	9251	6931	9646	12674	16856	11739	9596	10547	10086	10347	7362	7410	9036	7535	8037	7645	6684	4313	3984	3834	4163	3918	4742

Species	**Stock**	**Status**	**FlagName**	**GearGrp**	**DSet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	Rank	%	%cum
BFT	ATE	CP	Japan	LL	t1	1464	2981	3350	2484	2075	3971	3341	2905	3195	2690	2895	2425	2536	2695	2015	2598	1896	1612	2351	1904	1155	1089	1093	1129	1134	1386	1	28.3%	28%
BFT	ATE	CP	Japan	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		1		
BFT	ATE	CP	EU.España	BB	t1	1614	1200	1046	3718	1999	2878	4979	6634	2605	1278	1939	2168	2410	1239	1735	2012	1065	1903	1727	1197	562	562	197	163	92	10	2	22.7%	51%
BFT	ATE	CP	EU.España	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	2		
BFT	ATE	CP	EU.España	TP	t1	1911	1040	1271	1244	1136	941	1207	2723	1525	2005	1416	1240	1548	750	862	880	820	1348	1194	1209	902	902	1106	1370	1173	1466	3	16.1%	67%
BFT	ATE	CP	EU.España	TP	t2	ac	ac	ab	ab	ac	ab	ab	ab	ac	ac	ab	ac	ac	c	c	abc	b	a	abc	abc	abc	abc	abc	abc	ab	abc	3		
BFT	ATE	CP	Maroc	TP	t1	323	482	94	387	494	210	699	1240	1615	852	1540	2330	1670	1305	1098	1518	1744	2417	1947	1909	1348	1055	990	960	959	1176	4	14.7%	82%
BFT	ATE	CP	Maroc	TP	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	-1	-1	-1	-1	bc	abc	ab	abc	abc	abc	abc	abc	abc	abc	4		
BFT	ATE	CP	Maroc	PS	t1	54	46	462	24	213	458	323	828	692	709	660	150	884	490	855	871	179										5	3.8%	86%
BFT	ATE	CP	Maroc	PS	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1										5		
BFT	ATE	CP	EU.France	TW	t1	101	70	441	436	224	400		57	259	247	394	456	599	518	26		731	501	180	295	122	28	36	120	118	207	6	3.2%	89%
BFT	ATE	CP	EU.France	TW	t2	-1	-1	-1	-1	-1	-1		-1	-1	-1	-1	-1	-1	-1	-1		-1	abc	abc	ab	ab	abc	abc	ab	ab	ab	6		
BFT	ATE	CP	EU.France	BB	t1	367	448	372	164	66	181	310	134	282	270	91	105	150	130	47		50	128	67	62	83	74	85	74	2		7	1.8%	91%
BFT	ATE	CP	EU.France	BB	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1		-1	a	a	a	a	a	a	ab	ab		7		
BFT	ATE	CP	Libya	LL	t1			312				576	477	511	450							47										8	1.1%	92%
BFT	ATE	CP	Libya	LL	t2			-1				-1	-1	-1	-1							-1										8		
BFT	ATE	CP	EU.Portugal	LL	t1		99	4	4	8		97	246	18	404	398	383	160	33	1	63	71	6	12	5			8	0		0	9	1.0%	93%
BFT	ATE	CP	EU.Portugal	LL	t2		a	a	-1	a		-1	a	a	-1	-1	a	a	a	a	ab	a	a	a	a	a		a	a		ab	9		
BFT	ATE	CP	EU.Portugal	TP	t1						1	15	19	45	2	40	15	17	27	18	9	25	23	24	46	57	180	215	233	243	263	10	0.7%	93%
BFT	ATE	CP	EU.Portugal	TP	t2						-1	a	a	a	ab	ab	ab	ab	ab	b	b	b	b	b	b	ab	ab	b	ab	ab	ab	10		
BFT	ATE	NCC	Chinese Taipei	LL	t1				6	20	4	61	226	350	222	144	304	158			10	4										11	0.7%	94%
BFT	ATE	NCC	Chinese Taipei	LL	t2				-1	-1	ab	ab	ab	ab	ab	ab	ab	ab			ab	ab										11		
BFT	ATE	CP	EU.France	UN	t1					25			75							263	818	189		5		19					0	12	0.7%	95%
BFT	ATE	CP	EU.France	UN	t2					-1			-1							-1	-1	-1		-1		-1	a				-1	12		
BFT	ATE	CP	EU.France	GN	t1	42	47	74	497	21	144	253	3	72	71	57	68	6													0	13	0.7%	95%
BFT	ATE	CP	EU.France	GN	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1													-1	13		
BFT	ATE	CP	EU.Portugal	BB	t1	12		0	2	219	34	80	447	252	5	2	2	7	1	8	6	0	1									14	0.5%	96%
BFT	ATE	CP	EU.Portugal	BB	t2	a		a	ab	ab	ab	abc	abc	ab	ab	a	a	a	ab	abc	ab	a	a			a						14		
BFT	ATE	NCO	NEI (Flag related)	LL	t1		85	144	223	68	189	71	208	66																		15	0.5%	97%
BFT	ATE	NCO	NEI (Flag related)	LL	t2		-1	-1	-1	-1	-1	-1	-1	-1																		15		
BFT	ATE	CP	China PR	LL	t1									85	103	80	68	39	19	41	24	42	72	119	42	38	36	36	38	37	43	16	0.5%	97%
BFT	ATE	CP	China PR	LL	t2									-1	a	a	a	a	a	a	a	a	ab	a	a	a	ab	a	a	abc	-1	16		
BFT	ATE	CP	EU.España	HL	t1								162	28	33	126	61	63	109	87	11	4	10	6	2	19	19	25	21	16	62	17	0.4%	97%
BFT	ATE	CP	EU.España	HL	t2								ab	ac	ac	ab	ac	ac	c	c	abc	ab	abc	abc	abc	abc	abc	abc	abc	abc	ab	17		

Table 10. ICCAT catalogue of **BFT-E (MED)** on statistics (Task-I and Task-II) by major fishery (flag/gear combinations ranked by order of importance) and year (1990 to 2015). Only the most important fisheries (representing +90% of Task-I total catch) are shown. For each data series, Task I (DSet= "t1", in tonnes) is visualised against its equivalent Task II availability (DSet= "t2") scheme. The Task-II colour scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"= CAS exists) that represents the Task-II data availability in the ICCAT-DB. See the legend for the colour scheme pattern definitions.

BFT-E (MED)					T1 Total	17218	19884	24232	24910	39818	37642	38147	33619	28725	22834	23242	24530	23428	23813	23983	26826	23173	26495	16217	13080	6842	5790	7100	9081	9333	10931			
Species	**Stock**	**Status**	**FlagName**	**GearGrp**	**DSet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	Rank	%	%cum
BFT	MED	CP	EU.France	PS	t1	4663	4570	7346	6965	11803	9494	8547	7701	6800	5907	6780	6119	5810	5549	6339	8328	7438	9543	2536	2918	1546	678	678	1940	1944	2293	1	25.7%	26%
BFT	MED	CP	EU.France	PS	t2	bc	bc	b	b	b	b	b	b	bc	c	c	c	c	c	c	c	b	ab	ac	ac	ac	ab	ab	ac	ac	ac	1		
BFT	MED	CP	EU.Italy	PS	t1	2651	2652	3846	4162	4654	3613	7060	7068	3334	1859	2801	3256	3246	3849	3752	3961	4006	4311	1854	2339		752	1374	1474	1539	1678	2	14.5%	40%
BFT	MED	CP	EU.Italy	PS	t2	-1	-1	-1	-1	-1	ac	-1	-1	b	b	b	-1	b	b	b	b	b	a	ab	abc		abc	-1	-1	b	b	2		
BFT	MED	CP	Turkey	PS	t1	2059	2459	2817	3084	3466	4219	4616	5093	5899	1200	1070	2100	2300	3300	1075	990	806	918	879	665	409	528	536	551	544	957	3	9.4%	50%
BFT	MED	CP	Turkey	PS	t2	-1	-1	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	ab	ab	ab	ab	ab	ab	ab	abc	b	3		
BFT	MED	CP	Tunisie	PS	t1	114	1073	975	1997	2523	1617	2147	1992	1662	2263	2134	2432	2510	740	2266	3245	2542	2618	2679	1932	1042	852	1017	1057	1057	1248	4	8.2%	58%
BFT	MED	CP	Tunisie	PS	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	-1	-1	-1	a	b	abc	abc	ab	ab	ab	abc	ab	abc	b	4		
BFT	MED	CP	EU.España	PS	t1	635	807	1366	1431	1725	2896	1657	1172	1573	1504	1676	1453	1686	1886	1778	2242	2013	1649	1645	1167	877	877	1034	917	1122	1169	5	6.8%	64%
BFT	MED	CP	EU.España	PS	t2	a	a	a	a	ab	ab	ab	a	abc	abc	ab	ab	ab	ab	ab	ab	ab	bc	ab	ab	ab	ab	b	ab	ab	b	5		
BFT	MED	CP	EU.Croatia	PS	t1		1418	1076	1058	1410	1220	1360	1088	889	921	930	890	975	1137	827	1017	1022	817	821	609	370	366	367	380	378	438	6	3.9%	68%
BFT	MED	CP	EU.Croatia	PS	t2		a	a	a	a	-1	-1	-1	-1	-1	-1	a	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	6		
BFT	MED	CP	Libya	PS	t1	129	177	300	568	470	495	598	32	230	195	16		200	512	872	730	1140	1200	1267	1047	645		763	933	933	1153	7	2.6%	71%
BFT	MED	CP	Libya	PS	t2	-1	-1	b	-1	-1	-1	-1	-1	-1	a	a		-1	-1	-1	-1	-1	a	-1	-1	-1		ab	ab	-1	-1	7		
BFT	MED	CP	EU.Italy	LL	t1	79	102	78	135	1018	2103	2100	1620	674	515	287	260	395	475	302	310	286	217	216	193	521	670	256	180	115	312	8	2.4%	73%
BFT	MED	CP	EU.Italy	LL	t2	-1	a	a	b	ab	b	b	-1	ab	-1	ab	-1	-1	b	b	b	b	ab	abc	abc	abc	abc	abc	abc	ac	abc	8		
BFT	MED	CP	EU.España	LL	t1	59	51	28	40	178	368	369	871	253	418	493	644	436	583	529	484	668	745	804	590	58	58	26	24	34	57	9	1.6%	75%
BFT	MED	CP	EU.España	LL	t2	abc	ab	ab	ab	ab	abc	ab	ab	ab	ac	ab	ac	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	-1	9		
BFT	MED	CP	Algerie	PS	t1									900	1056	778	917	922		753	623	850	650	84				69	244	244	370	10	1.5%	76%
BFT	MED	CP	Algerie	PS	t2									-1	-1	-1	-1	-1		-1	-1	-1	-1	-1				ab	abc	ab	b	10		
BFT	MED	CP	Algerie	UN	t1	782	800	1104	1097	1560	156	156	157	175	179	101	145	145	1586	58												11	1.5%	78%
BFT	MED	CP	Algerie	UN	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1												11		
BFT	MED	CP	Libya	LL	t1	173	164	60	67	802	865	80	448	409	450	1002	1867	331	170	393	318	140	158	51	34							12	1.4%	79%
BFT	MED	CP	Libya	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	ac	a	a	-1	-1	-1	-1	-1	a	b	b							12		
BFT	MED	CP	Panama	LL	t1	74	287	484	467	1499	1498	2850	236																			13	1.3%	81%
BFT	MED	CP	Panama	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1																			13		
BFT	MED	CP	Japan	LL	t1	172	85	123	793	536	813	765	185	361	381	136	152	390	316	638	378	556	466	80	18							14	1.3%	82%
BFT	MED	CP	Japan	LL	t2	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	a	ac	ac	ac	abc	ac	abc	ab	ac							14		
BFT	MED	CP	EU.Greece	HL	t1	124	98	348	339	766	915	784	1127	279	233	597	341	394	245	73		6	7	93	66	135	52	39	35	78	90	15	1.3%	83%
BFT	MED	CP	EU.Greece	HL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	-1	-1	a	-1		-1	-1	a	a	a	a	a	a	a	a	15		
BFT	MED	CP	EU.Italy	SP	t1	442	352	368	410	480	491	360	350	5	415	383	401	600	500	500	500	277		17	58	161	66	8	10	10		16	1.3%	85%
BFT	MED	CP	EU.Italy	SP	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1		-1	a	b	-1	-1	-1	-1		16		
BFT	MED	CP	Maroc	HL	t1					373	816	541	455	634	600	650	195	407	570	597	80	187	19		2		78	120	130	134	138	17	1.2%	86%
BFT	MED	CP	Maroc	HL	t2					-1	c	-1	-1	-1	abc	ab	abc	b	b	b	b	b	b		b		abc	abc	abc	abc	abc	17		
BFT	MED	NCO	NEI (combined)	UN	t1					773	211		101	1030	1995	109	571	508	610	709												18	1.2%	87%
BFT	MED	NCO	NEI (combined)	UN	t2					-1	-1		-1	-1	-1	-1	-1	-1	-1	-1												18		
BFT	MED	CP	EU.Malta	LL	t1	81	105	80	251	572	587	399	393	407	447	376	219	240	255	264	321	263	144	165	263	136	92	137	89	91	49	19	1.1%	88%
BFT	MED	CP	EU.Malta	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	ac	ac	ac	-1	-1	-1	abc	bc	ab	ab	ab	ab	ab	abc	abc	abc	abc	19		
BFT	MED	CP	EU.Italy	TP	t1	279	263	364	199	182	241	297	154	419	308	353	427	364	145	119	69	125	93	149	144	281	165	125	222	231	192	20	1.1%	89%
BFT	MED	CP	EU.Italy	TP	t2	-1	-1	-1	-1	b	b	b	b	b	b	b	-1	-1	b	b	-1	b	abc	ab	a	a	abc	ac	-1	-1	-1	20		
BFT	MED	NCC	Chinese Taipei	LL	t1				328	709	494	411	278	106	27	169	329	508	445	51	267	5										21	0.7%	90%
BFT	MED	NCC	Chinese Taipei	LL	t2				-1	-1	b	b	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab										21		

Table 11. ICCAT catalogue of **BFT-W** on statistics (Task-I and Task-II) by major fishery (flag/gear combinations ranked by order of importance) and year (1990 to 2015). Only the most important fisheries (representing +90% of Task-I total catch) are shown. For each data series, Task I (DSet= “t1”, in tonnes) is visualised against its equivalent Task II availability (DSet= “t2”) scheme. The Task-II colour scheme, has a concatenation of characters (“a”= T2CE exists; “b”= T2SZ exists; “c”= CAS exists) that represents the Task-II data availability in the ICCAT-DB. See the legend for the colour scheme pattern definitions.

BFT-W				T1 Total		2780	2920	2282	2367	2113	2425	2514	2334	2657	2772	2775	2784	3319	2305	2125	1756	1811	1638	2000	1980	1876	2007	1754	1482	1626	1840			
Species	**Stock**	**Status**	**FlagName**	**GearGrp**	**DSet**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	Rank	%	%cum
BFT	ATW	CP	U.S.A.	RR	t1	752	696	324.25	540	462	844	840	931	777	760	683	1244	1523	991	716	425	376	634	658	860	682	592	568	365	478		1	30.4%	30%
BFT	ATW	CP	U.S.A.	RR	t2	ab	ab	abc	ab	ab	ab	b	ab	ab	ab	ab	abc	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc		1		
BFT	ATW	CP	Japan	LL	t1	550	688	512	581	427	387	436	330	691	365	492	506	575	57	470	265	376	277	492	162	353	578	289	317	302	347	2	18.6%	49%
BFT	ATW	CP	Japan	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		2		
BFT	ATW	CP	Canada	RR	t1	28	32	30	88	71	195	155	245	303	348	433	402	508	407	421	497	629	389	471	390	324	294	347	325	331	389.251	3	13.8%	63%
BFT	ATW	CP	Canada	RR	t2	a	ab	ab	ab	ab	ab	ab	ab	ab	b	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	-1	3		
BFT	ATW	CP	U.S.A.	LL	t1	275	305	347	177	185	211	235	191	156	222	242	130	224	299	275	211	205	173	233	335	239	241	295	208	222		4	10.0%	73%
BFT	ATW	CP	U.S.A.	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	b	ab	abc	ab	ac	abc	abc	abc	abc	abc	abc	abc	abc		4		
BFT	ATW	CP	U.S.A.	PS	t1	384	237	300	295	301	249	245	250	249	248	275	196	208	265	32	178	4	28		11			2	43	42		5	6.9%	80%
BFT	ATW	CP	U.S.A.	PS	t2	b	b	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	b	b	c	bc		bc			bc	bc	bc		5		
BFT	ATW	CP	Canada	TL	t1	404	447	403	284	203	262	298	138	172	125	81	79	39	42	49	44	35	23	24	37	40	30	34	52	40	35.198	6	5.9%	86%
BFT	ATW	CP	Canada	TL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		6		
BFT	ATW	CP	U.S.A.	HP	t1	129	129	105	88	68	77	96	98	133	116	184	102	55	88	41	32	30	23	30	66	29	70	52	45	68		7	3.4%	89%
BFT	ATW	CP	U.S.A.	HP	t2	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	bc	bc	bc	bc	bc	bc	bc	bc	bc		7		
BFT	ATW	CP	U.S.A.	HL	t1	210	341	218	224	228	66	33	17	29	15	3	9	4		1	2	0		1	0	3	1	1	0			8	2.4%	91%
BFT	ATW	CP	U.S.A.	HL	t2	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	b	c		c	bc	bc	bc	bc	bc			8		
BFT	ATW	CP	Canada	LL	t1	4	6	9	25	5	4	22	12	32	31	47	20	53	28	43	36	48	58	30	64	89	112	65	67	61	74.174	9	1.8%	93%
BFT	ATW	CP	Canada	LL	t2	ab	a	a	a	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	-1	9		
BFT	ATW	CP	Canada	TP	t1	2		1	29	79	72	90	59	68	44	16	16	28	84	32	8	3	4	23	23	39	26	17	11	20	6.473	10	1.4%	95%
BFT	ATW	CP	Canada	TP	t2	ab		ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	ac	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		10		
BFT	ATW	NCO	NEI (Flag related)	LL	t1							2			429	270	49															11	1.3%	96%
BFT	ATW	NCO	NEI (Flag related)	LL	t2							-1			-1	-1	-1															11		
BFT	ATW	CP	Canada	HP	t1				33	34	43	32	55	36	38	18	20	13	10	7	14	20	17	24	18	37	30	31	25	11	25.723	12	1.0%	97%
BFT	ATW	CP	Canada	HP	t2				ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc		12		
BFT	ATW	CP	Mexico	LL	t1					4		19	2	8	14	29	10	12	22	9	10	14	7	7	10	14	14	52	23	51	53	13	0.7%	98%
BFT	ATW	CP	Mexico	LL	t2					ab	b	ab	ab	ab	ab	ab	bc	b	ab	ab	ab	ab	abc	ab	ab	ab	ab	ab	ab	ab	-1	13		
BFT	ATW	NCO	Cuba	LL	t1													74	11	19	27	19										14	0.3%	98%
BFT	ATW	NCO	Cuba	LL	t2													ab	-1	-1	-1	-1										14		
BFT	ATW	NCO	Sta. Lucia	HL	t1	14	14	14	2	43	9																					15	0.2%	98%
BFT	ATW	NCO	Sta. Lucia	HL	t2	-1	-1	-1	-1	-1	-1																					15		
BFT	ATW	NCO	NEI (ETRO)	LL	t1	24	23	17																								16	0.1%	98%
BFT	ATW	NCO	NEI (ETRO)	LL	t2	-1	-1	-1																								16		
BFT	ATW	CP	Korea Rep.	LL	t1																1	52										17	0.1%	98%
BFT	ATW	CP	Korea Rep.	LL	t2																-1	-1										17		
BFT	ATW	CP	FR.St Pierre et Miquelon	LL	t1													3	1	10	5		4	3	2	8	0		0	0	9	18	0.1%	98%
BFT	ATW	CP	FR.St Pierre et Miquelon	LL	t2													-1	-1	-1	-1		a	a	a	ab	ab		ab	a	-1	18		

Table 12. Number of fish measured (1950-2015) in all T2SZ of ICCAT, by Stock, frequency type, and, time-area strata (in "red/yellow" the associated dataset samples requiring a revisions for the new CAS/CAA).

				TimeStrata GeoStrata														
				mm						qq						yy		
Stock	SubStock	FreqTypeCode	SzInterval	10x10	1x1	5x10	5x5	ICCAT	LatLon	10x10	10x20	1x1	5x10	5x5	ICCAT	1x1	5x5	ICCAT
BFT-E	ATE	CFL	5		432													
		FL	1	25434	23205		94602	186405			5019		19991	622	1470	1074		9000
			2		643	11588	6323	1013				67	13087	343				
			5		8027		101761	50463			239	170			5323	5077		
		SFL	1					27225										
		WGT	1		283265		70	1			30		24			79		
			2			671							10					
			10													29		
		WGT-FL	1		283245													
			5		14740													
	MED	CFL	1		6		5783											
			5		552													
		FL	1	119133	441472	834	503170	2082339		30	38	24	931	4269	10279	8346	181	357788
			2		8	656506	174						2877					7939
			5		153226		36983	3746	6			14333	1351	22496	9461	22209	4148	8964
			10		357											437		
		WGT	1		12748		188305						150			166458	181	192870
			5		419		1500					922	8295	136		117		4314
			10		99													
		WGT-FL	1				814	2962										
BFT-W	ATW	CFL	1		7795		5639	81078										
			5													192770		
		CPFFL	1				265	580										
		FL	1	3541	32439	31255	28920	53470		7	933		6306	5	428			
			2	487	923	29574	13145					1307	14897	3				
			5		1		1920	2476		6	114				115			
			10					153										
		LD1	1					17										
		WGT	1		714			9650			3	7						
			2			1651	1850											
			5					2040										
			10		175		1642									1577		
		WGT-FL	1					507										
total				**148595**	**1264491**	**732079**	**992866**	**2504125**	**6**	**43**	**6376**	**16830**	**67919**	**27874**	**27076**	**398173**	**4510**	**580875**

Table 13. Number of fish in the CPC "reported" catch-at-size (1950-2015) in all T2CS of ICCAT, by Stock, frequency type, and, time-area strata (in "red/yellow" the associated datasets requing a revision for the new CAS/CAA).

Sum of Nr				TimeStrata	GeoStrata										
				mm						qq			yy		
Stock	SubStock	FreqTypeCode	SzInterval	10x10	1x1	5x10	5x5	ICCAT	Stock	1x1	5x5	ICCAT	1x1	5x5	ICCAT
BFT-E	ATE	CFL	5		4311										
		FL	1		166960		593167	4559084					859		1455
			2		520		1542							66	
			5	75829	1114363	493839	933440	1067117						244884	41903
	MED	CFL	1				1239								
			5				835								
		FL	1		407542		780975	2120617			83				
			2			1239093		1172147							
			5		120290		68190	36430		12821	46351		61069	13452	147010
			10		1518			635							1099
		WGT	1										156050		
			5								975				
			10										68		
BFT-W	ATW	FL	1	2608		8786	73585	95069	102430			601			
			2				40043	36307							
			5				26								
		WGT	1					990							
			2				2445								
			5					2790							
total				78437	1815503	1741718	2495486	9091186	102430	12821	47409	601	218046	258402	191467

Table 14. Work plan aiming a full revision of the Bluefin tuna catch-at-size for the period 1950-2016.

Major goals by meeting:

• BFT data preparatory (March/2017):	Complete version ready (version 1)	[allowing minor adjustments and 2016 data]
• BFT stock assessment (Sep/2017 (?):	Final CAS/CAA (version 2)	[no more changes]

Task #	**Task**	**Description**	**Participation (*)**	**Start/ End**	**Deadline** (months)
1	Raw data revisions/corrections	Revise any required data source: - T1NC: corrections and UNCL gear "elimination" - T2CE: recover new & better resolution data (CATDIS improvement) - T2SZ: revise and harmonize series (month, 5x5, /1,2 cm, FL classes)	[CS]+[IS]+[GB]	Oct/2016	Dec/2016 (3)
2	CPCs CAS revision	Major CPCs (Japan, USA, Canada, Spain, France, Malta, Italy, Maroc) to revise/update their CAS estimations	[CS]	Oct/2016	Jan/2017 (4)
3	Report & database update	All the revised data (1) must be reported (format to be specified by the Secretariat in advance) to ICCAT in order to update ICCAT-DB	[CS]+[IS]	Nov/2016	Dec/2016 (2)
4	Estimate wild equivalent PS farmed samples	Redo the PS farmed samples work (inclusion of new data) SCRS/2014/162 (new W/L relationships [decisions required - small group]) ADD NAME OF CPCs OF THE SMALL GROUP	[CS]+[IS]	Nov/2016	Jan/2017 (4)
5	Update CATDIS	CATDIS update (box model) with data from (1) and reflecting Task I (Includes revision of the substitution criteria)	[IS]	Jan/2017	Jan/2017 (1)
6	Build CAS	Build CAS from scratch including ALL new T2SZ and CAS available (Includes revision of the substitution criteria)	[CS]+[IS]	Jan/2017	Feb/2017 (2)
7	Build CAA	Use "agit" software (default) and test other slicing approaches/algorithms	[IS]+[CS]	Mar/2017	During BFTdp
8	Final CAS/CAA	Final CAS adjustments (from 6) & decisions pending from	[IS]+[CS]	TBD	TBD

* Participation (FULL commitment): [CS] CPC scientists; [IS] ICCAT Secretariat; [GB] GBYP

Table 15. Available CPUE series for Eastern Atlantic and Mediterranean bluefin tuna in 2016.

Index	**Bay of Biscay Baitboat**	**Morocco and Spanish traps**	**Japanese East Atl &Med LL**	**Japanese NEAtl LL**	**Tunsian PS**	**Moroccan trap**	**Balfegó Purseiners**	**Portugal tuna trap**	**Sardinian Traps**
Fisheries Dependent/Independent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent
Stock	East and Med	East and Med	East and Med	East and Med	East and Med	East and Med	East and Med	East and Med	East and Med
Paper	SCRS/2014/054	SCRS/2014/060	SCRS/2012/131	SCRS/2016/122	SCRS/2016/148	SCRS/2016/136	SCRS/2016/132	SCRS/2016/118	SCRS/2011/075
Diagnostics	Most of the appropriate diagnostics are included	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	Availibale and can be provided by authors	Availibale and can be provided by authors	No diagnostics	No diagnostics	Appropriate diagnostics are 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 standardization	Data exclusions not discussed, targetting not an issue	Data exclusions are covered and included only main BFT target months	Data exclusions are covered and included only main BFT target months	All data used, no exclusion was made	All data used, no exclusion was made, BFT is the only traget species for traps	No data excluded	No data excluded but time series is short	Data are listed, detailed and standardised, methos are explained
Geographical Coverage (East or west Atlantic? Or Med)	Geographical coverage is limited to bay of Biscay, maps are provided	Coverage limited to the Straits of Gibraltar	NorthEast Atlantic, north of 40N, Distribution maps are provided	NorthEast Atlanic 30-40N and central and western Mediterranean, Distribution maps are provided	Tunisian water	Traps covered a relatively limited geographical area, but this applies to all other traps	Balearic spawning ground (Western Med) . One of the main spawning regions	Portugal water (covering migration route)	Geographical coverage is limitedto the SW part of Sardinia
Catch Fraction to the total catch weight (East or West) , or Percentage of abundance for fishey independent index	Catch fraction is roughly 5%	5%	10%	8%	less than 5%	less than 5%	less than 5%	less than 2%	1%
Length of Time Series relative to the history of exploitation.	1952 to 2014, but split in 1962 and 2006	1981 to 2013	1975 to 2009	1990 to 2016	2009 to 2015	1986 to 2015	2000 to 2016	1998-2015; exploitation began since 1950s	1993 to 2010
Are other indices available for the same time period?	Yes, although not for juveniles.	Yes	Yes	Yes	Serie runs from 2009	Yes	yes	1	no because there are not other Mediterranean traps
Does the index standardization account for Known factors that influence catchability/selectivity?	The 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	Gear type is included as is a selectivity proxy. area*month interaction was considered as random effect	Gear type is included as is a selectivity proxy. area*month interaction was considered as random effect	No	Standardised, with only 2 factors, including trap factor, catchability wouldn't change significantly among traps as their technical caracteristics haven't changed over time	Factors month vessel were not significant and area NA	Not standardized	The standardisation was made with a constant system
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	5 (No conflict noted)	No conflict noted		after the adoption of the quota the fishery was limited
Is interannual CV high, and is there potential evidence of unaccounted process error (trends in deviations from production model dynamics, high peaks, multiple stanzas, increasing or decreasing catchability)	CV=0.48 %Devs 0.453 Variability increases over the latter years of the series	CV=1.25 %Devs 0.62high interannual CV, very high spike in 2013 (no spanish traps then)	CV=0.49 %Devs 0.53	CV=1.12 %Devs 0.64northeast cpue hasc trend in deviations in recent years and very high interannual CV	CV=0.38 %Devs 0.5 high CV	CV=1.25 %Devs 0.62 high cv, positve tremd to recent deviations	CV=0.1 %Devs 0 very low CV, possible hyperstable	No values	CV=0.34 %Devs 0.47 Variability decreases over the latter years of the series, due to the quota
Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	Multiple factors and interactions included. Model design takes into account effort distribution. Discussions of data quality touched on. Since 2012, Bay of Biscay quota transferred, affecting seriously the quality of the data that could be used. Management regulations affected data quality but these effects are partially addressed	Document states LF data was recorded, but it is not presented. Document states series applied to spawners 10+, model is extremely low on factors	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 effort distribution as well as data assumptions/concerns and effort is presented	4	The assessment of catch data quality was carried out, interaction term was not included because of some gaps in data	Standardisation was provided and rejected because the natural logarith of the nominal CPUE is more reliable	Not standardized	
Is this CPUE time series continuous? (the number of observation in the CPUE period)	Yes, split into 3 but no gap (63 of 63 years)	Yes, no split (33 of 33 years)	Yes, no split (35 of 35 years)	Yes, no split (27 of 27 years)	Yes, no split (7 of 7 years)	Yes, no split (30 of 30 years)	Yes, no split (17 of 17 years)	Yes, no split (27 of 27 years)	Yes, no split (18 of 18 years)
Other Comment	2012-2014 is most problematic due to quota transfer to the Med. Check selectivity of the first period is consistent with CAA.	Spanish Trap index was not available after 2014	This index will not be updated because of no operation in the Med for bluefin				The catch in the gulf of Lion was not considered		Need to be split in 2007. Fisheries Research 127– 128 (2012) 133– 141

Table 16. Available CPUE series for west bluefin tuna in 2016.

Index	**Japanese West Atl LL**	**US Rod and Reel**	**US GOM Pelagic LL**	**Southern Gulf of St. Lawrence**	**Southwest Nova Scotia**	**Joint USA/CAN Pelagic LL**	**Joint USA/CAN Rod and Reel**	**French Aerial survey**	**Western Mediterranean larval index**	**Potential larval survival**	**GBYP Aerial Survey on Spawners**	**Acoustic Juvenile (Bay of Biscay)**	**GOM Larval survey**	**Gulf of Mexico, Oceanographic index**	**Canadian Acoustics**
Fisheries Dependent/Independent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Dependent	Fishery Independent	Fishery Independent	Fishery Independent	Fishery Independent	Fishery Independent	Fishery Independent	Fishery Independent	Fishery Independent
Stock	West	West	West	West	West	West	West	East and Med	East and Med	East and Med	East and Med	East and Med	West	West	West
Paper	SCRS/2016/122	SCRS/2014/055	SCRS/2014/058	SCRS/2014/039	SCRS/2014/039	SCRS/2015/171	SCRS/2015/178	SCRS/2016/153	SCRS/P/2016/041	SCRS/P/2016//043	SCRS/2015/144	SCRS/2016/137	SCRS/2014/057	SCRS/P/2016/037	SCRS/P/2016/034
Diagnostics	Most of the appropriate diagnostics appear to be included	Observed catch distributions and probability model fits are shown	Most of the appropriate diagnostics appear to be included	All the appropriate diagnostics were included	All the appropriate diagnostics were included	All the appropriate diagnostics were included	All the appropriate diagnostics were included	Different methodologies applied to compute indices have been published in peer-reviewed journals	QQ , residuals, tables of consistency provided in various documents	Diagnostics to be provided before next meeting	Appropriate diagnostics are included for the four main spawning areas		Most of the appropriate diagnostics appear to be included	No variance	None. Perhaps compare with CPUE
Appropriateness of data exclusions and classifications (e.g. to identify targeted trips).	Data exclusions are covered and included only main BFT target months	Data exclusions are covered and included only trip that targeted bluefin tuna during the main fishing season	Uses vessel as a repeated measure	No Exclusions	No Exclusions	Data exclusions are indicated, classifications appropriate	Data exclusions are indicated, classifications appropriate. Limited to Bluefin tuna above 110 kgs or 177 cm in straight fork length.	Raw data has been checked. Year 2013 was removed due to low effort. Corrections still remain to be implemented	Sampling designed for the purpose, strong documented data selection	N/A	Data are fully listed and detailed, but the strategy was different for the two series of years - standardisation was done for the four main areas		Data collection method clearly explained, as is a survey, presumabely few data exclusions	N/A	Fairly certain that the targets are Bluefin tuna. TS within acceptable bounds
Geographical Coverage (East or west Atlantic? Or Med)	West Atlantic. Distribution maps are provided	Moderate coverage of the stock foraging grounds in the West Atlantic during the summer and early fall	Covers entire Northern Gulf of Mexico	Gulf of St Lawrence where fishery occurs	Scotian shelf	Atlantic north of 15°N latitude and west of 45°W longitude	Mid-Atlantic, Maine, Gulf of St. Lawrence and north east Scotian Shelf areas	The whole Gulf of Lions is covered and the area surveyed is constant over time. However two main improvements could be implemented in the future (i) survey coastal area to follow the extension of the fish repartition towards the coast (ii) other nursery areas have to be followed.	Covers the whole Balearic spawning ground in half of the sampling years, 3/4 in the other half	NW Mediterranean, Balearic Sea	52% of the Mediterranean for the extended surveys, 10.7% of the Med for main areas		Northern Gulf of Mexico	Covers entire Gulf of Mexico	Coverage is limited. Major fishery occurs off PEI which is not covered. Yet fishing occurs where most of the licences are. Fish may be there but catches low due to fishing in other areas.
Catch Fraction to the total catch weight (East or West) , or Percentage of abundance for fishey independent index	20%	10%	5% (100% of US longline in GOM, but only a discard fishery)	14%	5%	10%	15%	10%	N/A	N/A	greater than 50% of spawners in Med.		No direct catch	N/A	N/A
Length of Time Series relative to the history of exploitation.	1976 to 2016	1993 to 2013	1987 to 2013, but split in 1992	1981 to 2013; exploitation began in 1972-73	1988 to 2013	1992 to 2014	1984 to 2014	2000 to 2013, with 2004-2008 data gap	2001 to 2014	2000 to 2016	2010, 2011, 2013, 2015		2001 to 2011	1993 to 2011	1994 to 2015
Are other indices available for the same time period?	Yes	Yes, but no overlap with the main U.S. fishery	Yes but no GOMEX spawners	Perhaps fishery independent index	No	Ye but not same area	This index is based on data used in 3 individual indices used in the assessment.	Only tiume series (I) fishery independent, (ii) for young fish and (iii) in the mediterranean	traps and purse seiners, unique fishery independent	All others	Not for spawners		Yes	Yes	Yes, but not fishery indepent.
Does the index standardization account for Known factors that influence catchability/selectivity?	Gear type is included as is a selectivity proxy. area*month interaction was considered as random effect	Index for bluefin trips by sizeclass targeted and standardized for year and area effects	Standardised, but few factors, accounts for change to weak hooks	Factors are month, fleet, gear and hours fished	Factors are month, fleet, gear and hours fished	Yes	Yes	Fishery independent index from scientific survey that does not have catchability-related caveats. Still some work to account for detectability of fish in relationship to vertical and horizontal behaviour linked to environmental fluctuations.	Factors affecting catchability included, also environmental	Model based on experimental data, factors of variability controlled	All factors were considered for the four main areas		Methodology for standardisation of the series appears to be appropriate for a survey	Fishery independent	Index has not been standardized as most factors constant over time
Are there conflicts between the catch history and the CPUE response?	No conflict noted	NA	No conflict noted	No, no detectable departures	No, no detectable departures	No	No	No conflict noted	No conflict noted, 0.9 correlation with last assessment	No conflict noted	N/A		No conflict noted	No conflict noted	N/A
Is interannual CV high, and is there potential evidence of unaccounted process error (trends in deviations from production model dynamics, high peaks, multiple stanzas, increasing or decreasing catchability)	CV=0.61 %Devs 0.56	CV=0.65 %Devs 0.62 interannual CV increases for larger fish, would expect small fish indices to be more variable	CV=0.45 %Devs 0.5	CV=1.15 %Devs 0.58 High CV even with 2010 which has been removed, positive trend in recent deviations	CV=0.31 %Devs 0.32	CV=0.53 %Devs 0.46 yes	CV=0.92 %Devs 0.5 high cv, positive trends in devs in recent years	CV=0.71 %Devs 0.67 juvenile survey so could expect high CV, devs	CV=1.04 %Devs 0.57 high interannual CV	CV=0.19 %Devs 0.57 devs not as applicable age 0 recruitment proxy (make index on rec devs)	No values	No values	CV=1.14 %Devs 0.79 high interannual variability	CV=0.22 %Devs 0.17 devs not as applicable age 0 recruitment proxy (make index on rec devs)	CV=0.59 %Devs 0.68
Assessment of data quality and adequacy of data for standardization purpose (e.g. sampling design, sample size, factors considered)	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	Review of the database and models is ongoing	Index has been used for a long time and reviewed many time. However recent (2015) changes in the fishery in 2015 may require breaking the index after this	Includes trends in forage fish and recent changes in environmental variables. Shows weight frequencies, trends in condition and describes a potential shift in the distribution of size components of the population to other areas.	some issues related to effort	includes environmental covariates. Large spatial domain	a derivative CAN and USA rod and reel. Spans a larger spatial domain.	NA – scientific index	Recomended improving assessment for gear change effect	Controlled variables in experiment	There are important concerns regarding the ability to calibrate different observers and among areas and years		Data is presented and methodolgy for standardisation explicitly presented. Factors appear to be appropriate for a survey	? Environmental index	Yes, but not likely necessary except for vessel/equipment change in 2015
Is this CPUE time series continuous? (the number of observation in the CPUE period)	Yes, no split (41 of 41 years)	Yes, no split (21 of 21 years)	Yes, split into 2 but no gap (27 of 27 years)	Yes, no split (33 of 33 years)	Yes, no split (26 of 26 years)	Yes, no split (23 of 23 years)	Yes, no split (31 of 31 years)	No, gap in 2004-2008 and 2013 cannot be used due to low effort. (8 of 13 years)	No, gap in 2006 to 2011 (8 of 14 years)	YES (17 of 17 years)	No (4 of 6 years)		Yes (11 of 11 years)	Yes (19 of 19 years)	Yes (22 of 22 years)
Other Comment			See above No break in 1992, and potential break in 2016	CPUE in 2010 was not used in the 2014 assessment		Overcomes issues related to the redistribution of the stock	Preliminary; Overcomes issues related to the redistribution of the stock	This is a series for number of schools and not direct fish abundance.		can be updated yearly	Possibly high CV, Power Analysis Report			Inclusion of environmental index	First two years of this index should be removed pending further evaluation

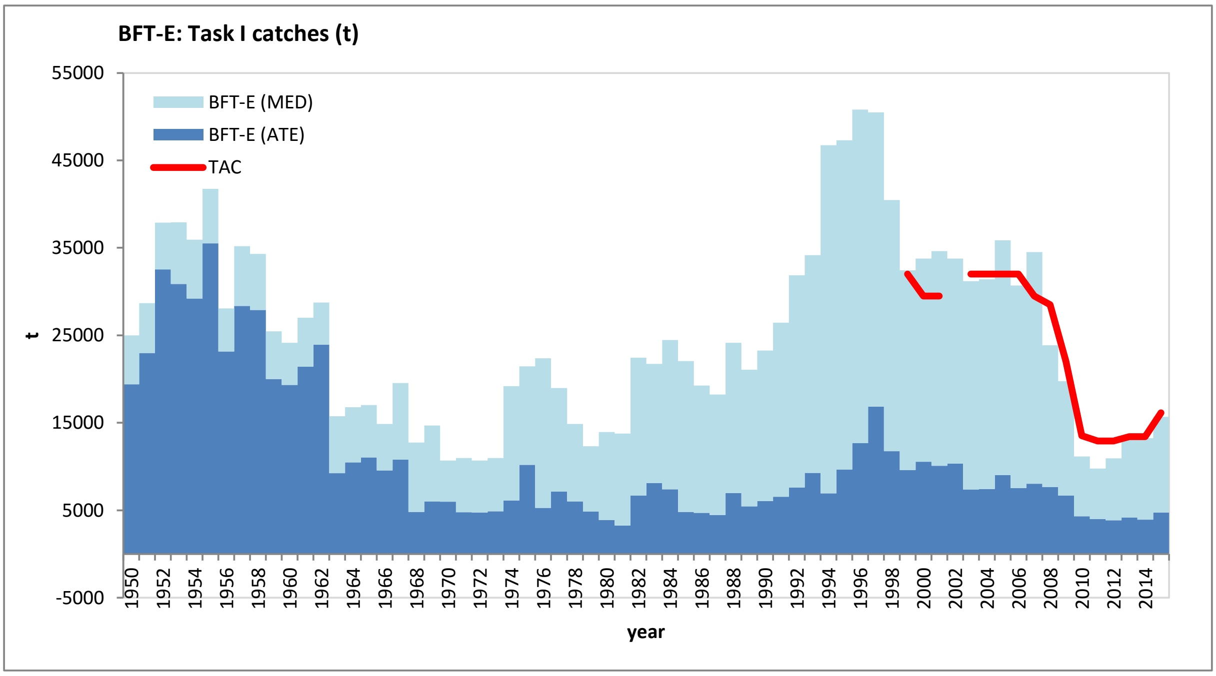

Figure 1. Eastern Atlantic bluefin tuna stock accumulated catches (t) by major region (ATE – Eastern Atlantic and MED – Mediterranean Sea) and year.

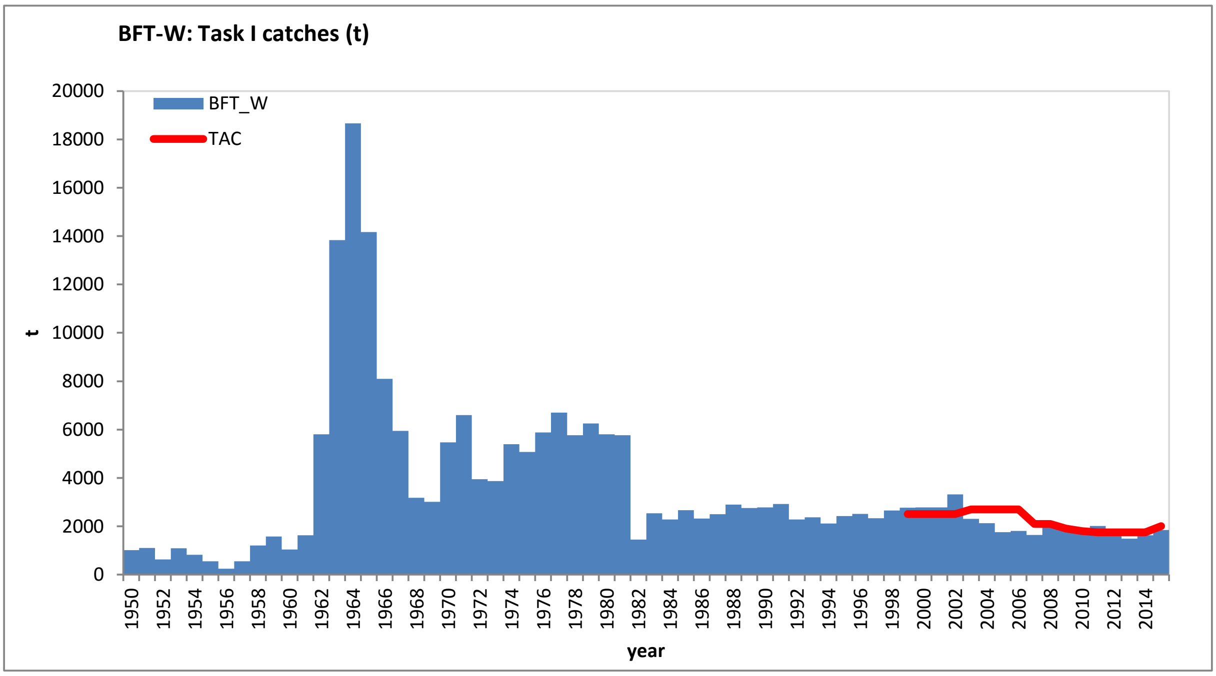

Figure 2. Western Atlantic bluefin tuna stock catches (t) by year.

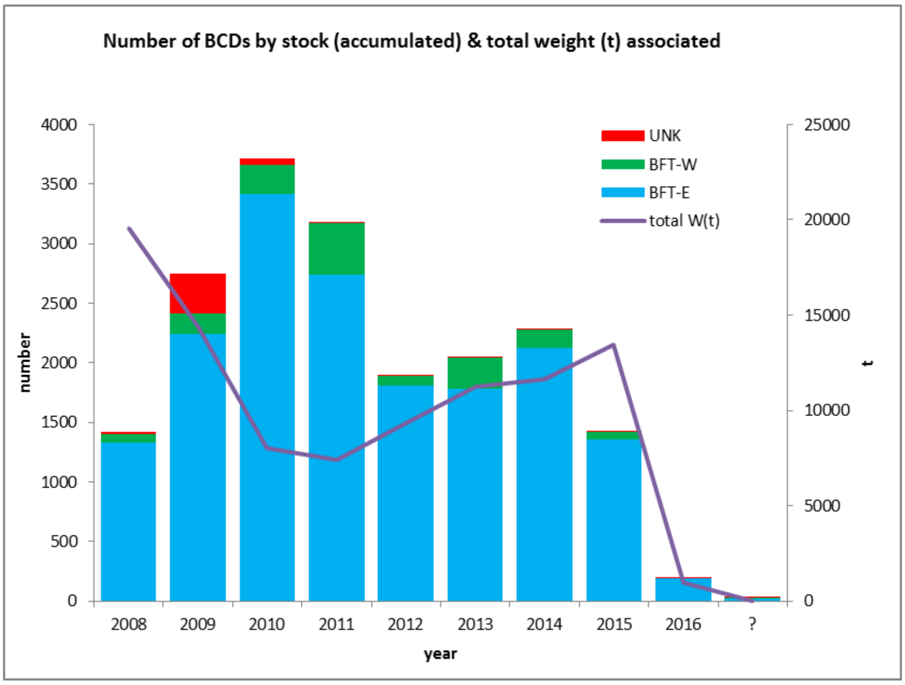

Figure 3. Number of BCDs stored in ICCAT-DB (accumulated by stock) and info. UNK – unknown; BFT-W – Western Atlantic; BFT-E – Eastern Atlantic and Mediterranean Sea)

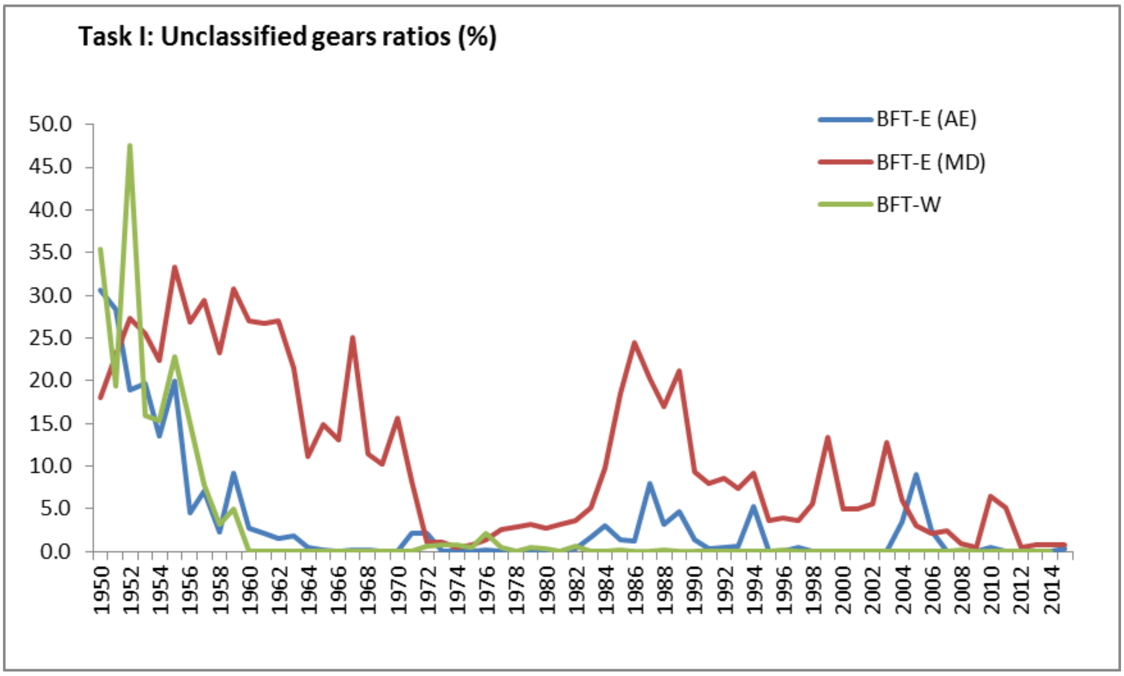

Figure 4. Proportions (%) of unclassified gears by stock (for BFT-E separated by MED and ATE regions) and year, in the Bluefin tuna catches (landings and dead discards) reported Task I. BFT-E (AE) – Eastern Atlantic; BFT-E (MD) – Mediterranean Sea; BFT-W – Western Atlantic.

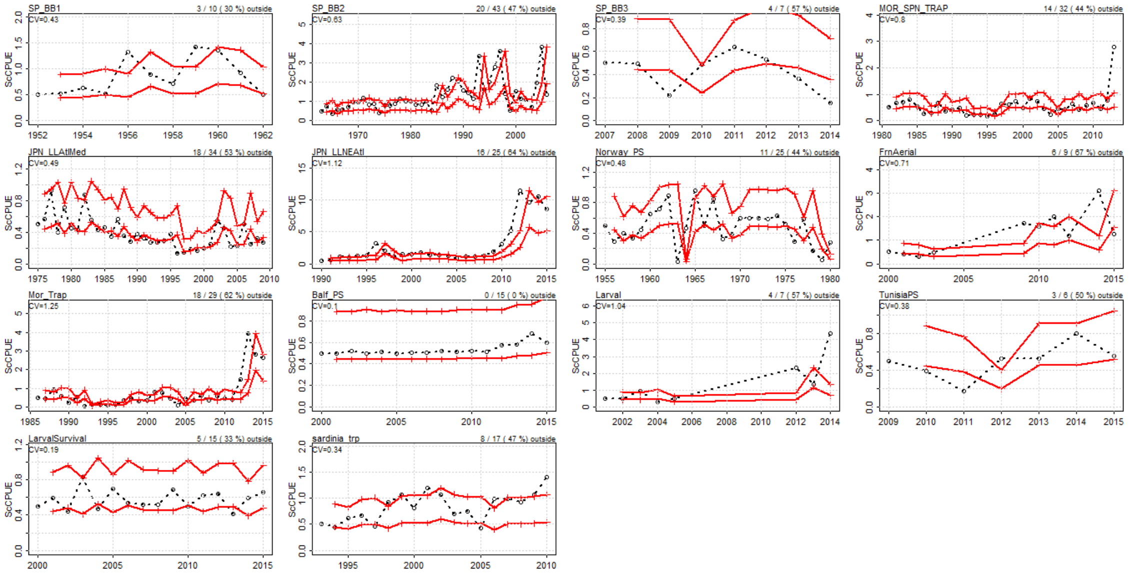

Figure 5. Analyses of the interannual variability of the index for Eastern Atlantic and Mediterranean bluefin tuna.

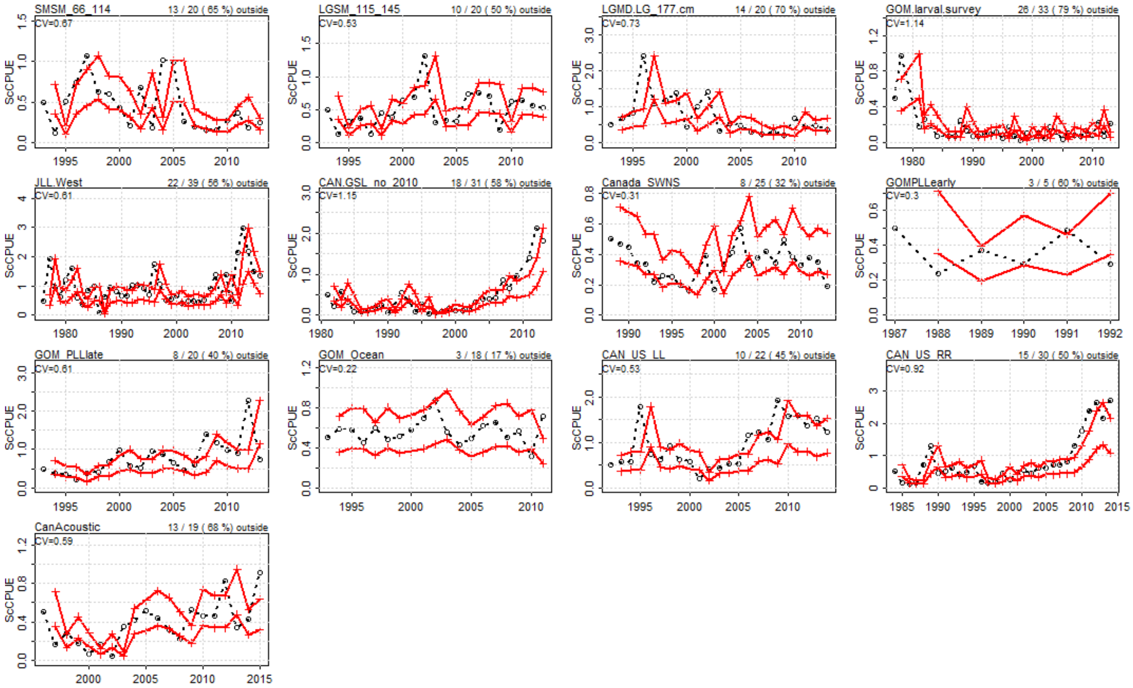

Figure 6. Analyses of the interannual variability of the index for Western Atlantic bluefin tuna.

Appendix 1

AGENDA

1. Opening, adoption of the Agenda and meeting arrangements
2. Review progress made by the ICCAT GBYP and Phase 6 programme
3. Review of historical and new information on biology and stock structure
    - 3.1. Review life history assumptions such as fecundity, maturity, mortality schedules
    - 3.2. Review stock structure and mixing rate information
        - 3.2.1. Review status of ICCAT electronic tagging data base and the response to the letter from the SCRS Chair
        - 3.2.2. Review/compile inventory of composition data (genetics, microconstituent) by fleet and area and year
        - 3.2.3. Determine preliminary stock definitions
    - 3.3. Review/develop movement matrices (probability of occurrence in a region, amongst 8 box model regions, by stock, month of the year, and size class)
    - 3.4. Review progress on age-length keys
        - 3.4.1. Evaluate performance of various ALK approaches and cohort slicing
        - 3.4.2. Develop preliminary age-length keys for each stock
        - 3.4.3. Review potential for developing age-stock-length keys
4. Review of Task I and Task II statistics
    - 4.1. Review Task I statistics to be used for the 2016 update projections
    - 4.2. Review CPC submissions of metadata describing the quality of the submitted statistics
    - 4.3. Review progress by CPCs on their submissions of Task II size data to include the actual size samples used to estimate the catch at size and using the new weight/length conversions
    - 4.4. Review and make final revisions to Task II by validating and integrating the catch at size statistics with new information from farms, harvesting and stereoscopic cameras, and other sources of information.
5. Evaluate indices available for use in next assessment (including the index criteria table)
    - 5.1. Review currently used indices and updates for 2016 species group meeting
    - 5.2. Review of new indices of potential use in 2017 assessment
    - 5.3. Review of progress towards combined CPUE indices
6. Review of assessment methods
    - 6.1. Review current models and proposed enhancements
    - 6.2. Review new models under consideration for 2017 assessment
    - 6.3. Review status of the ICCAT Software Catalogue
7. GPYP Core Modelling and MSE Group
    - 7.1. Review of activities relative to MSE/MP development
    - 7.2. Review, discuss and complete the technical specifications for the MSE/MP
    - 7.3. Recommend Task I and Task II statistics, abundance indices and other information to be used for the MSE/MP
8. Other matters
    - 8.1. Biometrics for farmed fish
    - 8.2. Observer coverage
9. Recommendations
10. Adoption of the report and closure

Appendix 2

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Appendix 3

LIST OF DOCUMENTS AND PRESENTATIONS

Reference	Title	Authors
SCRS/2016/115	A summary of bluefin tuna electronic and conventional tagging data	Guénette S., Hanke A., and Lauretta M.
SCRS/2016/118	Update on the bluefin tuna catches from the tuna trap fishery off southern Portugal (NE Atlantic) between 1998 and 2015	Lino P.G., Rosa D., and Coelho R.
SCRS/2016/122	Simple update of the standardized bluefin CPUE of Japanese longline fishery in the Atlantic up to 2016 fishing year	Kimoto A., and Itoh T.
SCRS/2016/123	Revision of Task II size data of bluefin tuna catch by Japanese longline from the 1970s to present	Itoh T.
SCRS/2016/124	Report of Japan's scientific observer program for tuna longline fishery in the Atlantic Ocean since 2013 fishing year	
SCRS/2016/128	Comparative analysis of origin assignments for bluefin tuna sampled within ICCAT GBYP	Brophy D., Arrizabalaga H., Fraile I., Haynes P., Kitakado T., and Hanke A.
SCRS/2016/129	Structures de taille de *Thunnus thynnus* capturé par les thoniers algériens	Ferhani K, and Bensmail S.
SCRS/2016/130	Contribution of the Gulf of Mexico population to US Atlantic bluefin tuna fisheries in 2015	Barnett B.K., Secor D.H., and Allman R.
SCRS/2016/131	Possible consequences of the use of Atlantic Bluefin tuna population biometrics in the algorithm of stereo cameras	Gordoa A.
SCRS/2016/132	Updated Bluefin CPUE and catch structure from the Balfegó Purse Seine Fleet in Balearic Waters from 2000 to 2016	Gordoa A.
SCRS/2016/133	Age-length keys availability for Atlantic bluefin tuna captured in the eastern management area	Quelle P., Rodriguez-Marin E., Ruiz M., and Gatt M.
SCRS/2016/134	Expanded comparison of age estimates from paired calcified structures from Atlantic bluefin tuna	Rodriguez-Marin E., Quelle P., Ruiz M., Busawon D., Golet W., Dalton A., and Hanke A.
SCRS/2016/135	A summary of bluefin tuna electronic and conventional tagging data	Hanke A., Guénette S., and Lauretta M.
SCRS/2016/136	Standardized CPUE of bluefin tuna (*Thunnus thynnus*) caught by Moroccan traps for the period 1986- 2015	Abid N., and Ben Mhamed A.
SCRS/2016/137	Acoustic-based fishery-independent abundance index of juvenile bluefin tunas in the Bay of Biscay: 2015 and 2016 surveys	Goñi N., Onandia I., Lopez J., Arregui I., Uranga J., Melvin G.D., Boyra G., Arrizabalaga H., and Santiago J.
SCRS/2016/138	ICCAT GBYP P-Sat tagging: the first five years	Tensek S., Di Natale A., and Pagá García A
SCRS/2016/139	Report on revised trap data recovered by ICCAT GBYP between Phase 1 and Phase 6	Pagá Garcia A., Palma C., Di Natale A., Tensek S., Parrilla A., and de Bruyn P.
SCRS/2016/140	A peculiar situation for YOY of bluefin tuna (*Thunnus thynnus*) in the Mediterranean Sea in 2015	Di Natale A., Tensek S., Celona A., Garibaldi F., Oray I., Pagá García A., Quilez Badía G., and Valastro M.

SCRS/2016/141	Studies on eastern bluefin tuna (*Thunnus thynnus*) maturity – Review of old literature	Di Natale A., Tensek S., Pagá García A.
SCRS/2016/142	Bluefin tuna weight frequencies from selected market and auction data recovered by GBYP	Di Natale A., Tensek S., Die D., Porch C., Bonhommeau S., Takeuchi Y., Melvin G., Mielgo Bregazzi R., de Bruyn P., and Palma C.
SCRS/2016/143	Bluefin tuna (*Thunnus thynnus*) growth derived from conventional tag data	Pagá Garcia A., Tensek S., and Di Natale A.
SCRS/2016/144	Simulation testing a multi-stock model with age-based movement	Carruthers T., and Kell L.
SCRS/2016/145	Issues arising from the preliminary conditioning of operating models for Atlantic bluefin tuna	Carruthers T., and Kell L.
SCRS/2016/146	Resolution of age at maturity and reproduction in Atlantic bluefin tuna: historical evidence and new insights from endocrine-based biomolecular approaches	Heinisch G., Correiro A., and Lutcavage M.E.
SCRS/2016/147	Improving growth estimates for western Atlantic bluefin tuna using the AMSFc approach	Ailloud L.E., Lauretta M.V., Hoenig J.M., Hanke A.R., Golet W.J., Allman R., and Siskey M.R.
SCRS/2016/148	Update of CPUE bluefin tuna *Thunnus thynnus* (l. 1758) caught by Tunisian purse seines in the Central Mediterranean	Rafik Z., and Missaoui H.
SCRS/2016/149	Morphometric relationships of fattening bluefin tuna (*Thunnus thynnus*) caught in the Central Mediterranean in 2013 and 2014	Rafik Z., and Missaoui H.
SCRS/2016/150	Overview of the bluefin tuna data recovery in GBYP Phase 6	Di Natale A., Pagá Garcia A., and Tensek S.
SCRS/2016/151	The impact of massive fishing of juvenile Atlantic bluefin tunas on the spawning population (1949-2010)	Cort J.L., and Abaunza P.
SCRS/2016/152	Statistical catch at length assessment methodology for Atlantic bluefin tuna	Butterworth D.S., and Rademeyer R.A
SCRS/2016/153	Aerial surveys of bluefin tuna in the western Mediterranean Sea: an operational fishery-independent abundance index for juvenile fish?	Rouyer T., Bonhommeau S., Fromentin J.-M., and Brisset B.
SCRS/2016/154	Analysis of the length–weight relationships for the Atlantic bluefin tuna, *Thunnus thynnus* (L.)	Cort J.L., and Estruch V.D.
SCRS/P/2016/032	A genetic traceability tool for differentiation of Atlantic bluefin tuna (*Thunnus thynnus*) spawning grounds	Rodríguez-Ezpeleta N., Díaz-Arce N., Alemany F., Deguara S., Franks J., Rooker J.R., Lutcavage M., Quattro J., Oray I., Macías D., Valastro M., Irigoien X., and Arrizabalaga H.
SCRS/P/2016/033	Using SatTagSim to provide transition matrices for Movement Inclusive Models	Galuardi B, Cadrin S.X., Arregui I., Arrizabalaga H., Di Natale A., Brown C.,Lam C.H., and Lutcavage M.E.
SCRS/P/2016/034	Herring Acoustic Surveys: A new fishery independent abundance index (1994 - 2014) for Atlantic bluefin tuna in the Gulf of St Lawrence	Melvin G., Munden J., and Finley M.
SCRS/P/2016/035	Review of BCD information (2008 to 2016) as a complement to improve Task I	Palma C.

SCRS/P/2016/036	Guidelines towards a “fully revised” catch-at-size/age estimation	Palma C.
SCRS/P/2016/037	Bluefin tuna larvae in the Gulf of Mexico: an overview of available oceanographic conditions during the past 20 years	Domingues R., Goni G., Bringas F., Walter J., Muhling B., and Lindo D.
SCRS/P/2016/038	Incorporating stock mixing into the assessment and long-term expectations of Atlantic bluefin tuna	Kerr L.A., Cadrin S.X., Secor D.H., and Siskey M.
SCRS/P/2016/039	Review progress made by the ICCAT GBYP and Phase 6 programme	Di Natale A., Tensek S., and Pagá García A.
SCRS/P/2016/040	Close-Kin Mark-Recapture for Eastern ABFT: Summary of scoping study for ICCAT	Davies C., Bravington M., and Thomson R.
SCRS/P/2016/041	Indices of larval bluefin tuna (*Thunnus thynnus*) in the western Mediterranean Sea (2001-2014)	Ingram Jr. G.W., Álvarez-Berastegui D., Reglero P., Balbín R., García A., and Alemany F.
SCRS/P/2016/042	Genetic close kin pilot project for West Atlantic bluefin tuna	Walter J., Lauretta M., Porch C., Grewe P., Bravington M., Davies C., McDowell J., Graves J., and Kaplan D.
SCRS/P/2016/043	A recruitment index for Atlantic bluefin tuna independent from the fishery	Reglero P., Balbin R., Ortega A., Mourre B., Alvarez-Berastegui D., Abascal F., Blanco E., Medina A., de la Gándara F., Juzá M., Kernec M., Tintoré J., and Alemany F.
SCRS/P/2016/049	Improving age composition estimates using hybrid Age Length Keys	Ailloud L.E., Hoenig J.M, Lauretta M.V.

Appendix 4

LIFE-HISTORY INPUTS DISCUSSED FOR MSE

The material presented in this Appendix was developed by a few members of the life-history subgroup and presented during the plenary session, however there was insufficient time to fully review the material in plenary and it was not formally adopted.

- Table 8.2 in DRAFT ANNEX FOR ATLANTIC BLUEFIN MSE SPECIFICATIONS_JULY 2016.pdf
- Natural mortality rate at age
- Maturity at age

A. Areas with potential spawning for MSE

The quarters and areas with probability of spawning activity were classified in two categories (yes and no) using the criteria of average value quarter SST >20ºC assuming 20ºC is the minimum temperature for the larvae to survive (SCRS/P/2016/043). Average temperatures per quarter were estimated from monthly SST NOAA NASA AVHRR Oceans Path-finder on a grid of 5x5º cells. Areas and quarters with positive probability of spawning activity might be overestimated due to the size of the geographical areas considered.

Area	**Q1**	**Q2**	**Q3**	**Q4**
GOM	yes	yes	yes	yes
W. Alt	yes	yes	yes	yes
GSL	no	no	no	no
C. Atl	yes	yes	yes	yes
E. Atl	yes	yes	yes	yes
NE. Atl	no	no	no	no
W. Med	no	no	yes	no
E. Med	no	no	yes	yes

B. Stock-Recruitment

Recent modeling exercises have attempted to incorporate mixing rates into the assessments for eastern and western stocks of bluefin tuna (SCRS_P_2016_038_Kerr_et_al.pdf). It was noted that when the estimates of spawning stock biomass and recruitment for the western stock were separated from eastern fish, the former seemed to show increasing recruitment with increasing SSB in recent years. The Group agreed that while there is high uncertainty in the estimates for the most recent years of both SSB and recruitment, should this trend continue in future assessments it may prove informative in elucidating the spawner recruit relationship for WBFT.

Egg production modeling for assessment purposes

In addition, The Group discussed and agreed that the total number of eggs produced by the spawning stock S is the product of the number of females in each age class during the spawning season N_a and the average number of eggs produced per female E_a, summed over all ages:

$$S = \Sigma E_a N_a$$

Egg production for both stocks was expected to be similar between the East and West, and to vary with age (as agreed in Tenerife). There was considerable discussion regarding the meaning of various terms. For example, when assessment scientists use the term maturity what they often mean is the relative fraction of the population that is spawning, whereas the term maturity used in a physiological sense refers to the stage when viable gametes are produced and the animal has the potential to be reproductively active (regardless of whether they actually do reproduce). In order to avoid further confusion, the Group discussed the quantity that is ultimately needed for the operating model and the assessment: the relative egg production of each age/size class (or equivalent measure of spawning capacity at age).

The number of eggs per female is the product of the number of spawning events *n* and the average number of eggs produced per spawning event (batch fecundity) *f*:

$$E_a = n_a f_a$$

For stock assessment purposes, it is not generally necessary to know the absolute number of eggs produced, but rather the relative change in egg-production with age. Thus, the values for *n* or *f* may be expressed relative to their maximum values (for example, *n* may be interpreted as the relative fraction of each age class that spawns).

The dependence of batch fecundity on age has not been determined for Atlantic Bluefin Tuna, although there is evidence that batch fecundity per gram of body weight is fairly constant at about 58 eggs gr^{-1} regardless of fish size (e.g., Medina *et al*., 2002, Corriero *et al*., 2005; Knapp *et al*., 2015The relationship between the number of spawning events and age is poorly known for BFT and there was considerable discussion regarding the best proxy for this quantity. One approach is to assume that all mature fish spawn the same number of times per year regardless of their age (i.e., that they spawn with the same frequency and stay on the spawning grounds for the same amount of time). In that case, the maturity vector *m* (calculated from histology and endocrinal work could serve as the proxy for number of spawners (*n*). This, together with the previous assertion that batch fecundity is proportional to body weight, implies mature biomass as a proxy for egg production:

$$^{m}B=\Sigma m_a w_a N_a$$

In other words, one is assuming mature fish produce eggs in direct proportion to their body mass. The assessment for the Eastern Atlantic similarly used mature biomass as a proxy for egg production and it was pointed out that this approach can be regarded as a limit in the sense that it attributes the greatest possible impact to younger mature fish.

Another possible alternative is to infer the contribution of each age class from the frequency of occurrence of each age class on the spawning grounds relative to the frequency in the overall population *p*:

$$^{p}B=\Sigma p_a w_a N_a$$

Variations of this approach were used for the Western Atlantic population (assuming most spawning occurs in the Gulf of Mexico), in which case the relative contribution of younger fish was much less than expected based on maturity alone. It was pointed out that there is some evidence from PSAT data in the Gulf of Mexico and observations of fish movement patterns in the Mediterranean that younger fish may have shorter resident times in the spawning grounds than older fish. A preliminary review of purse seine catches on the Mediterranean spawning grounds also suggested that the contribution of younger mature fish might be less than expected based on maturity alone. However, further analyses were required to account for possible biases owing to the effects of size selection by the fishery. In any case, proxies obtained from relative age frequencies on the spawning ground could potentially be regarded as another limit in the sense that they attribute the least possible impact to younger mature fish by assuming they do not spawn outside the putative spawning grounds.

Two other alternatives were identified that may be intermediate between the ‘limits’ (^{p}B and ^{m}B) discussed above. One of these was based on the observation that the estimates of spawning potential from a close-kin genetic tagging study of Southern Bluefin Tuna showed that younger fish contributed substantially less to the spawning stock than was expected based on the histologically-based maturity vector. It was pointed out that there are important differences between BFT and SBT, as well as the environments they live in. Thus, rather than use the SBT vector directly, it was proposed to use the relative difference between the close-kin and histologically-based SBT vectors as a correction factor for BFT:

$$^{adj}B = \sum_a m_a w_a N_a \frac{E_a\ [SBT, genetics]}{E_a\ [SBT, histology]}$$

This adjustment essentially assumes that the basic physiological processes that might cause younger fish to contribute proportionately less than older fish are similar for BFT and SBT (rather than making the more restrictive assumption that the animals are identical).

Establishing hypotheses about the contribution of each age to spawning

The latest stock assessments of ABFT made assumptions about the relative contribution of each age group to the spawning output of the population. The assumed vectors are different for the eastern and western stock (Table LH1).

The only tuna where the contribution of different age groups to population spawning output has been directly measured is Southern Bluefin tuna. These estimates were derived from the close kin analysis (Bravington *et al*. 2014). Estimates of this contribution show that it departs significantly from the assumption that spawning output can be approximated by the weight of the spawner (Figure LH1). Estimates differ significantly from the assumption that weight of spawner is a good measure of spawning contribution. Close-kin results strongly suggest that older fish contribute relatively more to the spawning output of the population than what it would otherwise be expected because of their weight.

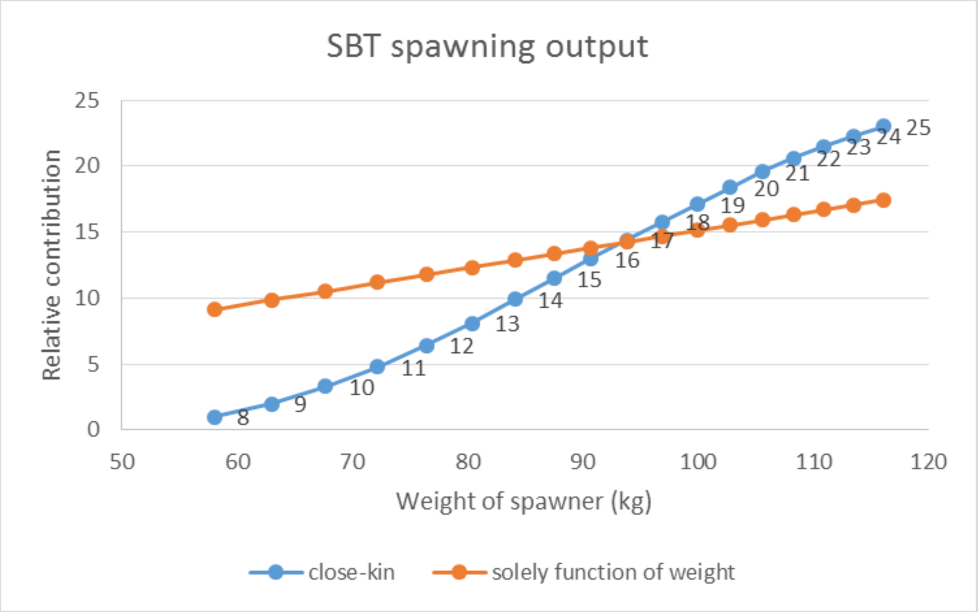

Figure LH1. Relative contribution of southern bluefin tuna to population spawning output as a function of weight. Labels on line correspond to age of each spawner. Blue line corresponds to estimates from close-kin analyses. Orange line corresponds to assumption that relative contribution can be solely calculated from the weight of the spawner (redrawn from Bravington *et al*., 2014)

After further discussion the Group agreed in plenary to develop two alternative vectors to condition the operating model. One uses the latest results of the endocrine studies (reference needed) which suggest that ABFT start maturing at age 3 and are all mature by age 5. The second vector was developed by using the vector estimated for SBT by Bravington *et al*. (2014) and shifting it so that the youngest ABFT contributing to the spawning output would be assumed to be fish of age 4 rather than fish of age 8 like in SBT.

These 2 alternative vectors were compared with the maturity vectors used in the previous stock assessment. The resulting 4 vectors show that option 1 developed herein is relatively close to the vector assumed for eastern stock of ABFT. Option 2 is more aligned than the vector assumed for western stock of ABFT, however, option 2 assumes a gradual change in the contribution rather than a knife-edge shift (**Figure LH2**). Previous studies of size composition of ABFT in the GOM are consistent with the vector in option 2 (Diaz, 2011).

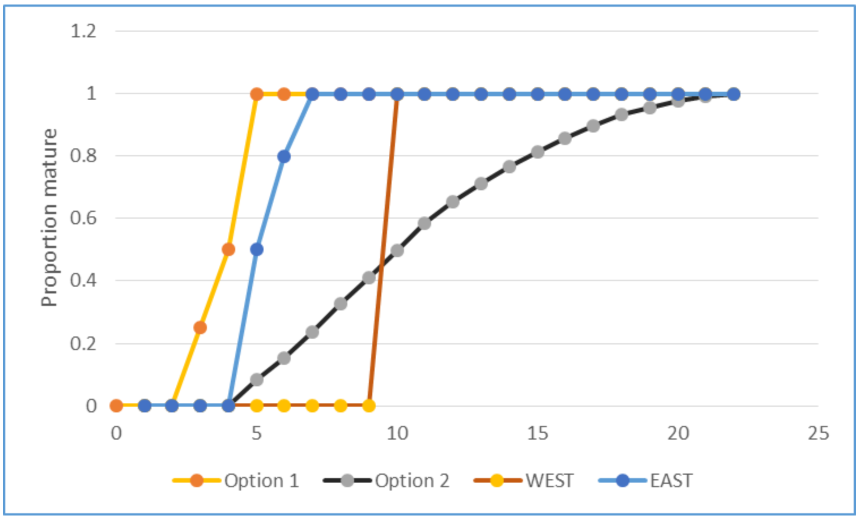

Figure LH2. Proportion mature at age as a proxy for the relative contribution of ABFT to the total population spawning output.

To evaluate the consequences of these assumptions on the calculation of spawning biomass it is useful to calculate the SSB on the basis of the simple product of %mature x biomass of mature fish. The biomass of mature fish in equilibrium would be the product of Number_{age} x Weight_{age}. Assuming that Number_{age} of a fully exploited stock can be expressed as $N_{age} = N_{age-1}\ e^{-2M}$. This assumes that F=M on a fully exploited stock. Calculations were made with the M_{age} and Weight_{age} values included in MSE model specifications document.

When these calculations are done for the four vectors it is clear that the ages that contribute the most to population spawning output are different (**Figure LH3**). When such contributions are done cumulatively it is more apparent that the current Eastern stock assumption is very similar to option 1 and the western stock assumption to option 2, except that option 2 acknowledges some contribution of fish age less than 9 (**Figure LH 4**).

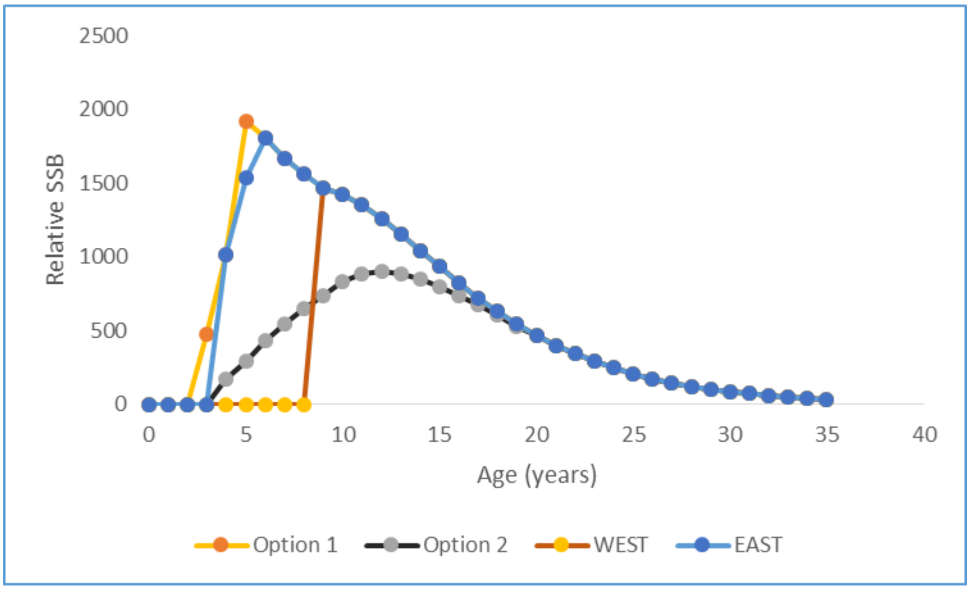

Figure LH3. Relative spawning stock biomass as a function of age for a fully exploited stock. Each line represents a different assumption about the relative contribution of each fish as a function of age.

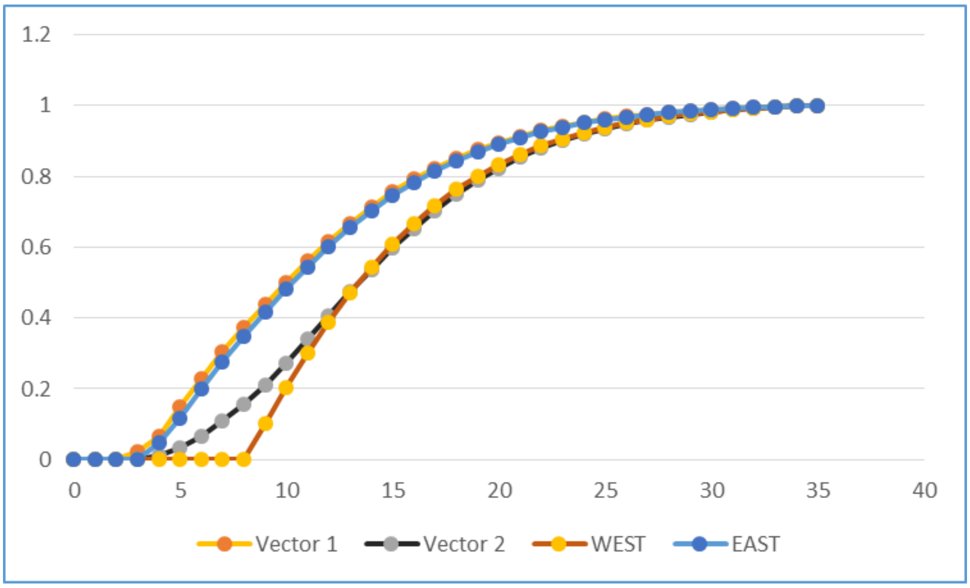

Figure LH4. Cumulative relative spawning stock biomass as a function of age for a fully exploited stock. Each line represents a different assumption about the relative contribution of each fish as a function of age.

Table LH1. Maturity vectors used to represent the proportion of any age group that will contribute to the spawning biomass. East and West rows correspond to assumptions made in the latest ICCAT stock assessment for each of the two ABFT stocks. Option 1 and Option 2 are the vectors proposed for the conditioning of the MSE GBYP operating model.

Age	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
East	0	0	0	0	0.5	1	1	1	1	1	1	1	1	1	1	1
West	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
Option 1	0	0	0	0.5	1	1	1	1	1	1	1	1	1	1	1	1
Option 2	0	0	0	0	0.08	0.15	0.24	0.33	0.41	0.5	0.58	0.65	0.71	0.82	0.86	0.9

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Appendix 5

AGE-LENGTH KEY AND STOCK KEY SMALL WORKING GROUP REPORT

In order to be consistent with the recommendations and work plan of the 2015 Bluefin tuna Working Group, their report on the feasibility of producing an ALK was used as a template to guide the discussions. The Group also recognized that 4 papers and 1 presentation provided at this year's meeting would be informative (SCRS/2016/133, SCRS/2016/134, SCRS/2016/143, SCRS/2016/147 and SCRS/P/2016/049). The material presented in this Appendix was developed by members of the age-length subgroup and presented during the plenary session, however there was insufficient time to fully review the material in plenary and it was not formally adopted.

The 2015 Working Group's recommendations/evaluation below was amended with actionable items as noted following each point:

1. Verify that all ages used same protocol and that we are tracking cohorts properly:

    a. The currently accepted (Busawon *et al.* 2014, Secor *et al.*, 2014) aging protocol counts the number of opaque bands and assigns the age according to this number.[***The biological database includes a field that indicates if the new protocol was used in ageing. Prior to the next meeting, the group will confirm with each contributor that the entries are correct for years prior to the introduction of the protocol (SCRS/P/2016/049),).***]

    b. In an assessment that works on calendar years to correctly track cohorts it is necessary to assign the fish correctly to the year it was born. [***The protocol for assigning a fish to the year it was born was confirmed to be as described in c) below. It was also agreed that a correction should be done to account for the type of section shape used for the reading: V or Y type, where one year should be added to the readings of V sections (Secor et al., 2014)]***

    c. To do so we propose a rule that if the fish is caught between January 1 and the assumed time of the opaque band formation (June 1) then 1 year is added to the age. The timing of opaque band formation was inferred from monthly formation of edge type in bluefin tuna fin spines (Cort 1990, Luque *et al*., 2014) and band formation from chemical tagging in southern bluefin tuna (*Thunnus maccoyii*) (Clear *et al*., 2000). Both sources coincide in opaque bands forming annually in summer. [***Recent chemical analyses of opaque and translucent zones of Atlantic bluefin tuna otoliths (Siskey et al. 2015) also show that opaque zones are apparent (distinguishable from the edge) by June 1.The database includes the direct age estimate and the adjusted age based on the this protocol and it was confirmed that the adjusted age was correctly applied by all investigators.***]

    d. For future otolith reads we recommend measuring the width of the translucent band and continuing to determine if the timing of opaque band formation in otoliths can be more precisely determined. [***This depends on data that do not exist for each otolith and hence cannot be accomplished in the short term.***]

2. Evaluate the suitability of the existing information to use the ALKs:

    a. Identify and verify any outlier age-length pairs (Otolith readers) [***Prior to generating eastern and western ALKs from both otolith and spine samples, the outliers in length for a given age were removed when they were further than 3 standard deviations from the mean. As a consequence, approximately 50 western observations and one eastern observation were removed.***]

    b. Are all bins filled, define appropriate size bin? [***The Group agreed that the resolution of the ALK should not be coarser than that used in slicing and that ALKs would be developed at several resolutions and evaluated. Six methods were proposed for dealing with an absence of observations (i.e. gaps in the key). These approaches are: 1) Hybrid key (SCRS/P/2016/049), 2) Gap fill using data form other years, 3) Inverse key, 4) follow Butterworth's ALK method (SCRS/2016/152) 5) follow an approach integrating several methods and 6) Smooth ALK. The group was not in favour of borrowing data from another stock region because of the potential***

for differences in probability in age-at-length between the two stocks (which forward ALKs are based on), which can result from differences in annual recruitment strengths (see SCRS/P/2016/049)There was also a preference for an approach that did not involve reliance on a growth model. Finally, it was thought that the use of a plus group in the assessment may allow one to overcome gaps at older ages. These approaches will be evaluated intersessionally, however an interim ALK (as described below) will be made available for use in the MSE operating model (LA).]

c. Are sample sizes sufficient for the EastWest ***Recent years data have been added to the database (East: 2800 fish over years 2005-2013; West: 3400 over years 2009-2015). The existence of GBYP data for the western management zone, that were not included in the Biological Database, was noted and efforts will be made to include them (ERM). Bubble plots of year by age were produced to determine if the data was sufficient for detecting cohort progression. In the eastern bubble plot (Figure 1) it was possible to detect some cohort progression whereas in the west there was no strong evidence (Figure 2***]

d. Are sufficient years represented and is there trend over year, evaluate mean age at length. [***Approximately 5 annual ALKs could be constructed using data from the west. The east has approximately 5 years. The adequacy of the annual ALKs (whether sample sizes are sufficient) is yet to be determined (LA). The 2016 ages should be available for the 2017 assessment.]***

e. Are samples representative of the fishery? [***This was assessed by comparing the catch at size from each stock (east, west, Mediterranean) with the length composition of the relevant samples (Figures 3** to **5). In all cases the sampling covered the size range of the catch, though the eastern samples were closer to being collected in proportion to the size distribution of the catch. Two catch at size options were provided for the Mediterranean and the length distribution of the sample matched that of the catch at size that include data from caging operations. It still remains to be verified that the distribution of samples from smaller western fish (100 to 110 cm) is correct.]***

f. Do we need a 'rule' to deal with holes in the ALK? [***As described in b) above, there are several alternatives for dealing with holes. The approach will be contingent on the seriousness of the gaps and the performance of the various ALK approaches (LA).***]

3. Does the new aging data provide new information on growth [***The new data in addition to tagging data were used to generate a new growth model for the western stock (SCRS/2016/147). There was no new model provided for the east, although the group was informed about two recent publications with same results on this topic (Cort et al., 2014; Luque et al., 2014). The group considered that before the new Richards model could be accepted, it should be refit after outlier removal and removal of age 1 and 2 fish as these could introduce a bias because of under-representation of slowing-growing fish (LA). It was recommended that the east also adopt a model fit using a Richards curve to be consistent with the west. However, since the von Bertalanffy growth estimates for each stock (Restrepo et al. (2010) and Cort (1991)) are very similar to one another, there is no reason to suspect much difference between the Richards models fitted to eastern and western samples. Given that the east has few older fish it was recommended that the model is fit with priors on shape parameters. The intent is for the new models for the east and west to be used whenever slicing is required.***]

   a. Do we need to re-estimate Restrepo *et al.* (2010) , Cort (1991) and Cort *et al*., 2014 growth curves to be consistent with the new aging protocols and the substantial new age-length data. [***The ageing data that produced the Restrepo et al. (2010) and Cort (1991) growth curves used old ageing protocols and involved modal progression. Recent analyses using more data under the new protocols match the Restrepo et al. (2010) fit but also indicate that the Richards model is free of residual bias for the older ages.***

   b. Re-estimate Restrepo *et al.* (2010) growth curves (cohort progression or without)?

4. 2-3 step evaluation of which method replicates known ages (To be completed for Species group meetings) [***The group recognized that steps 4 and 5 represent a reasonable approach for evaluating the ALKs once produced. These comparisons can be accomplished in time for the Species Working Group Meeting (LA).***]

    a. Use Restrepo *et al.* (2010) and Cort (1991) and run cohort slicing on known age-length info;
    b. Fit growth curve to new direct aging data, use cohort slicing to generate ages from the same lengths;
    c. Use ALK to generate ages;
    d. Compare Age comp with known ages to test the three methods.
5. Estimate full CAA with slicing and ALK to evaluate (To be completed for Species group meetings):
    a. CAA from slicing and Restrepo *et al.* (2010) and Cort (1991) (continuity CAA);
    b. CAA from slicing and new growth curves;
    c. CAA from ALKs

In addition to the work and decisions indicated above, the group considered how spines would inform the key (SCRS/2016/134). It was felt that spine age could be included in a key when an otolith was not available, however spine age was not suitable for fish older than 13 y and there were moderate concerns over using spine age for fish between 7 and 13 years of age.

Diagnostics and quality control
Prior to the 2017 data preparatory meeting the biological database will be summarized so that the completeness of the data and the availability of ages for annual keys can be assessed. Also, checks for inconsistencies in age assignment by lab will be checked using the relationship to the new Richards growth curve. Lastly, the effect on the ALK of using lengths estimated from weights or snout length will be evaluated.

Preliminary age-length key comparisons
Following a review of related diagnostics, preliminary ALKs were developed for both the east and western stocks. Catch at age matrices were created for the western stock using 3 approaches and included in the 2014 BFT western VPA. Retrospective analyses yielded estimates of Mohn's Rho calculated for both F and recruitment on 10 year retrospective peels. These performance statistics were used to assess the effect of the 3 approaches on cohort progression. The three approaches considered were as follows:

1) Use a hybrid key (SCRS/P/2016/049) for each year with direct ages. Gaps are filled using cohort slicing. For all other years, cohort slicing is applied to the catch at size data. The growth model used to perform the cohort slicing was based Restrepo *et al*. (2010).
2) Apply a pooled key to all the catch at size data.
3) Apply cohort slicing to all the catch at size data using the growth model described 1.

Results
For the pooled key, convergence of the VPA was a problem and the retrospective pattern was bad (**Figure 6**). Relative to cohort slicing, the hybrid method had very little retrospective pattern until the transition to years where no or few direct ages were available (**Figure 7**). The pattern coincided with the change in method but also because the von Bertalanffy curve used in cohort slicing was not a good fit to the age-length data. There was some concern that the retrospective issue was also a function of other features which can't be disentangled from the effect of the age assignment method.

Estimates of Mohn's Rho show that the hybrid method was less biased over the most recent 5 years (**Table 1**, **Figure 8**). Performance over the most recent 10 years was much worse. This could be indicative of the influence of more years of ALK providing a differential cohort or growth signal relative to the assumptions of age-slicing. The pooled key was the worst performing key for both 5 and 10 year peels. For both recruitment and SSB, the hybrid method had higher bias; however, the bias decreased with the shorter (5 year) retrospective span.
Some considerations for future analyses were:
1) Retest with the addition of the most recent years of ageing data.
2) Use a Richards's model throughout.
3) Explore other age assignment methods described above (e.g. combined forward and inverse key).
4) Compare slicing using the Richards and von Bertalanffy growth models.
5) Explore the sensitivity to gap filling (i.e. explore alternative bin widths and sample size thresholds).

Stock specific age-length key

The possibility of constructing stock specific ALKs was not assessed. The availability of stock origin information across all ages and by area could be more properly assessed by the small working group on stock mixing which compiled all available mixing information.

Recommendations

1) The GBYP has collected otoliths and spines that have not been aged. It is recommended that in the short term gaps be identified in the ALK and that these be filled by ageing those GBYP samples that will fill the gaps (e.g. **Tables 2** and **3**).
2) It was noted that many institutions have conducted Bluefin tuna sampling programs which could yield samples not part of the GBYP or Biological Sampling databases. It is recommended that a request for these data be circulated.
3) It is recommended that all the biological data be included in the Biological Database. To that end, an Excel workbook can be provided to each investigator to facilitate data transfer.

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Table 1. Mohn statistics for Mean squared error, Mean absolute error (a measure of error) and Mohn bias from 10 year and 5 year retrospective peels for the three methods of obtaining catch at age.

10 years	Recruits			SSB		
	MSE	MAE	BIAS	MSE	MAE	BIAS
Slicing	3.36E+09	0.421	0.04	38414041	0.214	-0.132
Pooled	3.02E+10	0.407	-0.226	2.79E+09	0.368	-0.363
Hybrid	3.03E+09	0.46	0.128	39929636	0.245	-0.232

5yrs	Recruits			SSB		
	MSE	MAE	BIAS	MSE	MAE	BIAS
Slicing	1.04E+09	0.359	-0.121	30407307	0.164	-0.117
Pooled	1.35E+10	0.342	-0.342	1.19E+09	0.221	-0.207
Hybrid	6.95E+08	0.266	-0.092	24094263	0.157	-0.128

Table 2. Summary of age-length data (otoliths and spines) available for the East Atlantic/Mediterranean. Gaps in data are highlighted in gray.

EAST ATLANTIC/MED:

size bin	2005	2006	2007	2008	2009	2010	2011	2012	2013
20	25	0	0	0	8	30	20	0	0
40	11	1	21	0	0	3	23	0	0
60	89	36	40	73	4	2	57	5	0
80	57	3	26	88	47	72	105	6	0
100	52	8	18	39	44	16	229	26	0
120	7	2	6	40	29	5	123	41	0
140	10	23	2	2	18	12	95	20	0
160	8	14	29	27	12	50	41	21	0
180	19	5	26	45	20	32	87	21	0
200	46	1	6	41	4	54	110	80	9
220	58	0	2	15	2	16	94	29	8
240	6	0	0	1	0	8	26	16	4
260	0	0	0	0	0	0	6	3	0
280	0	0	0	0	0	0	2	1	0
300	0	0	0	0	0	0	0	0	0
320	0	0	0	0	0	0	0	0	0
340	0	0	0	0	0	0	0	0	0
360	0	0	0	0	0	0	0	0	0
380	0	0	0	0	0	0	0	0	0

Table 3. Summary of age-length data (otoliths and spines) available for the West Atlantic. Gaps in data are highlighted in gray.

WEST ATLANTIC

size bin	1974	1975	1976	1977	1978	1996	1997	1998	1999	2000	2001	2002	2009	2010	2011	2012	2013	2014
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	24	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0
60	0	53	0	1	0	1	4	12	4	1	0	0	0	0	19	3	1	16
80	0	7	7	3	0	4	11	5	7	2	0	0	0	0	46	24	4	64
100	0	5	4	1	0	0	2	11	9	3	0	0	0	3	89	109	40	37
120	0	4	8	4	0	0	6	8	1	0	0	0	2	10	55	88	45	13
140	1	1	6	5	0	0	4	4	0	0	0	0	10	0	75	61	16	13
160	1	0	1	1	0	4	6	1	0	0	0	1	4	53	65	60	69	7
180	0	1	0	0	0	34	0	0	0	0	2	12	7	124	270	45	29	23
200	0	4	1	0	1	11	0	0	0	0	2	7	7	112	67	100	62	60
220	0	26	13	6	17	17	0	0	0	0	1	20	18	59	95	41	104	100
240	0	19	12	4	62	3	0	0	0	0	0	12	32	71	100	69	74	88
260	0	8	13	1	16	1	0	0	0	0	0	2	26	23	93	66	91	61
280	0	2	2	0	1	0	0	0	0	0	0	0	5	7	24	16	42	18
300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
320	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
380	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

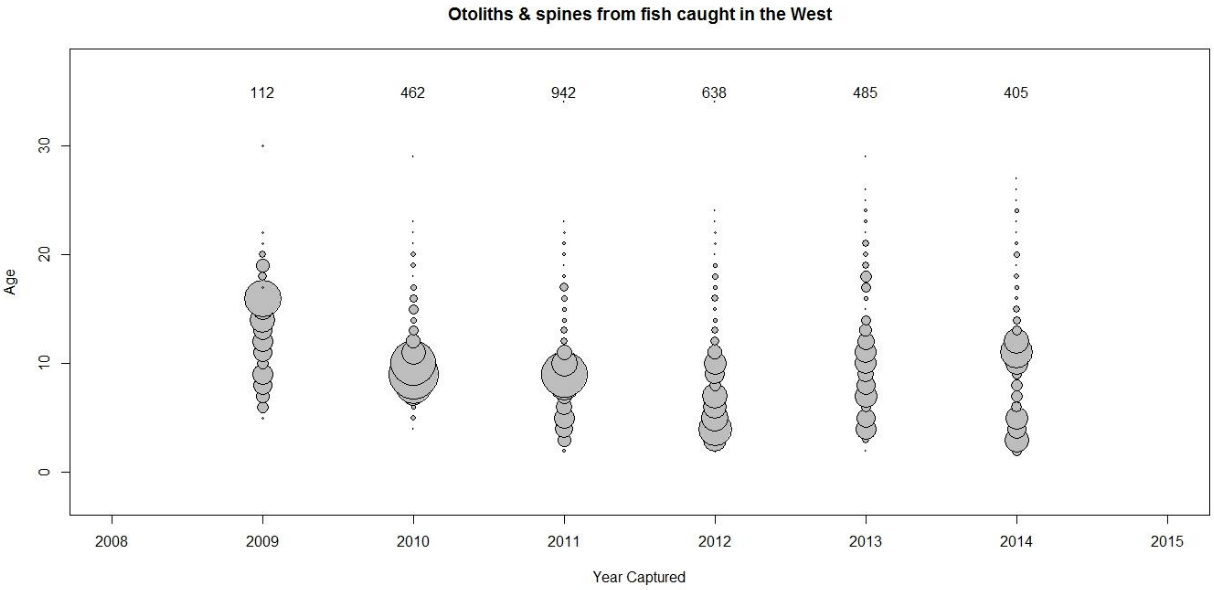

Figure 1. Bubble plot representing the direct ages form spines and otoliths collected in the west.

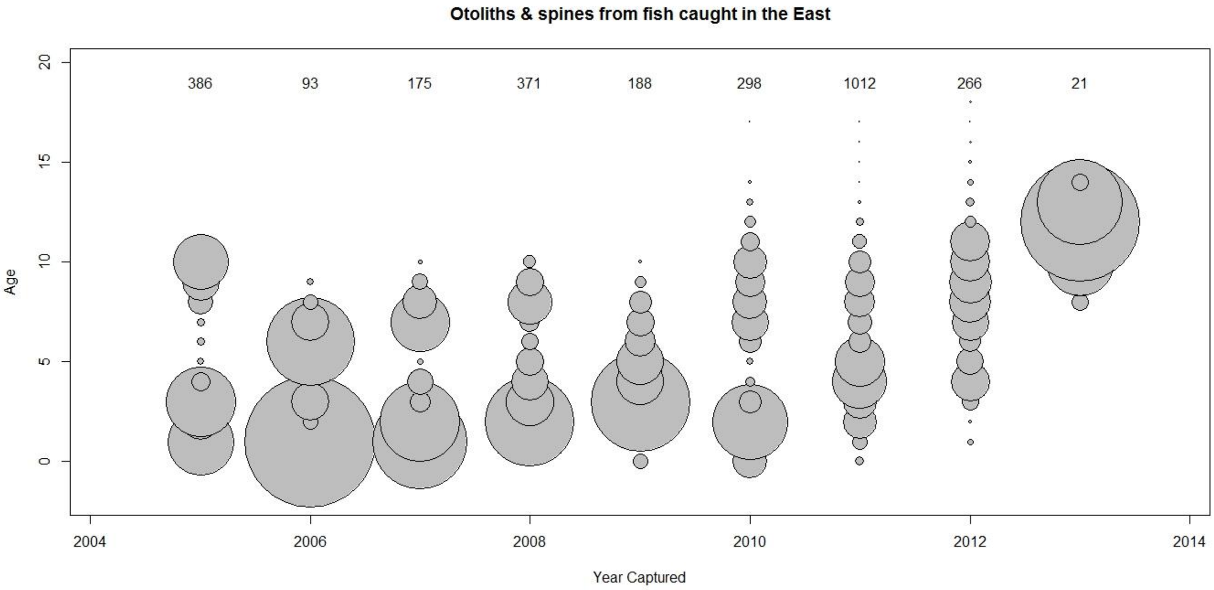

Figure 2. Bubble plot representing the direct ages form spines and otoliths collected in the east.

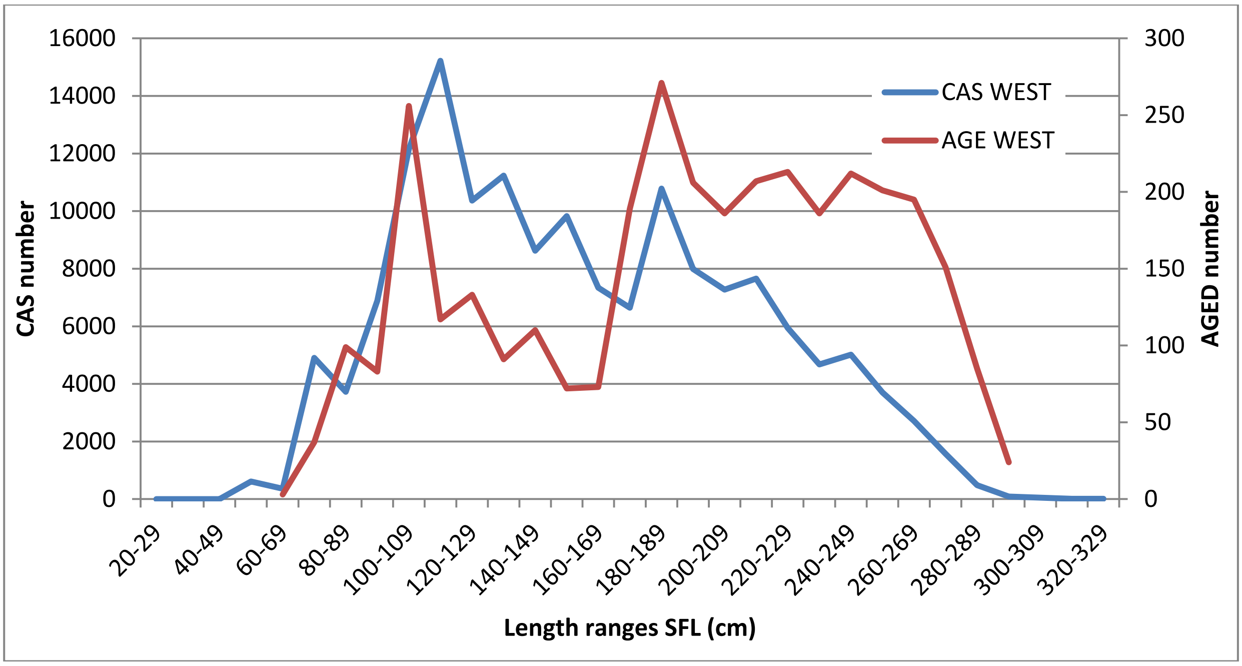

Figure 3. A comparison of catch at size (2005-2013) in the western management zone with the distribution of the samples collected from the same area (2009-2015).

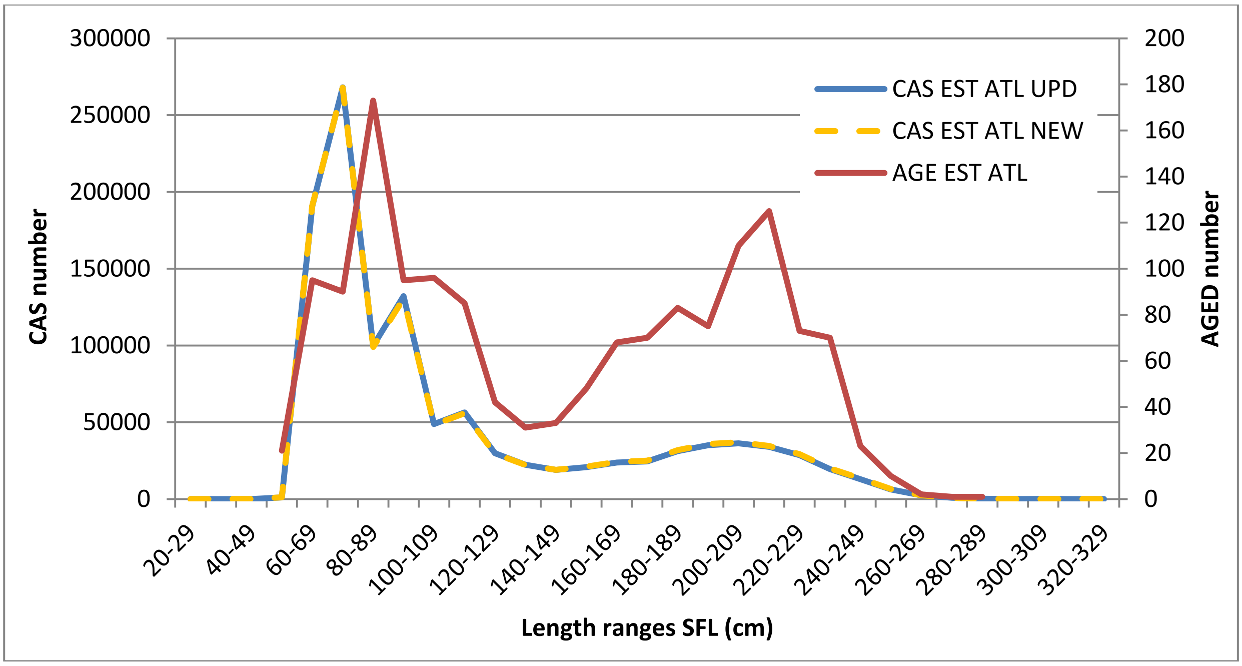

Figure 4. A comparison of catch at size (2005-2013) in the eastern management zone with the distribution of the samples collected from the same area (2005-2014).

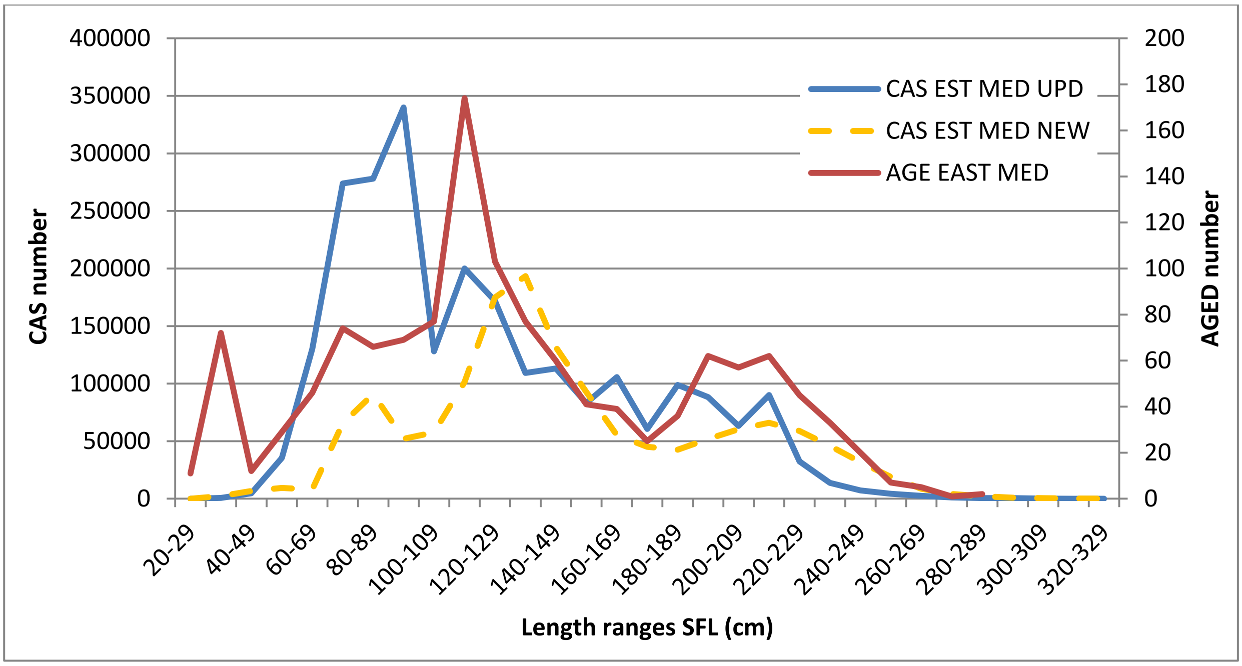

Figure 5. A comparison of catch at size (2005-2013) in the Mediterranean management zone with the distribution of the samples collected from the same area (2005-2014).

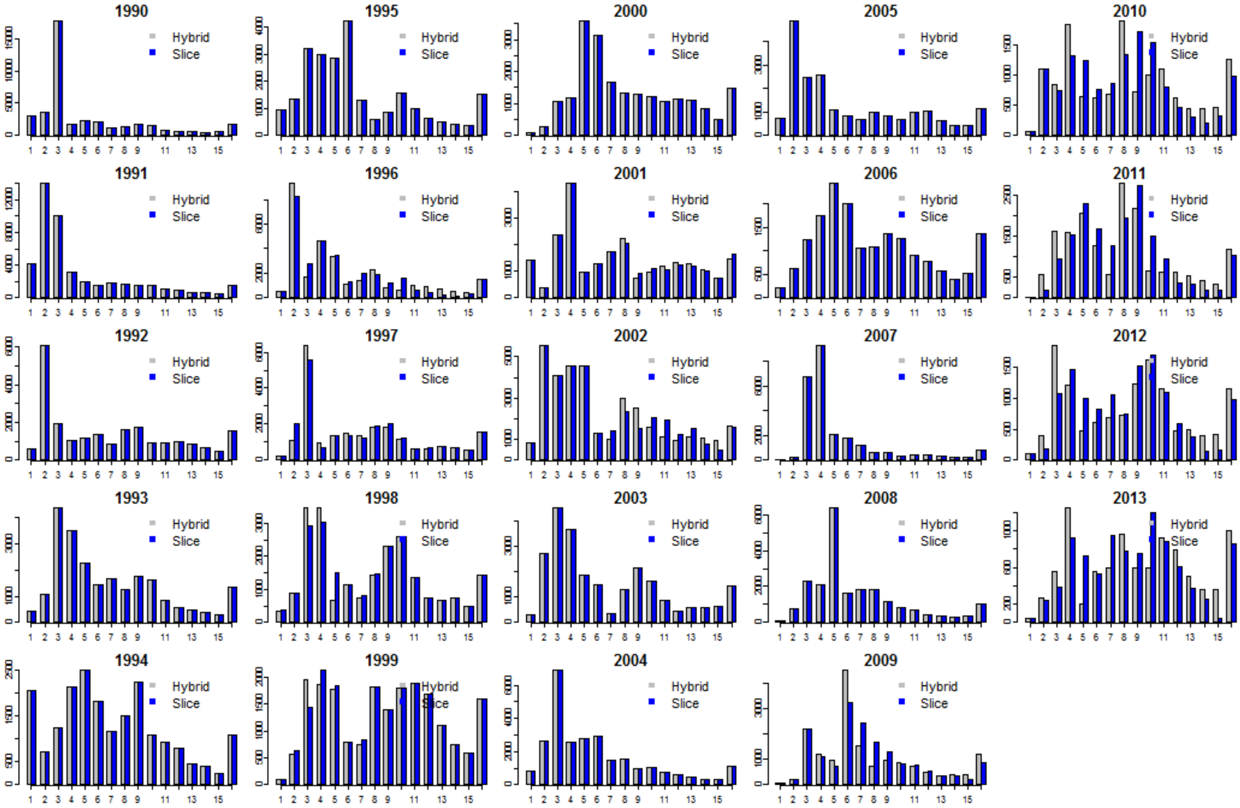

Figure 6. Comparison of CAA obtained from the hybrid method versus age-slicing for WBFT for years 1990-2013, where the CAA differs between slicing and the hybrid method when annual ALK information is available (primarily 2009-2013).

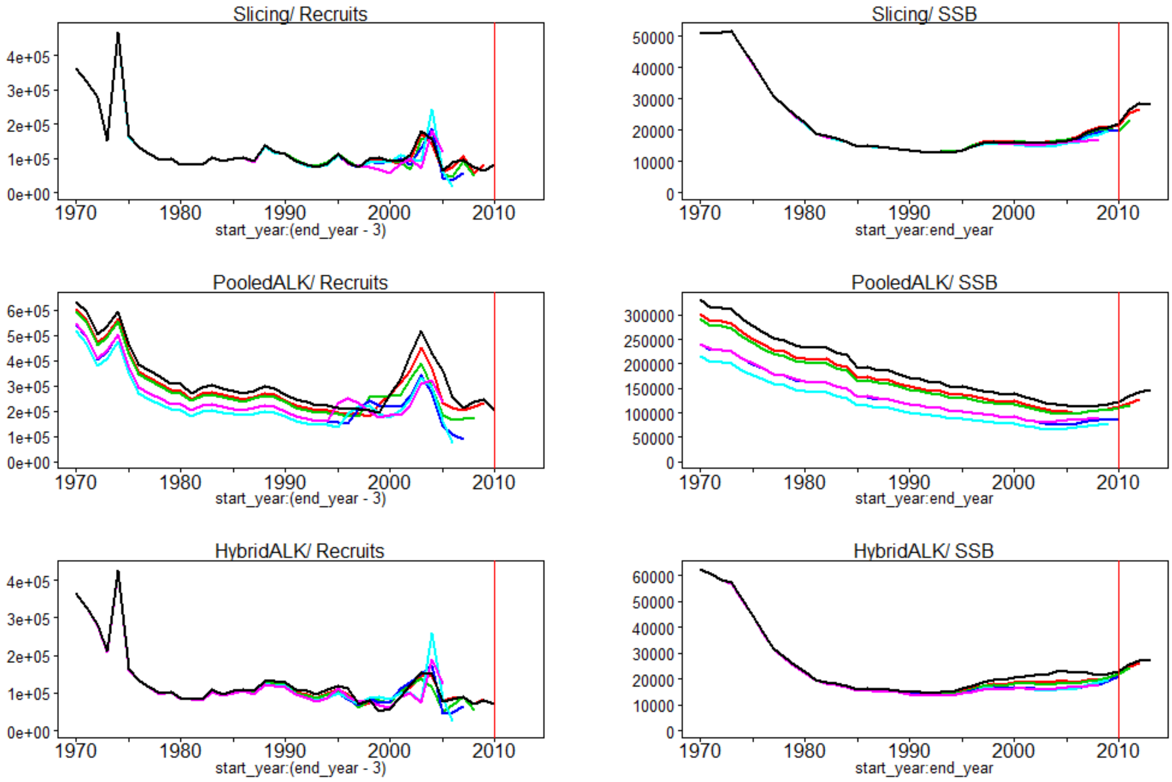

Figure 7. Retrospective VPA results between the three methods of obtaining CAA for WBFT. The red line indicates the year (2010) that most ageing data enters in the models for the hybrid method.

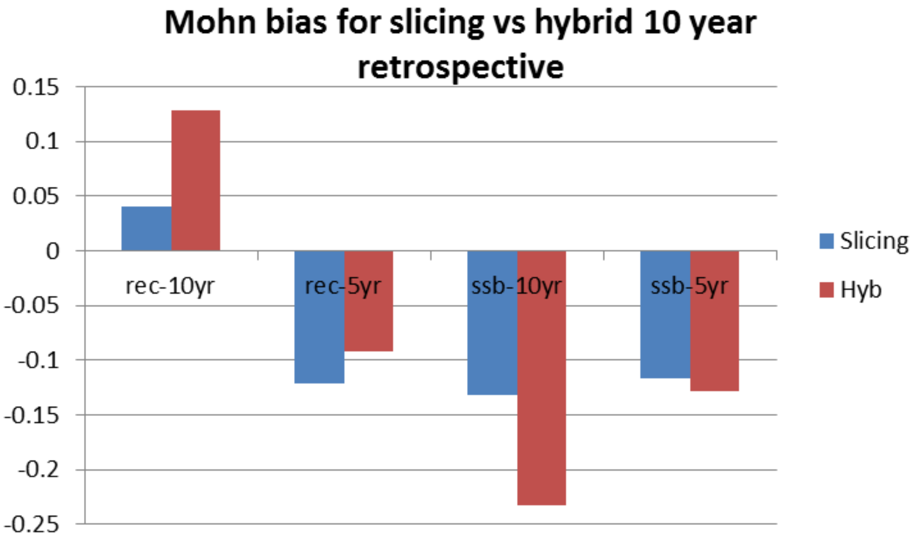

Figure 8. Mohn retrospective bias for 10 year vs 5 year retrospectives comparing slicing to the hybrid method of obtaining CAA.