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

Item 10 M. Neves dos Santos

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 discussion. 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 program**

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 GBYP Coordination undertook the analysis of GBYP PSAT tags data, revision of trap data, review of old literature on BFT maturity, review and selection of best trade, market and auction data, study of BFT YOYs in 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 1 and Task 2 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 BFT 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 2 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 Med resulting in otolith signals that even more different than that from the Gulf of Mexico. The Group observed that the document described that 3 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. A special attention was put on 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 thePluriannual 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 *SFL*3.020584, *WEST*; and *RW*= 0.0000315551 *SFL* 2.898454, *EAST* ), together with the models used to date (*RW*= 0.0000152 *SFL*3.0531, 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 fit 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* clearly underestimates the weight of spawning ABFT being the models used to date, as well as the alternative model presented in this paper, that 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/2016/P/037 presented an oceanographic index of BFT 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 (SCRS/2015/149). 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., Correiro et al., 2005; Knapp et al., 2015). 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 of BFT is influenced by the quality of female nutrition, not by size (REFERENCE?).

*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., 2015) 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 BFT 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 BFT data preparatory meeting held in Tenerife 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. (2015). 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 BFT 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 BFT 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 program. 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/2016/P32 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 3.2.1.1**). 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 3.2.1.2**). Four regions had zero tag releases, the 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 3.2.1.3**). 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 yea*

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 (SCRS/2015/170) and made available to SCRS and associated scientists and stakeholders.
* To the extent possible, data providers agreed on the format constructed within the GBYP program.
* 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 (SCRS 2014) 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 behaviors 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 personal communication).

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/2016/P32) 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 (SCRS 2014) 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 BFT 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 BFT (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. SCRS/2014/170 incorporated both gravity and bulk transfer approaches to estimate movement matrices to inform an operating model with stock mixing. SCRS/2014/177 (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 X2 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 SCRS/2013/093 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∞= 263.77cm FL) than the model currently used in the stock assessment (𝐿∞= 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 going 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. 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 recover-ies, 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 1 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 4.1** and **Figure 4.1**) and western stocks (**Table 4.2** and **Figure 4.2**). 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 4.3** (and **Figure 4.3)** 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 4.4** 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 4.5**). 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 4.4)** 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 4.11**) 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 Spain, Portugal, Morocco, and, Italy, 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** **4.6** (BFT-E Atlantic region), **Table** **4.7** (BFT-E Mediterranean sea) and, **Table 4.8** (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 4.9**, 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 4.10**) 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 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, GBYP) needs to be made to achieve this goal. The work plan presented in **Table 4.11** 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 WG 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 (SCRS/2015/169) 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 GBYP aerial surveys of spawners currently covers four years (SCRS/2015/144). 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/2016/P34) 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 in the stock assessment 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 5.3.1 and 5.3.2**). 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 (SCRS/2009/193) 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 5.3.1 and 5.3.2**). 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**

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. 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 Software Catalogue***

Under the SCRS Strategic Plan for 2015-2020 it was agreed to consolidate the stock assessment 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 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 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](http://github.com/ICCAT/software/wiki/1.-Introduction)

**7. GPYP Core Modelling and MSE Group**

***7.1 Review of activities relative to MSE/MP development***

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 allow flexibility to allow selectivity *alias* 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 comp data from 1988 on due to missing data from some fleets prior to this year.
* All other fleets other (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 (Anonymous 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, US 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 (SCRS/2015/171).
* **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 1653 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 year. 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 programs 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 4.11**) 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 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 including:

* 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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