Annex 16

REPORT OF THE PACIFIC BLUEFIN TUNA WORKING GROUP WORKSHOP

International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean

17-22 February 2014
La Jolla, California, USA

1. INTRODUCTION

1.1. Welcome and Introduction

R. Vetter, Director of the Fisheries Resources Division, NOAA Southwest Fisheries Science Center, opened the meeting on 17 February 2014. He welcomed participants and explained administrative and logistical arrangements. The Chair of the Pacific Bluefin Tuna Working Group (PBFWG), Z. Suzuki, highlighted the main objectives of the meeting: an update of the stock assessment report assigned by the ISC Plenary in July 2013; developing a response to the requests from the Ninth Session of the Northern Committee in September 2013; describing stock status and developing conservation advice for Pacific bluefin tuna; and planning for the work of the PBFWG.

1.2. Adoption of Agenda

The Chair introduced the agenda for the meeting and proposed that Agenda Item 8 include adoption of both the Working Group Report and the Stock Assessment Report. The PBFWG agreed with this amendment and adopted the agenda with this change (Attachment 1). A list of participants is provided as Attachment 2.

Some participants called attention to the objectives of the PBF update stock assessment as stated in Section 6.2 of the ISC13 Plenary Report: to conduct future projections using a better F-level scenario, which is more consistent with the current management measures used by WCPFC and IATTC, and to determine details of projection scenarios, including F-levels and future recruitment. The ISC13 Plenary Report also calls for the PBFWG to i) provide more accurate estimates of the immediate risk of declining SSB below the historically lowest observed SSB; and ii) evaluate stock status since CMMs were introduced and address actual fishing mortalities under management (*Fs* in 2011 and 2012), recognizing that uncertainties still remain.

Participants inquired whether the CIE review and ISC's response to this review would be discussed. The Chair clarified that since the CIE review was not yet in the public domain, and because this meeting is focused on updating the assessment, this item would be deferred to a later meeting.

The PBFWG considered that presentations relating to data or model parameter issues that are relevant only to future improvements to the stock assessment, rather than to the limited scope of the current update to the stock assessment, should be discussed under Agenda Item 7 – Other Matters. The PBFWG Chair reiterated that the purpose of this meeting was to re-run the previous stock assessment with two additional years of catch and catch-per-unit-effort data, but without modifying any other specifics of the model. It was noted that some of the papers on the agenda discussed issues relevant to the update of the stock assessment as well as other issues which could be considered for future stock assessment model modifications. For example, during data preparation some errors (e.g. minor discrepancies in catch reporting among database sources) were discovered and participants discussed whether it was appropriate to correct these errors in the update of the stock assessment. The PBFWG concluded that such issues should be decided on a case-by-case basis as each of the working papers was presented.

In order to facilitate progress of the meeting, the Chair noted that draft text for some sections of the Stock Assessment Report had been distributed to participants in advance of the meeting. Participants were encouraged to provide any comments on this draft text to Y. Ishida (Japan) and the rapporteur at their earliest convenience so that revisions could occur prior to adoption of the report upon close of the meeting.

Korea indicated that it would provide updated text concerning Korean fisheries for inclusion in the report. Korea also indicated that it wished to make a presentation on preliminary analysis of catch-at-size data, and this presentation was included under Agenda Item 7 – Other Matters.

1.3. Appointment of Rapporteurs

S. Clarke was appointed as the lead rapporteur for the meeting and support rapporteurs were assigned by the Chair as follows: Item 2.1-Biological parameters and data for the stock assessment (N. Suzuki and K. Piner); Item 2.2-Fishery data for input of the stock assessment model (Y. Hiraoka and A. Aires-da-Silva); Item 3.1-Confirmation of key model setting of the base case model (S. Iwata and S. Teo); Item 3.2-Base case model results (K. Oshima and M. Maunder); Item 4.1-Confirmation of the scenarios and results (M. Ichinokawa and K. Piner); Item 4.2-Analysis of the fisheries indicators and stock dynamics during the past low recruitment period and Item 4.3-Consideration for environmental impacts on the stock dynamics (H. Honda and A. Aires-da-Silva); Item 5-Stock status and conservation advice for Pacific bluefin tuna (PBFWG Chair assisted by Y. Takeuchi and S. Teo); and Item 6-Work plan and recommendations and Item 8 – Adoption of the Report (PBFWG Chair).

1.4. Distribution, Number and Determination of the Availability of Working Papers

The PBFWG Chair noted that there were 12 Working Papers submitted for discussion at the meeting (Attachment 3). Some authors noted that additions or revisions to Working Papers would be produced during the meeting.

The PBFWG Chair asked whether any Working Paper authors wished to withhold their papers from posting on the ISC website. The authors of Working Papers *ISC/14/PBFWG-1/08* and *ISC/14/PBFWG-1/09* indicated that their papers should not be posted; the authors of the presentations under Agenda Item 7.1 and 7.2 also indicated that since they are not submitting working papers to the meeting, their presentations should also not be posted on the ISC website.

2. REVIEW OF STOCK ASSESSMENT INPUT DATA

2.1. Biological Parameters and Data for Stock Assessment

2.1.1 Revision of the natural mortality estimates for age-0 fish of the Pacific Bluefin tuna using 1996-2012 mark-recapture data in Tosa Bay presented by S. Iwata (ISC/14/PBFWG-1/08)

The aim of this paper is to revise the estimates of natural mortality rate for age-0 Pacific bluefin tuna (*Thunnus orientalis*) using updated data from mark-recapture experiments conducted from 1996-2012 in Tosa Bay. A tag-attrition model used in previous studies was extended to investigate the year and month effects in the natural mortality rate. Analysis with a constant natural mortality provided an estimate of M_0 of 2.25 per year, which is slightly smaller than in previous studies. On the other hand, analysis based on models with year effects indicates that a change in natural mortality was observed in 2004. However, it was not possible to examine the month effects in M_0 because of difficulties with convergence. As a by-product of the analysis, it was observed that the quarterly pattern of fishing mortality changed in 2004. The authors recommend that future PBF stock assessments use the new estimate and a year effect for natural mortality, at least as a sensitivity test.

Discussion

In response to a question, S. Iwata explained that even though *M* was found to vary by year, the variance in *M* does not produce a large amount of variance in the output of the stock assessment model, perhaps because the troll fishery does not have a major impact on the stock of PBF. It was suggested that if obtaining convergence when using quarterly effects is problematic, two seasons instead of four quarters could be modeled instead.

Another suggestion was to estimate *M* based on growth (changes in length) of PBF, and S. Iwata indicated that this approach would be investigated.

It was considered that the change in *M* from 2.86 to 1.4 is implausibly large and may suggest that there is a problem with the experimental design. S. Iwata explained that there is little information regarding the experimental design prior to 2007. It was also suggested that a thorough review of changes in all potentially important experimental parameters be conducted across all years.

Another approach was suggested involving using a smoothness prior to resolve convergence issues in future work.

2.2. Fishery data for input of the stock assessment model

2.2.1 Standardized catch per unit effort of Pacific Bluefin tuna (*Tunnus orientalis*) by general linear model for the Taiwanese small-scale longline fishery in the southwestern North Pacific Ocean presented by H.Y. Wang (ISC/14/PBFWG-1/01)

Longline is the main gear type used to harvest Pacific bluefin tuna (PBF) in the southeastern, eastern and northeastern waters off Taiwan. The fishery seasonally targets giant PBF spawners larger than 165 cm in fork length from April to June each year when the spawners aggregate to spawn. The standardized catch per unit effort of PBF for this fleet is important for stock assessment as an abundance index of spawners. The Taiwanese PBF fishery is composed of three longline vessel size classes. Other fisheries such as set nets may catch a few PBF incidentally. The longline fleet can change its target species easily to yellowfin or bigeye tunas, billfish and swordfish depending on the fishing season and market price. Catches are mainly landed at the ports of Tungkang, Suao and Hsinkang. A trip lasts from a few days to longer than a week on an average, depending upon the fishing conditions and whether they deployed either 1 or 2 set(s) per day according to the number of hooks used per set. Salted or fresh squid bait is used. The fishing season for PBF has extended from March to September recently, and most PBF catches are usually taken in May and June when giant PBF migrate and aggregate spawn in the waters off Taiwan. Currently more than 60% of PBF landed are domestically consumed and the rest are exported. Collections of catch and effort data of PBF for this fleet were initiated in 1999 from auction records at fish markets for landing information and Port Security Inspection Stations to estimate fishing effort. Accordingly, a time series of standardized CPUE was estimated by applying a generalized linear model with year, month and vessel size class as fixed factors with an assumption of a lognormal error structure. The standardized catch per unit effort declined from 1999 to 2002, stayed steady in 2003 and 2004, dropped again in 2005, and remained steady with a slight fluctuation until 2008, decreased to the historical lowest level of this series in 2010, and then increased.

Discussion

In response to a question, C.C. Hsu explained that the proportion of PBF landed in the three ports of Tungkang, Suao and Hsinkang began to change beginning in 2010 as a result of the fishing grounds shifting from the southeast of Chinese Taipei to the northeast of Chinese Taipei (toward Ishigaki). This may have made landing in Suao more attractive for fishermen. Prior to 2011, Taiwanese PBF data were collected from one port only (Tungkang). It was queried whether this change in the database was appropriately accounted for in the CPUE standardization, and if not whether it might create a bias or inconsistency for the stock assessment. In particular, investigating whether PBF landed in all three ports were included in the analysis for years prior to 2010 was suggested, but C.C. Hsu explained that it would take some time to separate the data by port and it could not be accomplished during the meeting. It was then asked whether the update stock assessment should use the Taiwanese longline CPUE series presented in this paper or the Taiwanese longline CPUE from the previous assessment, i.e. without the most recent two years' data. It was agreed that a sensitivity analysis would be run to determine whether the choice between these two CPUE indices results in a material change in the stock assessment results.

Participants discussed differences between the CPUE indices for the Taiwanese and Japan longline fleets and whether these might be caused by different ages/sizes of PBF being targeted. It was clarified that the fishing areas for these two fisheries do not overlap and that the size composition is also different. The Taiwanese longline fishery for PBF takes place in a very localized area and catches a narrow size range of spawners, therefore, it is easily influenced by spawners aggregation size. The Japanese longline fishery caches smaller sizes of large PBF. Participants further explained that there is variability in the Taiwanese dataset due to i) variability in individual fish due to spawning condition; ii) data raising which may not be reflected in the data provided to the ISC database. It was clarified that 292 kg is the mean weight for PBF caught by the Taiwanese longline fleet in 2013.

The PBFWG discussed why catches declined from 1999 to 2011 but CPUE increased in 2006-2007, and whether this could indicate a major decrease in effort. C.C. Hsu suggested that the trend may be because the data show only the number of vessels permitted to fish, and since it is difficult to know which of these vessels are actively fishing, there is considerable uncertainty about fishing effort. However, it could also be that fishing efficiency is higher now that the fishing trips have become shorter.

In response to a question regarding which PBF year classes were the targets for the Taiwanese longline fleet in 2013, C.C. Hsu responded that there would not necessarily have to be a strong connection between the higher CPUE in 2013 and a strong year class. Instead, the higher CPUE could be due to other factors such as oceanographic conditions, migration patterns or targeting.

It was agreed that the results of a sensitivity analysis comparing the Taiwanese LL fleet's CPUE with and without the most recent two years' data would be used to determine whether the most recent years' data should be used in the update stock assessment (see Section 3.2 for continuation of discussion).

2.1.2 Updated standardized CPUE and size frequency for Pacific Bluefin tuna caught by Japanese coastal longliners presented by Y. Hiraoka (ISC/14/PBFWG-1/02)

This document presented the standardized CPUE for the Japanese coastal longline fleet through 2013 (calendar year). The standardized CPUE continuously declined from 2007 to 2012, then slightly recovered in 2013. The length and weight frequencies indicated the signal of relatively strong year classes, which are assumed to represent 2007 and/or 2008. It was suggested that the new recruitment of those year classes into the Japanese coastal longline fishery contributed to the increase of CPUE observed in 2013.

Discussion

Participants considered whether in applying a filter to the data to determine which areas of the spatial grid to include in the assessment, the spatial area used in the CPUE standardization changed from the previous assessment because the filter became stricter with time. Y. Hiraoka clarified that the filter requires that there be at least one PBF caught in more than nine years since 1994 (a 20 year timespan), and that when the new data set were subjected to this filter, some grid cells were added and some were removed but there was no obvious shrinkage of the fleet distribution.

It was noted that there was an inconsistency between the Taiwanese and Japanese longline fleets' CPUE in the 2012 and 2013 data points and whether the Japan fleet follows a cohort through time, or whether those cohorts move successively through the fishing grounds was discussed. The reasons why the Japanese and Taiwanese fish sizes are similar in 2010 and 2011 but different in 2012, and at the same time (in 2012) the CPUE begins to differ as well, were also discussed. It was considered that if the Japanese fleet's selectivity did not change greatly in 2012, then a large cohort was moving through the fishery, but if so the CPUE should have also increased.

It was explained that the Taiwanese longline fleet's fishing grounds are limited because it cannot fish inside Japanese national waters. Therefore the size of fish available to the Taiwanese longline fleet is different. It was also considered that the cohort which appears in 2012 in the analysis is relatively large but its size might appear exaggerated by the use of proportions, rather than numbers, in the plot. Changes in availability by size may explain the much higher variability observed in the PBF sizes caught by Japanese longliners.

Further discussions of the potential inconsistency between the relatively large cohort but lower CPUE in 2012 in the Japan LL fleet continued under Agenda Item 3.2.

The PBFWG agreed that the CPUE series for the Japanese longline fleet as presented in *ISC/14/PBFWG-1/02* would be used in the update stock assessment.

2.1.3 An update on PBF catch size composition for the Mexican fishery directed to farming operations in the EPO presented by M. Dreyfus (ISC/14/PBFWG-1/04)

PBF catch size data from Mexican purse seine operations in 2012 and 2013 were presented. The size information was taken with stereoscopic cameras during pen transfer operations to the permanent feeding pens. This proivdes a better picture of the selectivity of the fleet (especially those vessels associated with farming operations off the Baja California Peninsula in Mexico). The information presented in this document confirms that the selectivity has shifted upwards since 2002. The data presented here shows a mean fork length of 83 cm for 2012 and 109 cm for 2013.

Discussion

In response to questions about the coverage of the stereoscopic surveys, M. Dreyfus clarified that all data derive from one of three companies with an 80% share of the catch. Approximately 3000 individuals were measured each year, with a limit of no more than 200 fish measured per transfer.

In response to a question about what further steps would be necessary before these data can be used in a stock assessment, M. Dreyfus replied that individual lengths rather than mean lengths would be necessary as stock assessment input, however, the estimates from this sampling are consistent with the size selectivity estimates already produced for the Eastern Pacific Ocean. In response to a question about inter-annual variability in size selectivity estimates, A. Aires-da-Silva further clarified that this sampling was designed to address concerns about a potential bias toward the measurement of weak fish by observers. Since the sampling and the observer data have very similar results it shows that the observer data are not biased.

The Chair noted that while no decision by the PBFWG on these topics was required, this sampling represents an important step toward cross-validation of observer data. The PBFWG encouraged the collaborative work between the PBF fishing industry, Mexico and the IATTC to continue, with this type of data continuing to be collected on a yearly basis.

2.1.4 Updates of input data for stock assessment model, Stock Synthesis 3, on Pacific Bluefin tuna presented by K. Oshima (ISC/14/PBFWG-1/05)

In order to support an update of the stock assessment for Pacific bluefin tuna (PBF) in February 2014, and based on work plans proposed in the ISC13 Plenary, input data for the 2011 and 2012 fishing years were added to those used for the previous stock assessment in 2012, i.e. as before, fishery data from 1952 (fishing year) to 2010 (fishing year) were included and essentially did not change. Quarterly catch data were updated for all fleets. In addition, catch data for Japanese troll for farming were included into the Japanese troll fleet to reflect the actual catch of the Japanese troll fishery. Minor discrepancies, e.g. inconsistencies in catch reporting among database sources, in data used for the previous stock assessment were detected in several fleets but applying revised catch data series in the next full stock assessment was proposed. Size frequency data were updated for all fleets except for three fleets for which size data had low priority. Abundance indices from the Japanese longline, Japanese troll and Taiwanese longline fleets were updated through the 2012 fishing year.

Discussion

The PBFWG discussed whether to use corrected catch data in the update stock assessment. There was consensus that the corrections to Fleet 5 (i.e. to include the Japan troll fleet's catch for farming) and the units of catch for Fleet 13 should be included in the update stock assessment. Sensitivity analyses have already confirmed that the effect of these corrections on the assessment results is minimal (see *ISC/14/PBFWG-1/11*).

It was considered that the other identified potential corrections, which would involve remedying inconsistencies between the catch data used in the assessment and annual catch data reported in the ISC catch tables, would benefit from further consideration and should not be applied in the 2014 updated assessment. If these corrections are to be used in future assessments (as base case or in sensitivity runs) the effects of the changes on the stock assessment results should be investigated at that time.

The PBFWG agreed that corrections to catch and CPUE data for Fleet 5 (i.e. adding the Japan troll fleet's catch for farming) and Fleet 13 (changing the units of catch from biomass to number of fish) should be made. These corrections to the catch series, and the addition of new data points for 2011 and 2012 (fishing year), should be used in the update stock assessment.

2.1.5 Recruitment abundance indices of young Pacific Bluefin tuna revealed by Japanese troll fisheries presented by K. Fujioka (ISC/14/PBFWG-1/07)

In order to determine the yearly trends of abundance indices of young Pacific bluefin tuna (PBF), CPUE derived from the Japanese troll fishery operating in the East China Sea (off Nagasaki Prefecture) was standardized for the period 1980-2012. The CPUE was standardized based on the same procedures and assumptions as in previous studies (Ichinokawa et al. 2012, Oshima et al. 2013). The standardized CPUE had a similar trend to the previous CPUE until 2011, but greatly decreased in 2012. The CPUE in 2012 is the second-lowest level observed historically.

A recently identified mistake in the selection of the best model for the Nagasaki troll fleet was explained. The actual best model consists of main effects for year, month and port without any interactions. The use of the best model does not result in a material difference in the CPUE, SSB or recruitment outputs from the stock assessment.

Discussion

The PBFWG considered that the update stock assessment should use the Japan troll CPUE index produced using the best CPUE standardization model (i.e. the corrected model proposed by the presenter consisting of main effects (only) for year, month and port).

The PBFWG agreed that the Japan troll CPUE standardization model should be re-run using the "best" model selection (main effects only for year, month and port) and that this CPUE index be used in the update stock assessment.

2.1.6 Preliminary trial to estimate age separated stock indices by using Japanese purse seine in the Sea of Japan presented by M. Kanaiwa (ISC/14/PBFWG-1/09)

Despite the recent development of the purse seine fishery for Pacific bluefin tuna in the Sea of Japan, no abundance index would be provided for the 2012 stock assessment conducted by the ISC because of the difficulty of defining effective fishing effort. In this paper, a mixed model comprising a normal distribution whose mean length was represented by each mode, followed by von Bertalanffy growth curve, were applied. Age-separated catches and CPUE were estimated using a maximum log-likelihood method. These indices were evaluated by comparing them with the output from estimated stock abundance at age using the base case model (Fukuda et al. 2014). The models with three cohorts were adopted as the optimal models, and abundance indices based on the second cohort performed better than other indices. However more work to standardize this index by some usual factors such as area and/or season etc. will be necessary.

Discussion

The Chair noted that while no decision by the PBFWG on this topic was required, purse seine CPUE standardization remained an important issue to consider and try to resolve.

3. MODEL RESULTS

3.1. Confirmation of Key Model Setting of the Base Case Model

3.1.1 A review of the model setting for the update of the stock assessment for Pacific bluefin tuna presented by H. Fukuda (ISC/14/PBFWG-1/11)

The PBF stock assessment was updated with fishery data for two additional years (through 2012 (fishing year)) in accordance with the original work plan endorsed at the ISC13 Plenary (Table 3-1). This document describes the setting of the updated stock assessment model. Four issues including the catch unit for Fleet 13 (USA recreational fishery), the selectivity parameters for Fleets 8 and 10 (Japanese set net), the input effective sample size of Fleet 12 (Eastern Pacific Ocean commercial fisheries), and the catch time series for farming in the Western Pacific Ocean (Fleet 5), were modified after confirming their effect. These modifications did not have any major effect on the model parameter estimations and the population dynamics estimated.

Table 3-1. List of updates of input data showing the additional years of data included in the update.

Fleet	Catch data	Size composition data	Abundance index
F1	2011, 2012	2010, 2011[1]	1993-2012 (F15, S1)
F2	2011, 2012	2011, 2012	-
F3	2011, 2012	2011, 2012	-
F4	2011, 2012	Not updated	-
F5[2]	1998- 2012	2011, 2012	1980-2012 (F19, S5)
F6	2011, 2012	Not updated	-
F7	2011, 2012	2011, 2012	-
F8	2011, 2012	2011, 2012	-
F9	2011, 2012	2011, 2012	-
F10	2011, 2012	2011, 2012	-
F11[3]	2011, 2012	2011, 2012	1998-2012 (F23, S9)
F12	2011, 2012	2011, 2012	-
F13	2011, 2012	Not updated	-
F14	2011, 2012	2011, 2012	-

[1] Size composition data in the terminal year (2012) cannot be calculated using the estimation procedure proposed by Mizuno et al. (2012).
[2] Catch by troll gear for faming from 1998 to 2012 was added.
[3] Units were corrected from metric tonnes to individuals.

Discussion

The PBFWG discussed the proposed model setting for the base case model and agreed that there were small changes that would fix minor errors in the previous model, and which would not substantially affect model results and conclusions.

The PBFWG agreed to move forward with the changes proposed in ***ISC/14/PBFWG-1/11***. The PBFWG agreed that sensitivity analysis for Taiwanese longline and Japanese longline CPUE and size composition data should be run to investigate the effects of using differing time series of Japanese and Taiwanese longline CPUE and size composition data on the model results. These sensitivity runs are specified in the following section.

3.2. Base Case Model Results

3.2.1 Preliminary population dynamics model for the updated stock assessment of Pacific bluefin tuna presented by H. Fukuda (ISC/14/PBFWG-1/03)

The model diagnostics and population dynamics results for the provisionally updated stock assessment model were provided. The provisional model likely converges to a global minimum, with total negative log likelihood of 2411. Most of the parameters were well-estimated by the updated model and not drastically changed from the last stock assessment in 2012. However, a bootstrap analysis and retrospective analysis showed the uncertainty of the terminal year's spawning stock biomass (SSB) and recruitment. The trend of SSB in the updated stock assessment model was similar to that of the last stock assessment. The highest SSB occurred in 1961 (139,746 t) and the second highest peak was in 1995 (86,601 t). After 1995, SSB continuously declined until 2011 (25,114 t) and the SSB for the terminal year (2012) was 26,270 t. Recruitment after 2008 was lower for the update stock assessment than for the previous stock assessment. The estimated recruitment for 2011 and 2012 was lower than the historical average and the average recruitment of the most recent five years (2008-2012) was also lower than the historical average. The current level of fishing mortality ($F_{2009\text{-}2011}$) was estimated to exceed all listed BRPs (F_{max}, $F_{0.1}$, F_{med}, F_{loss} and $F_{10\%\text{-}40\%}$) except for F_{loss}. (It was noted that the SSB values referenced here changed slightly as a result of additional model runs conducted during the meeting.)

Discussion

H. Fukuda also presented the latest results of the sensitivity runs. Regarding the sensitivity of the model to including the last two years' data for the Taiwanese longline CPUE series, the model fit to the data improved only for Fleet 15 (S1) and was not significantly different for other fleets when the series was truncated in 2011 (fishing year). In addition, two fleets (F1 and F11) had lower log likelihoods with the truncated series. Overall, however, the recent SSB continued to decline sharply with either CPUE series, but its absolute value was slightly larger when the Taiwanese longline CPUE series extended through 2013.

It was considered that differences in trends in SSB in the most recent period are strongly influenced by including or excluding the Taiwanese and Japanese longline CPUE series.

The PBFWG reconfirmed its acceptance of the changes to the Japan troll fleet catch for farming (i.e. changes to the first quarter catches for Fleet 5), and the correction of units from biomass to number of fish for Fleet 13. It also confirmed its acceptance of the proposed changes in the selectivity parameters for Fleets 8 and 10, and the input sample sizes for Fleet 12.

Regarding the Taiwanese longline CPUE series, concerns were expressed that the sensitivity runs provide further evidence that the model provides a poor fit to the data for 2012 and 2013 (calendar year). In particular, it was pointed out that the recent Japanese longline CPUE data, the Taiwanese longline CPUE data, and the Japanese and Taiwanese longline length composition data conflicted. After further discussion of potential explanations for the poor fit (see discussions in Section 2.2), the group agreed to use the full Taiwanese longline CPUE series (i.e. through 2013) for the base case, and to conduct additional sensitivity runs to assist with interpretation of the base case results when giving management advice. This interpretation should touch upon whether the model was specified correctly and whether it is possible to provide any further characterization of the PBF stock status given an additional two years of data but using the same model. Concerning the need to provide information to the NC on recent recruitment of PBF, participants noted that it was not necessary to conduct a full assessment for this purpose.

Revisiting an issue raised in connection with ***ISC/14/PBFWG-1/02*** under Agenda Item 2.2, the WG discussed whether the Japanese longline fleet targets a specific cohort and therefore the large fish that are currently in the population. One view was that the Japanese fleet has recently been fishing closer to Chinese Taipei where the larger fish are located. However, another view was that recently the fishery moved closer to Japan where the young adults are located.

The WG agreed to conduct the following base case and sensitivity runs:

1. A base case run with both the Taiwanese and Japanese longline CPUE series through 2012; the size composition for the Japanese longline fleet extending through 2011 (fishing year) and the size composition for the Taiwanese longline fleet extending through 2012 (fishing year);

2. A sensitivity run removing CPUE data for the Japanese longline fleet for 2011-2012 (fishing year), and removing size composition data for the Japanese longline fleet for 2010 and 2011[1];

3. A sensitivity run removing CPUE data for the Taiwanese longline fleet for 2011-2012 (fishing year), and removing size composition data for the Taiwanese longline fleet for 2011 and 2012;

4. A sensitivity run with both the Japanese and Taiwanese longline CPUE series for 2011 and 2012 (fishing year) removed, and also removing the Japanese longline size composition data for 2010 and 2011, and the Taiwanese longline size composition data for 2011 and 2012.

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[1] Size composition data in the terminal year (2012) cannot be calculated using the estimation procedure proposed by Mizuno et al. (2012).

4. RESPONSE TO THE REQUESTS FROM NC9

4.1. Confirmation of the Scenarios and Results

4.1.1 Updated future projections of Pacific Bluefin tuna with draft results to answer the requests from NC (ISC/14/PBFWG-1/10)

This working paper reports on enhancements to the future projection software used for the ISC PBF stock assessments in terms of both its functionalities and performance as well as in terms of the future projection calculations from the current version of the base case run of Fukuda et al (2014) in response to the requests made by NC9. The results (Scenario 1) clearly indicate that unless future recruitments remain within the historical average range of variation, continuation of perfect implementation of management measures in 2014 by both WCPFC and IATTC is not strong enough to increase the spawning stock from the current historically very low level. Out of six additional alternative candidate management measures from 2015, Scenario 6 performed relatively better in terms of expected increases in the spawning stock size within 10 or 15 years from 2014 and the probability that the SSB will decline below the historically lowest observed level. This working paper also introduced the preliminary results using an alternative formulation of future recruitments to consider for use in the next full stock assessment as one alternative scenario of future recruitments.

<u>**Discussion**</u>

The PBFWG reviewed and discussed the projections in ***ISC/14/PBFWG-1/10*** that were prepared in response to NC9's requests. The PBFWG noted that the definition of juvenile catches as ages 0-2 given by NC9 was not consistent with the stock assessment definition of maturity-at-age. The PBFWG acknowledged that although the definition of juvenile age-classes does not include all juvenile fish, a new projection analysis is not feasible at this meeting. The PBFWG recommended that the results of this analysis be presented to NC10 acknowledging this issue.

The PBFWG also discussed the probability of SSB declining below the historically lowest observed level within each projection scenario as presented in ***ISC/14/PBFWG-1/10***. Some participants noted that this statistic is somewhat hard to interpret. The PBFWG noted that it was not requested by NC9. The PBFWG decided not to include this statistic in its response to the NC.

The PBFWG also discussed the calculation of $SSB_{F=0}$. Two versions were presented based on the years used to calculate $SSB_{F=0}$: i) the last 10 years in the stock assessment (2002-2011) or ii) the last 3 years in the stock assessment (2009-2011). The latter option represents a shift to a lower productivity period. The PBFWG agreed that although current recruitment is low, information showing that PBF have transitioned to a lower productive period is limited. The PBFWG recommended that only those results using $SSB_{F=0}$, 2002-2011 be forwarded to the NC.

4.2. Analysis of the Fisheries Indicators and Stock Dynamics During the Past Low Recruitment Period and Consideration of Environmental Impacts on Stock Dynamics

4.2.1 Changes in recruitment of Pacific Bluefin tuna (*Thunnus oreintalis*) from 1980 to 2012 presented by Y. Ishida (ISC/14/PBFWG-1/06)

Changes in recruitment of PBF were examined for 1980-2012. Shifts in recruitment were detected in 1994 and 2009 by a sequential regime shift detection method and the following three periods were defined: 1980-1993, 1994-2008 and 2009-2012. The recruitment of PBF was significantly lower in 1980-1993 and 2009-2012 than in 1994-2008. Catch per unit effort (CPUE) in Nagasaki (troll fishery S5) was also significantly lower in 1980-1993 than in 1994-2008. Significant positive relationships were found between the recruitment and CPUE in Nagasaki (R^2=0.581), Kochi (R^2=0.206) and Wakayama (R^2=0.288), and the recruitment forecasts using these relationships were thought to be promising. Significant but weak negative relationships were found between the recruitment and Pacific Decadal Oscillation (PDO) in fall (R^2=0.202) and winter (R^2=0.193).

Discussion

Some participants considered that the relationship between recruitment and the PDO was too speculative to be endorsed by the PBFWG.

Y. Ishida noted that the recruitment shift delineations are not robust to retrospective analysis; if, for example, recruitment since 1952 is analyzed, the results would be different. He noted that recruitment in the period 1980 to 1993 is considered a low recruitment period but is relatively stable compared to other periods.

It was suggested that Table 2 and other information from the paper (***ISC/14/PBFWG-1/06***) be included in the workshop report as part of the response to NC9.

The PBFWG noted NC9's request for information regarding the range of historical variation in recruitment, such as in terms of standardized CPUEs for particular fisheries, or other appropriate measures, specifically, information for the low recruitment period during the 1980s, and for the last 10 years.

The PBFWG agreed that:

i) shifts in recruitment were detected in 1994 and 2009 by a sequential regime shift detection method and the following three periods were defined: 1980-1993, 1994-2008 and 2009-2012;

ii) the recruitment of PBF was significantly lower in 1980-1993 and 2009-2012 than in 1994-2008; and

iii) significant positive relationships were found between the recruitment and CPUE in Nagasaki (R^2=0.581), Kochi (R^2=0.206) and Wakayama (R^2=0.288), and the recruitment forecasts using these relationships were thought to be promising.

The following additional information in the form of a figure (Figure 4-2) and a table (Table 4-2) was also provided in response to NC9's request:

Figure 4-2. Recruitment estimated by the base case model and standardized CPUE in Nagasaki, Kochi and Wakayama from 1980 to 2012. The thin line indicates the means and shifts in recruitment detected by a sequential regime shift detection method. The first shift was detected in 1994, and the second shift was found in 2009.

Table 4-2. Recruitment (in thousands of fish) from the base case model and standardized CPUE from 1980 to 2012.

Year	Recruitment	Nagasaki CPUE	Kochi CPUE	Wakayama CPUE
1980	6715	0.66	3.69	
1981	18681	1.14	0.81	
1982	8473	0.58	0.25	
1983	11591	0.89	0.20	
1984	8791	0.89	1.13	
1985	11306	0.83	0.76	
1986	12062	0.95	0.29	
1987	8317	0.68	0.16	
1988	8125	0.77	0.60	
1989	6413	0.62	0.31	
1990	29494	1.23	0.65	
1991	3718	1.32	0.57	
1992	5955	0.57	0.31	
1993	4798	0.47	0.51	
1994	38732	1.97	3.16	1.40
1995	11822	1.07	1.09	0.78
1996	18584	1.60	0.91	1.26
1997	9362	0.90	0.50	0.71
1998	16022	0.82	1.48	0.55
1999	21816	1.49	0.33	0.18
2000	16558	1.15	0.31	0.53
2001	18579	1.16	2.17	0.94
2002	14190	0.73	0.86	0.62
2003	10292	0.65	0.41	0.30
2004	27678	1.29	3.41	4.37
2005	13598	1.36	0.92	1.08
2006	10700	0.71	1.07	1.04
2007	24642	1.38	1.33	1.51
2008	18001	1.44	0.71	1.20
2009	7200	1.11	0.10	0.13
2010	14679	1.09	1.58	0.40
2011	9701	0.94	2.05	
2012	7015	0.52	0.39	

5. STOCK STATUS AND CONSERVATION ADVICE

The update stock assessment model was unable to adequately represent much of the updated data. Poor fit to the two adult indices of abundance and their associated size composition in the last two years indicate that results are highly uncertain. Improvements to the model are advisable before re-assessment, and the current results with regard to the recent trends in SSB should be interpreted with caution.

Stock status

1. Using the update stock assessment, the current (2012) SSB of 26,324 t is slightly higher than that estimated for 2010 (25,476 t).

2. Across sensitivity runs in the update stock assessment, the estimates of recruitment were considered robust. The recruitment level in 2012 was estimated to be relatively low (the 8th lowest in 61 years), and the average recruitment level for the last 5 years may have been below the historical average level (Figure 5-1). Estimated age-specific fishing mortalities on the stock in the recent period (2009-2011) relative to 2002-2004 (the base period for the current WCPFC Conservation and Management Measure 2010-04) increased 19%, 4%, 12%, 31%, 60%, 51% and 21% for ages 0-6, respectively, and decreased 35% for age 7+ (Figure 5-2).

3. Although no target or limit reference points have been established for the PBF stock under the auspices of the WCPFC and IATTC, the current F (average 2009-2011) exceeds all target and limit biological reference points (BRPs) commonly used by fisheries managers (Table 5-1) except for F_{loss}, and the ratio of SSB in 2012 relative to unfished SSB (depletion ratio) is low (Table 5-2). In summary, based on reference point ratios, overfishing is occurring (Table 5-1) and the stock is overfished.

4. For illustrative purposes, two examples of Kobe plots (plot A based on SSB_{med} and F_{med}, plot B based on $SSB_{20\%}$ and $SPR_{20\%}$, Figure 5-3) were prepared and presented. The PBFWG noted that because no reference points for PBF had yet been agreed to, these versions of the Kobe plot represent alternative reference points. It was agreed to present the two Kobe plot versions for further discussion.

5. Historically, the WPO coastal fishery group has had the greatest impact on the PBF stock, but since about the early 1990s the WPO purse seine fleet has increased its impact, and the effect of this fleet is currently greater than any of the other fishery groups. The impact of the EPO fishery was large before the mid-1980s, but decreased after the 1990s until the mid 2000s. The WPO longline fleet has had a limited effect on the stock throughout the analysis period. The impact of a fishery on a stock depends on both the number and size of the fish caught by each fleet; i.e., catching a high number of smaller juvenile fish can have a greater impact on future spawning stock biomass than catching the same weight of larger mature fish (Figures 5-4 and 5-5).

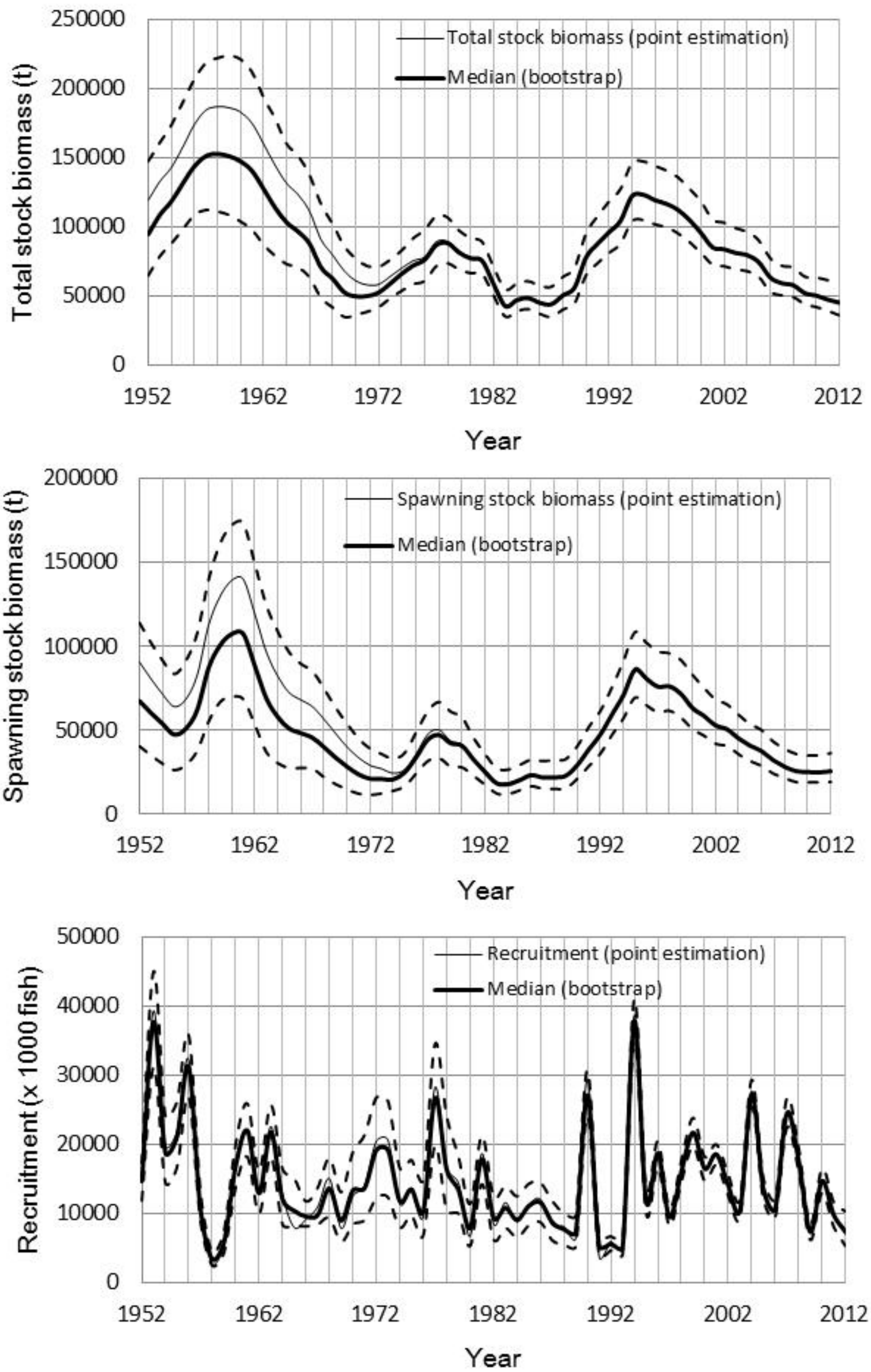

Figure 5-1. Total stock biomass, spawning stock biomass and recruitment of Pacific bluefin tuna (*Thunnus orientalis*) from the base case run (Run1). The thick line indicates median, thin line indicates point estimate, and dashed lines indicate the 90% confidence interval.

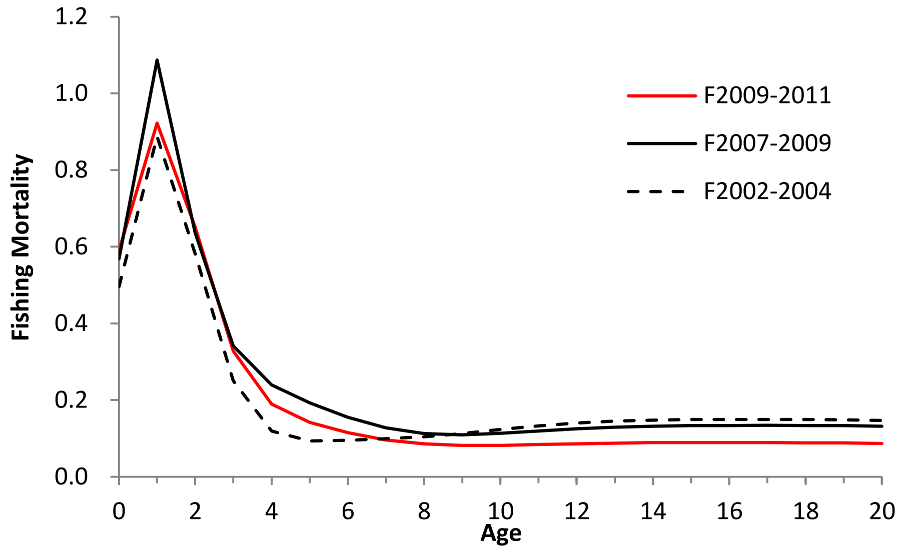

Figure 5-2. Geometric mean annual age-specific fishing mortalities of Pacific bluefin tuna (*Thunnus orientalis*) in 2002-2004 (dashed line), 2007-2009 (solid line) and 2009-2011 (red line).

Table 5-1. Ratio of the estimated fishing mortalities $F_{2002\text{-}2004}$, $F_{2007\text{-}2009}$ and $F_{2009\text{-}2011}$ relative to computed F-based biological reference points for Pacific bluefin tuna (*Thunnus orientalis, PBF*), depletion ratio (ratio of SSB in 2012 relative to unfished SSB), and estimated SSB (t) in year 2012 for four model configurations (runs). Run 1 is the base case assessment model for the PBF update stock assessment. Values in the first eight columns above 1.0 indicate overfishing.

Run4	1.77	2.52	1.20	0.95	1.29	1.85	2.49	3.27	0.043	26,952

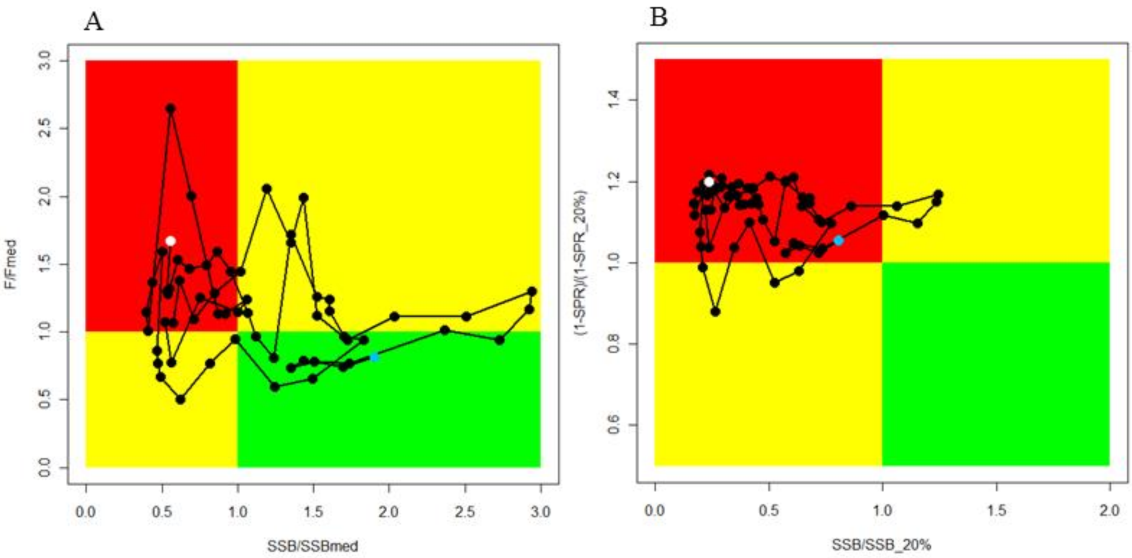

Figure 5-3. Alternative Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*). A. SSB_{med} and F_{med}; B. $SSB_{20\%}$ and $SPR_{20\%}$. Citation of these Kobe plots should include clarifying comments in the text.

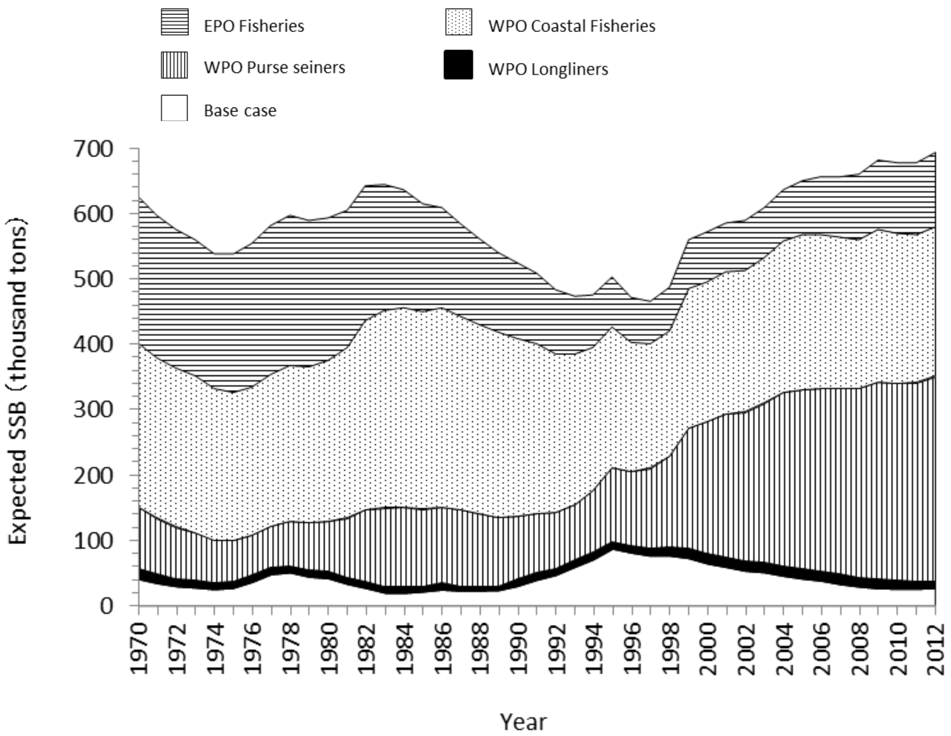

Figure 5-4. Trajectory of the spawning stock biomass of a simulated population of Pacific bluefin tuna (*Thunnus orientalis*) that was unexploited (topmost line) and that predicted by the base-case (white area). The shaded areas between the two lines show the proportions of impact of each fishery.

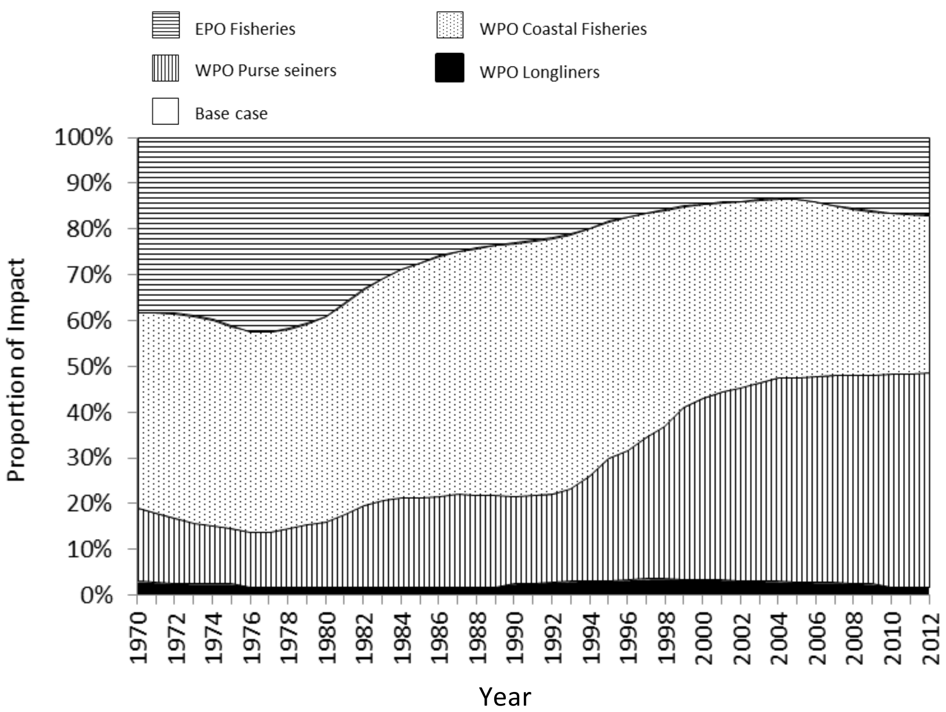

Figure 5-5. The proportion of the impact on the Pacific bluefin tuna (*Thunnus orientalis*) spawning stock biomass by each group of fisheries.

Future Projections

6. If the low recruitment of recent years continues, the risk of SSB falling below its historically lowest level observed would increase. This risk can be reduced with implementation of more conservative management measures (Figure 5-6 a through c).
7. Based on the results of future projections requested by NC9 (Scenarios 2-7), unless the historical average level (1952-2011) of recruitment is realized, increase of SSB cannot be expected under the current WCPFC and IATTC conservation and management measures[2], even under full implementation (Scenario 1)[3]. If the specifications of the harvest control rules used in the projections were modified to include a definition of juveniles that is more consistent with the maturity ogive used in the stock assessment, projection results could be different.

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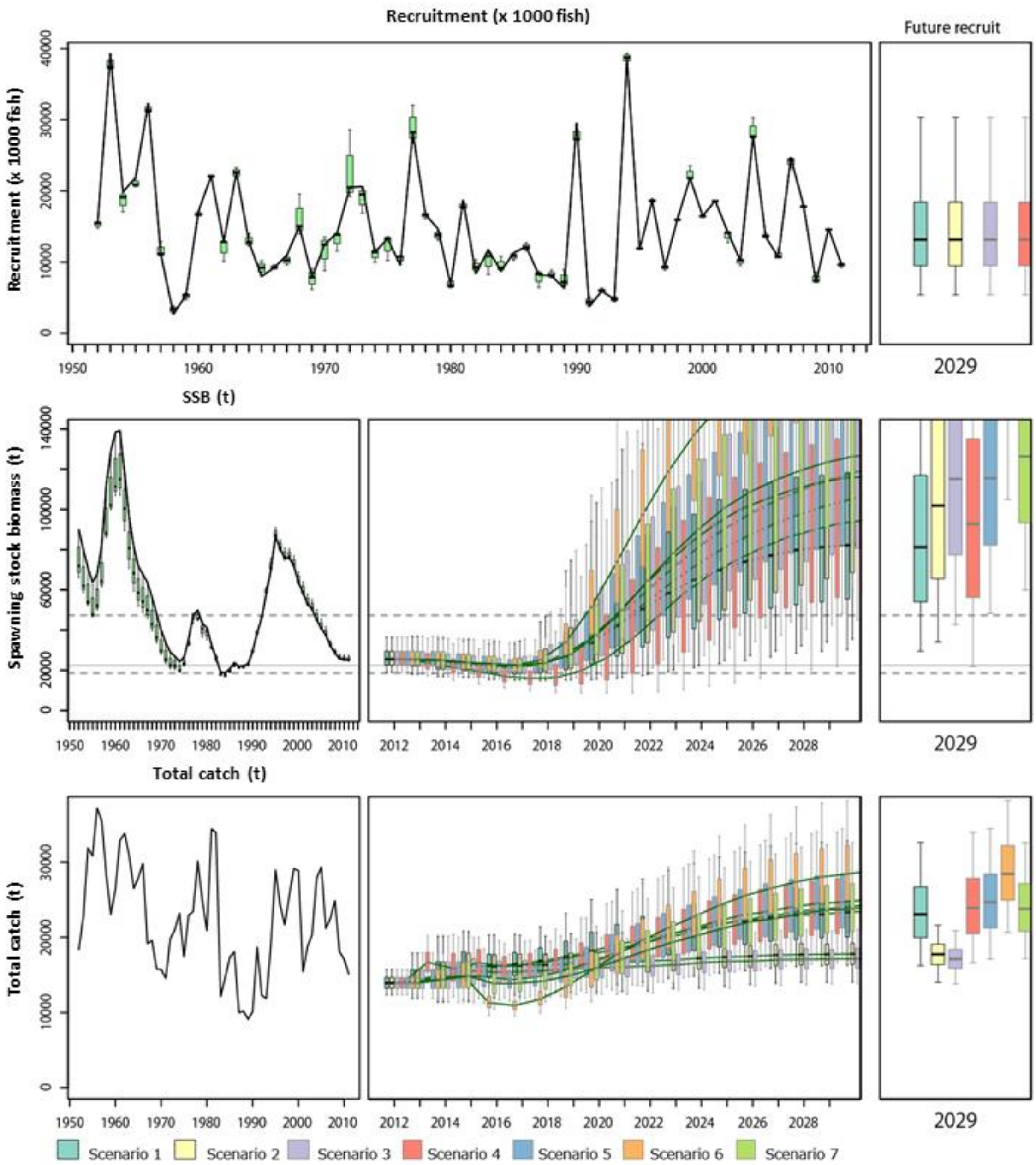
[2] WCPFC: Reduce all catches of juveniles (age 0 to 3-(less than 30 kg)) by at least 15% below the 2002-2004 annual average levels, and maintain the total fishing effort below the 2002-2004 annual average levels. IATTC: Catch limit of 5000 t with an additional 500 t for commercial fisheries for countries with catch history. (1. In the IATTC Conservation Area, the commercial catches of bluefin tuna by all the CPCs during 2014 shall not exceed 5000 metric tons. 2. Notwithstanding paragraph 1, any metric tons of eastern Pacific bluefin tuna annually. (C-13-02) see https://www.iattc.org/PDFFiles2/Resolutions/C-13-02-Pacific-bluefin-tuna.pdf)

[3] Although these measures assume F be kept below $F_{2002\text{-}2004}$, $F_{2009\text{-}2011}$ was higher than $F_{2002\text{-}2004}$.

Figure 5-6 (A) Comparison of future Pacific bluefin tuna (*Thunnus orientalis*) SSB trajectories in seven harvest scenarios under low recruitment conditions. Error bars represent 90% confidence limits. (B) Comparison of future Pacific bluefin tuna (*Thunnus orientalis*) SSB trajectories in seven harvest scenarios under average recruitment conditions (resampling from recruitment in 1952-2011). Error bars represent 90% confidence limits. (C) Comparison of future Pacific bluefin tuna (*Thunnus orientalis*) SSB trajectories in seven harvest scenarios under 10 years (2014-2023) of low recruitment conditions followed by average recruitment conditions after 2024 (resampling from recruitment in 1952-2011). Error bars represent 90% confidence limits.



Conservation Advice[4]

8. The current (2012) PBF biomass level is near historically low levels and experiencing high exploitation rates above all biological reference points except for F_{loss}. Based on projection results, the recently adopted WCPFC CMM and IATTC resolution for 2014 and if continued, are not expected to increase SSB if recent low recruitment continues.

9. In relation to the additional six future projections requested by NC9, no scenario except for Scenario 6[5], the strictest one, demonstrates increase of SSB assuming the current low recruitment continues. Given the result of Scenario 6, further substantial reduction of fishing mortality and juvenile catch over the whole range of juvenile ages should be considered to reduce the risk of SSB falling below its historically lowest level.

10. However, the working group has noted differences in the definition of juveniles from NC9 and those specified in the stock assessment model. Therefore, the PBFWG recognized that juvenile catch reduction, including all non-mature individuals, should be considered in management decisions.

11. Given the low level of SSB and uncertainty in future recruitment, monitoring of recruitment should be strengthened to allow the trend of recruitment to be understood in a timely manner.

[4] The draft on stock status and conservation advice was included in this report. The final text on stock status and conservation advice adopted during the emergency meeting on March 13, 2014 was included in both the executive summary and stock assessment report.

[5] For the WCPO, a 50% reduction of juvenile catches from the 2002-2004 average level and F no greater than $F_{2002\text{-}2004}$. For the EPO, a 50% reduction of juvenile catches from 5,500 t. From the scientific point of view, juvenile catches were not completely represented in the reductions modeled under Scenario 6 for some fisheries although these reductions comply with the definition applied by the NC9.

6. FUTURE WORK PLAN AND RECOMMENDATIONS

The PBFWG reviewed the status of responses to the CIE Review comments and noted those items which have already been addressed and those items for which responses are still being formulated.

The PBFWG proposed the following indicative schedule for its future meetings:

- Early 2015 – Model and Data Improvement Meeting
- Late 2015 – Data Preparatory Meeting
- Early March 2016 – Benchmark Stock Assessment
- July 2016 – Benchmark Stock Assessment presented to ISC16 Plenary

The following research recommendations were formulated:

1. The PBFWG should continue work to improve the PBF stock assessment model.
2. The PBFWG agreed that further work on *M* estimates would be useful to inform future PBF stock assessments.
3. The PBFWG agreed that in the future Taiwanese LL fleet landings by port should be appropriately accounted for in CPUE standardization models for this fleet.
4. The PBFWG recommends further research on purse seine CPUE standardization.
5. The PBFWG recommended that the present spawning ogive by age should be confirmed if it is satisfactory for stock assessment.
6. The PBFWG recommends further research into the use of otolith microchemistry to clarify the definition of the two PBF spawning areas and migration patterns.
7. The PBFWG recommends that members continue to investigate the close-kin, tag-recapture approach to estimating stock size. As a first step, the PBFWG should develop a specific plan for research on this topic for presentation at the ISC14 Plenary.
8. The PBFWG recommends that USA scientists develop a plan for size sampling of PBF in the USA recreational fishery.
9. The PBFWG encourages research into the use of management strategy evaluation in evaluating PBF management options.
10. Research should be focused on further improvements in the CPUE and length composition series (e.g. spatially disaggregating the Japanese longline and other important fisheries).

7. OTHER MATTERS

7.1. Presentation of Preliminary Document on Management Strategy Evaluation (MSE) for Pacific Bluefin Tuna

M. Maunder (IATTC) made a presentation on a simple example of management strategy evaluation (MSE) implementation in Stock Synthesis (SS). A procedure to conduct MSE using the SS general stock assessment software as the operating model is described. Samples from the posterior distribution of a Bayesian application of SS using MCMC are used to represent the possible states of nature allowing for uncertainty in parameters used in typical stock assessment models. The bootstrap procedure built into SS for generating random observations was used to include observation uncertainty in the future data used in the harvest control rule. Process error was included by extending the "estimation" period of the stock assessment used to create the operating model to include the period over which the MSE will be conducted. Priors can be put on model parameters that are usually fixed (e.g. natural mortality) and the parameter estimated to more accurately represent uncertainty. R code is developed to communicate between the SS based operating model and the harvest control rule that was being evaluated. The advantage of using SS is that assessments are already available for many stocks using SS and these can easily be converted into SS based operating models to conduct MSE. The procedure was illustrated using a simple generic example that evaluates the performance of a FMSY decision rule based on a Schaefer surplus production assessment model.

<u>Discussion</u>

M. Maunder indicated that he will work toward developing simple harvest control roles for PBF in order to implement a trial of the MSE for this species and welcomed input from the PBFWG.

One participant inquired which uncertainties are considered to be the key uncertainties for this stock which should be incorporated into future MSE. M. Maunder replied that as for most stocks natural mortality and steepness are the most uncertain parameters and that placing priors on each may not be a solution to getting convergence for these parameter estimates. Instead, it may be necessary to evaluate several different levels for each parameter. In addition to these parameters, movement of PBF between the WPO and EPO may also be a key uncertainty.

One participant asked how using SS3 could assist in resolving data conflicts without resorting to bootstrapping methods. M. Maunder suggested that data sets can be created to provide SS3 with “contaminated” residuals and then these can be used to examine the effects on the parameters being estimated and determine which are problematic. One important consideration is to ensure proper setting up of the model to avoid creating biases in the way the model estimates the parameters.

7.2. Size sampling of USA Recreational Fishery

USA scientists presented preliminary work on the influence of macroeconomics and fishing conditions on the relative effort of the Commercial Passenger Fishing Vessel (CPFV, also known as “party boats”) segment of the USA recreational fishery in

Southern California. The USA recreational fishery in Southern California can be broadly divided into the private vessel (vessels for personal use) and CPFV segments, with the CPFV segment further divided into multiple classes based on trip duration. A generalized linear ,model (GLM) was used to model effort of the USA CPFV fleet stratified by USA and non-USA waters effort as a function of economics variables (i.e., relative per capita income and price of trip), and fishing conditions (i.e., weather, availability of fish). Effort was defined as the angler hours per California fishing license to account for growth in the angler population. Price of trip was found to be primarily endogenous and was therefore corrected for changes in fuel price, which is the primary cost for vessels. Model results suggest that angler effort was more elastic to income and price of trip for trips to Mexican waters than for trips within USA waters. Angler effort was also strongly influenced by the weather and less so by fish CPUE. In addition, USA scientists presented future plans for the size sampling of Pacific bluefin caught by the USA recreational fishery and the incorporation of Pacific bluefin fishery statistics in the presented model.

Discussion

In response to a question, USA participants clarified that in general in USA recreational fisheries a fish that is recorded as “caught” may be kept or discarded. However, for PBF most of the “caught” fish are kept.

Participants discussed the importance of re-starting the PBF sampling program for the USA recreational fishery. USA participants noted that this is a priority for them but suggested that it might be necessary to re-design the sampling strategy as a first step. Regardless, the USA will continue to seek close cooperation with Mexican scientists to sample PBF wherever they occur including not only size sampling but otoliths, DNA, fat content and whatever other data may be useful for management. The importance of identifying the precise catch location of the sampled PBF was also noted.

7.3. Korean Presentation on Working Toward Catch-At-Size Data

Korea introduced a preliminary analysis of length and weight data as a step toward providing catch-at-size for PBF caught by Korean offshore large purse seiners (OLPS). This presentation reviewed available length and weight data for PBF caught by OLPS in terms of quantity and quality. The length-weight relationship equation was estimated as $BW=0.0003FL^{2.918}$ using length and weight measurements collected at the Busan Fisheries Cooperative Fish Market from 2009 to 2013. Estimated quarterly average body weight of PBF ranged from 2.1 to 16.8 kg. The PBF quarterly catch ranged from 1 t to 1,003 t during 2004-2013. The number of fish estimated from quarterly catch and average body weight ranged from 360 to 250,000. In the length composition data, mean lengths ranged from 50-60cm with three modes at 50cm, 70-80cm and 110 cm, and two or three modes of weight at 2kg, 10kg and 30kg in 2004, 2008, 2009, 2010 and 2013.

Discussion

The PBFWG discussed whether the good fit in the length-weight relationship below 100 cm and the relatively poorer fit in the length-weight relationship above 100 cm could indicate that larger fish are measured after they have been processed. S. Yoon clarified that all fish are measured prior to processing.

In response to a question about collection of age and maturity characteristics, S. Yoon explained that such data, including otolith samples are collected through monthly sample processing at the Busan laboratory. However, since most samples are juveniles, the amount of data collected for adult fish is small.

7.4. Presentation on Data Conflict in the PBF Stock Assessment Model

M. Maunder (IATTC) presented an exploratory analysis of the PBF longline length composition data. The Japanese longline length composition data shows a strong cohort entering the fishery in 2000 and this cohort comprises a majority of the catch for all later years included in the model. The same cohort can be seen entering the Taiwanese longline length composition data in 2007 and comprises the majority of the catch for all later years included in the model. This strong cohort is seen at large sizes in 2008 but never seen in the Japanese longline fishery in later years. It is also seen at a large size in the Taiwanese, but these sizes were seen in the early 1990s. This suggests that the Japanese fleet has been targeting the strong cohort at larger sizes more than it has targeted other cohorts. There are a few years of Japanese longline length composition data that show more than one strong cohort. However, these additional strong cohorts do not persist. The separation of the two modes are similar among the years suggesting there may be two growth patterns (e.g. males and females, two populations with different growth rates, eastern and western originating fish, or two areas with different environmental conditions). In addition, fish caught in the main fishing season are larger than fish caught in the other seasons. The smaller fish caught in the "off" seasons could also be from a different growth pattern. The increase in Japanese longline CPUE in the early 2000s and then the decrease in later years is consistent with a strong cohort entering the fishery. The Taiwanese CPUE does not show the same consistency and it is not clear if the recent increase in CPUE is consistent with the strong cohort. The strong cohorts timing is generally consistent with the strong cohort seen in the Japanese troll CPUE in 1994.

<u>**Discussion**</u>

One participant explained that in the "off" season the fishery occurs in a different area where there are smaller fish.

One participant explained that growth rates differ between males and females, as female growth reduces when they become mature. There is also annual variation in growth rates.

One participant reported that age data (from Japanese and Taiwanese longline data for 2010 and 2011) show that there are many ages at any given length, suggesting that length modes consist of many cohorts. The presenter noted that multiple ages for a cohort may be due to aging error. Some participants noted that genetic analysis has not been able to identify multiple populations. A historic morphometric study also did not show differences among areas.

8. ADOPTION OF REPORT

The PBFWG reviewed, discussed and amended the draft Working Group report prepared by the rapporteurs. The report was adopted by consensus.

9. ADJOUNMENT

The meeting was adjourned on 22 February 2014.

Attachment 1. Meeting Agenda

INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN (ISC)

PACIFIC BLUEFIN TUNA WORKING GROUP
WORKING GROUP MEETING

February 17-22, 2014

Southwest Fisheries Science Center, La Jolla, California, USA

1. Opening and Introduction
   1.1. Welcome and introduction
   1.2. Adoption of agenda
   1.3. Appointment of rapporteurs
   1.4. Distribution, numbering and determination of the availability of working papers

2. Review of stock assessment input data
   2.1. Biological parameters and data for the stock assessment
   2.2. Fishery data for input of the stock assessment model

3. Model results
   3.1. Confirmation of key model setting of the base case model
   3.2. Base case model results

4. Response to the requests from the NC9
   4.1. Confirmation of the scenarios and results
   4.2. Analysis of the fisheries indicators and stock dynamics during the past low recruitment period and consideration for environmental impacts on the stock dynamics

5. Stock status and conservation advice for Pacific bluefin tuna

6. Work plan and recommendations

7. Other matters
   7.1. Presentation of preliminary document on Management Strategy Evaluation (MSE) for Pacific bluefin tuna
   7.2. Size sampling of USA recreational fishery

8. Adoption of the report

9. Adjournment

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Attachment 3. List of Documents

No	Title	Author	Contact	Publication
ISC/14/PBFWG-1/01	Standardized catch per unit effort of Pacific bluefin tuna (*Thunnus orientalis*) by general linear model for Taiwanese small-scale longline fishery in the southwestern North Pacific Ocean	Hui-Yu Wang, Jia-Lung Shih, Chien-Chung Hsu	hsucc@ntu.edu.tw	Available
ISC/14/PBFWG-1/02	Updated standardized CPUE and size frequency for Pacific Bluefin tuna caught by Japanese coastal longliners	Yuko Hiraoka, Momoko Ichinokawa Kazuhiro Oshima and Yukio Takeuchi	yhira415@affrc.go.jp	Available
ISC/14/PBFWG-1/03	Preliminary Population Dynamics Model for the updated stock assessment for Pacific Bluefin Tuna	Hiromu Fukuda, Isana Tsuruoka, Yaoki Tei, Kazuhiro Oshima, Hitoshi Honda and Yukio Takeuchi	fukudahiromu@affrc.go.jp	Available
ISC/14/PBFWG-1/04	An Update on PBF catch size composition for the Mexican fishery directed to farming operations in the EPO (2012-2013)	Michel Dreyfus1 and Alexandre Aires-da-Silva	dreyfus@cicese.mx	Available

ISC/14/PBFWG-1/05	Updates of input data for stock assessment model, Stock Synthesis 3, on Pacific bluefin tuna	Kazuhiro Oshima, Ko Fujioka, Yuko Hiraoka, Hiromu Fukuda, Isana Tsuruoka, Yaoki Tei, Yukio Takeuchi, Sang-Chul Yoon, Chien-Chung Hsu, Hui-Yu Wang, Ren-Fen Wu, Steven Teo, Michel Dreyfus and Alexandre Aires-da-Silva	oshimaka@affrc.go.jp	Available
ISC/14/PBFWG-1/06	Changes in recruitment of Pacific bluefin tuna (*Thunnus orientalis*) from 1980 to 2012	Yukimasa Ishida, Yukio Takeuchi, Kazuhiro Oshima, Yuko Hiraoka, Ko Fujioka, Hiromu Fukuda, Momoko Ichinokawa, and Hideki Nakano	ishiday@affrc.go.jp	Available
ISC/14/PBFWG-1/07	Recruitment abundance indices of young Pacific bluefin tuna revealed by Japanese Troll Fisheries	Ko Fujioka, Kazuhiro Oshima, Yaoki Tei, Momoko Ichinokawa, Yukio Takeuchi	fuji88@affrc.go.jp	Available

ISC/14/PBFWG-1/08	Revision of the natural mortality estimates for age-0 fish of the Pacific bluefine tuna using 1996-2012 mark-recapture data in Tosa bay	Shigehide Iwata, Toshihide Kitakado, Ko Fujioka, Hiromu Fukuda and Yukio Takeuchi	siwata0@kaiyodai.ac.jp	NA
ISC/14/PBFWG-1/09	Preliminary trial to estimate age separated stock indices by using Japanese Purse Seine in Sea of Japan	Minoru Kanaiwa, Rie Nagasawa, Ayumi Shibano, Yukio Ishihara and Yukio Takeuchi	m3kanaiw@bioindustry.nodai.ac.jp	NA
ISC/14/PBFWG-1/10	Updated future projections of Pacific bluefin tuna with draft results to answer the requests from NC9.	Yukio Takeuchi, Yaoki Tei and Isana Tsuruoka	yukiot@fra.affrc.go.jp	Available
ISC/14/PBFWG-1/11	A review of the model setting for the update of stock assessment for Pacific bluefin tuna	Hiromu FUKUDA, Kazuhiro Oshima, and Yukio Takeuchi	fukudahiromu@affrc.go.jp	Available
ISC/14/PBFWG-1/12	Preliminary analysis of catch at size for Pacific bluefin tuna, *Thunnus orientalis* caught by Korean offshore large purse seiner	Sang Chul Yoon, Zang Geun Kim, Sung II Lee and Dong Woo Lee	Yoonsc75@gmail.com	Available