NORTHERN COMMITTEE
SIXTH REGULAR SESSION
7-10 September 2010
Fukuoka, Japan

Report of ISC Pacific Bluefin Tuna Working Group for 2010

WCPFC/NC6/IP-01
27 August 2010

ISC

Annex 7

REPORT OF THE PACIFIC BLUEFIN TUNA WORKING GROUP WORKSHOP

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

6-9 July 2010
Nanaimo, Canada

1.0 INTRODUCTION

1.1. Welcome and Introduction

The ISC Pacific Bluefin Tuna (*Thunnus orientalis*) Working Group (ISC PBFWG) workshop was opened by the Chair, Yukio Takeuchi. John Holmes, on behalf of Fisheries and Oceans Canada (DFO), welcomed all the participants to the Pacific Biological Station in Nanaimo, British Columbia, Canada.

Nineteen Scientists from Canada, Japan, Korea, Mexico, Taiwan, the U.S.A. and the IATTC participated in the workshop (Appendix 1).

1.2. Adoption of agenda

A provisional agenda was distributed to the participants for review prior to the meeting. The Chair recommended combining Sections 3 (Comprehensive sensitivity runs to the updated stock assessment results) and 4 (Review of recent fishing mortality trend with the addition of data from 2006 and 2007 fishing seasons). Working Group members agreed with this suggestion and the revised agenda was adopted (Appendix 2).

1.3. Appointment of rapporteurs

Rapporteurs were appointed for each agenda item prior to the meeting and names were circulated to Working Group members via email. Two rapporteurs were assigned to each major section of the agenda (shown in parentheses in Appendix 2) and John Holmes was given the task of assembling the Workshop report. This procedure was followed because of the need to have agreement on the final report by the end of Workshop as there is no time for the Working Group to further review the report prior to the upcoming ISC Plenary meeting.

1.4. Working Papers

Twelve working papers and two oral reports were presented and discussed at the workshop (Appendix 3). Working paper authors were asked by the Chair if they wished to make the full paper available through the ISC website and responses are recorded in Appendix 3.

2.0. UPDATE OF FISHERIES STATISTICS AND REVIEW OF FISHERIES

2.1. Catch by country and gear

The PBFWG table of catches (Appendix 4 table 1) by country and gear was updated to 2009 by Kazuhiro Oshima based on data provided by participants.

2.2. Reviews of recent PBF fisheries

2.2.1 Japanese catch updates for Pacific bluefin tuna. Kazuhiro Oshima and Yukio Takeuchi (ISC/10-1/PBFWG/06)

Japanese catches of Pacific bluefin tuna (PBF) were updated to 2009. Two new data sources were incorporated in this catch update. First, monthly catch data by landing ports, derived from the Survey on Catch of Bluefin Tuna in Japan's Coastal Areas implemented by the Japan Fishery Agency, Ministry of Agriculture, Forestry and Fisheries, were used to estimate PBF catch in the troll fishery. Second, sales slip data from markets in the Kyusyu region were used to estimate PBF catch by the small pelagic fish purse seine fishery. Total annual catch of PBF decreased from 17,137 mt in 2008 to 13,322 mt in 2009 with declines in the catches in all the fisheries. The tuna purse seine fishery catch in 2009 was the second lowest catch since 2000.

Discussion

The authors clarified that the tuna purse seine fishery targets larger bluefin tuna while the small purse seine targets age 1 and 0 bluefin tuna in addition to other species. Furthermore, there are two main fishing grounds for the tuna purse seine fleet. In the northwest Pacific a wide range of lengths are caught, whereas in the sea of Japan the fishery targets strong year-classes. Because of the decline in catch from the northwest fishery the most recent catches come mainly from the Sea of Japan. Thus, the variability of the small purse seine catch may be due to variability in age class strength or target switching to other species.

2.2.2 Recent variations in the catch of Pacific bluefin tuna by Korean domestic purse seiners. Joon-Taek Yoo, Zang Geun Kim, Jae Bong Lee, Seon-Jae Hwang, Jong-Bin Kim, Doo-Nam Kim , Kyu-Jin Seok, and Dong-Woo Lee (ISC/10-1/PBFWG/12)

Pacific bluefin tuna (PBF) in Korean waters are caught by Korean domestic purse seiners as non-target species. While the annual catch of PBF tended to increase after 1994, the size of the offshore purse seine fleet has decreased since 1994. The quarterly catch ratios of PBF from 2000 to 2009 were highly variable from year-to-year. Length composition of PBF from the offshore purse seiners showed several modes between 30 and 80 cm fork length, and a weak but noticeable mode at > 100 cm FL in 2008 and 2009. Annual mean fork length of PBF gradually increased from 2000 to 2009. The large fish > 100 cm FL observed in 2008 and 2009 were caught in late winter and spring and were generally larger compared to other seasons. The fishing ground of PBF is mainly formed around Jeju Island and the main fishing season was spring in 2008 and 2009.

Discussion

The WG noted that the catch reported for 2006 in the paper was larger than previously reported to the ISC plenary in 2009. It was clarified that catches reported in this paper are from different data sources than used to report to the plenary. Furthermore, the catches reported in this paper are derived from the preferred data reporting method. The WG requested a clarification on the difference between round and whole weight as used in the working paper. Korea will investigate the issue and will report its findings at a future PBFWG Workshop. The WG recommended that catch be reported in a metric that corresponds to the weight of the whole fish and that this metric be used for all years. The WG also questioned if there was evidence of spawning of bluefin tuna in Korean waters. It was clarified that a new research activity, consisting of sampling egg and larval PBF in Korean waters was initiated in April and will continue in August-November. The working group noted that the only significant catch of PBF reported in Korean waters was made by the purse seine fishery.

2.2.4. Size composition of BFT in 2008. Data collected from farms in Baja California, Mexico. Michel Dreyfus-Leon. (ISC/10-1/PBFWG/11)

The Mexican PBF fishery in the EPO is directed to farming, making it almost impossible to collect size data from the fishery. For the first time, size composition data from the farms is presented for the 2008 fishery. Size data at the time of the harvest from the farming industry is between 70 cm to 105 cm, although some bigger fish were also collected. In future PBFWG workshops more data from more years will be available and a retro-calculation of the size composition from the harvest time to the time of catch will be done.

Discussion:

The author clarified that the fishery supporting the pen operations are the same boats that target yellowfin tuna, and that the farming (fattening) operations are licensed. The Working Group noted that estimating the number and size of bluefin caught in this fishery is difficult because the fish are transferred into cages while in the water. The estimate of catch that is provided to the WG was based on the captain's estimate, The author noted that an overestimation of catch is quite possible in some occasions when fishermen sell the catch to the farms. It was also noted that each vessel has a fishery observer onboard. The WG acknowledged the difficulty due to the characteristics of the fishing process in getting detailed information for stock assessment from farming operations. The WG stressed the need for accurate estimates of total number or weight of PBF put into the cages and the biological information associated with those catches (length or weight). It was also noted that with information on the growth and mortality of PBF in the pens it may be possible to back-calculate the size and numbers of fish originally caged. The authors also pointed out that catch in the most recent year was below the recent average level. It was suggested that recent experience in the Mediterranean with Atlantic bluefin farming might provide insight into future approaches to data collection in the Mexican PBF fishery, recognizing that the Mexican fishery has the advantage of 100% observer coverage on its purse seine fleet.

2.2.4. Review of recent catches in US fisheries – Steve Teo; oral presentation only

Preliminary data indicate that US catches of Pacific bluefin tuna in 2009 totalled 566 mt. The two main sources of catch in 2009 were the purse-seine and recreational fisheries, which had 410 and 151 mt, respectively. In addition, minor catches of 4 and 1 mt were made by the gillnet and longline fisheries, respectively. The size of Pacific bluefin tuna caught by the recreational fishery in 2009 ranged between 12 and 19 kg and averaged approximately 14.5 kg.

Discussion:

The WG noted that the increased US catch in 2009 relative to 2006 occurred in the purse seine fishery. It was clarified that this catch occurs opportunistically and is not a developing PBF fishery. Factors affecting the availability of PBF to the purse seine fishery are unknown but may be environmental. The primary US fishery is recreational fishing that occurs in both US and Mexican waters.

2.3. Other matters

There were no additional items raised during the meeting concerning fishery statistics or fisheries.

3.0. REVIEW OF RECENT FISHING MORTALITY TRENDS WITH TWO ADDITIONAL YEARS OF FISHERY DATA (2006 and 2007 FISHING YEARS) AND COMPREHENSIVE SENSITIVITY ANALYSES

3.1. The update of input data of stock assessment of Pacific Bluefin Tuna, *Thunnus orientalis* for Stock Synthesis III. Masayuki Abe , Kazuhiro Oshima, Mikihiko Kai, Momoko Ichinokawa, Izumi Yamazaki, Chien-Chung Hsu, Joon-Taek Yoo, John Childers, Michel Dreyfus, Alexandre Aires-da-Silva and Yukio Takeuchi. (ISC/10-1/PBFWG/09)

This paper summarizes updated input datasets (catch, CPUE, size composition) used in the Stock Synthesis 3 (SS3) version of the Pacific bluefin tuna (PBF) stock assessment model and provides the results of sensitivity analyses to assess which data sets are most influential on model outputs. Sensitivity analyses comparing the effect of the versions of SS3 used in the July 2009 analysis and July 2010 analysis on model outputs are also reported. The updated fishery data covered the period from 01 July 1952 to 30 June 2008. Only three CPUE time series - Japanese coastal longline, Japanese troll and Taiwanese longline fisheries - were updated for this analysis. The CPUE time series of the EPO purse seine fishery was not updated. Different versions of SS3 had little influence on the major benchmarks examined, SSB and recruitment. The updated input-data had large influence on SSB. The intermediate data sets which incorporated only two years catch or two years catch and length frequency data highly influenced SSB. CPUE of the Japanese coastal longline fishery, the length data of the tuna purse seine fishery and the Taiwanese longline fishery also influenced SSB.

Discussion:

The WG noted a change in the size composition from the Japanese tuna purse seine fleet in 2007-2008. It was thought that potential targeting of a large cohort and spatial change in the location of the catch could have contributed to the change in the composition data. The WG discussed whether potential changes in targeting practices might necessitate compiling the data at a finer spatial or temporal scale for use in the next stock assessment. The WG also noted that the paper included sensitivity analysis of the assessment to data sources. The working group discussed the importance of the Japanese longline CPUE and the assumption that this index was an unbiased estimate of relative change of the population is critical to model results. While noting the above, additional sources of CPUE indices are preferable in the future.

3.2. Stock assessment of Pacific bluefin tuna with updated fishery data until 2007.

Momoko Ichinokawa, Mikihiko Kai and Yukio Takeuchi. (ISC/10-1/PBFWG/01)

This document updates the stock assessments of PBF to 2007 by adding the data in 2006 and 2007 to investigate the most recent stock status and fishing mortality. Using 2010 model including the updated fishery data, spawning stock biomass (SSB) during the whole assessment period is estimated to be lower than estimated in the 2009 WG (PBFWG09-1). This lower estimate results in higher depletion and fishing mortality rates (F) throughout the assessment period. The lower estimates of absolute SSB in the 2010 update could be considered to be in the range of expected uncertainty, because bootstrap and full sensitivity analysis reveal high sensitivity of the estimation of absolute SSB to assumed parameters such as natural mortality (M) of adult fish and fishery data. Considering the high uncertainty of the estimated absolute SSB, and related parameters such as absolute Fs, estimates of absolute SSB and F levels should be interpreted with caution. On the other hand, estimation of trends of relative SSB and F seem to be very robust to the same uncertainties.

SSB in 2007 is estimated within the 40-60 percentiles of the historically observed SSB. The estimates of fishing mortality during 2004-2006 are approximately 1.2-1.3 times higher on juveniles (ages 1-4) and 1.1 times higher on recruits (age 0) and adults (ages 5+) than Fs during 2002-2004. With $F_{2004\text{-}2006}$, there is a 50% probability that SSB will decline to the lower 25th percentile of historically observed SSB and a >0% probability of falling below the observed minimum SSB (B_{loss}). In contrast, with $F_{2002\text{-}2004}$ future SSB is expected to recover to near the historical median level with no risk to fall below B_{loss}. Future projection trends relative to the historically observed SSB are also relatively robust to the assumption of natural mortality rates on adult fish. Thus results of the projections suggest that fishing mortality during 2004-2006 should be reduced to the level during 2002-2004 for the purpose of avoiding the risk that SSB declines below B_{loss}. If SSB declined below B_{loss} it might result in recruitment overfishing and jeopardize the recovery of SSB to near the historic median level.

Discussion:

The WG noted that the sensitivity analyses presented in the paper were focused on structural assumptions of the assessment model. It was also noted that the model appeared to be most sensitive to changes in the assumed natural mortality schedule. The working group noted that even relatively minor changes to adult M had significant impact on the scaling of absolute biomass and recommended future work to understand the causes of this sensitivity. The working group also noted that while scaling of absolute measures was variable, many of the relative measures were not as variable.

3.3. Overall Summary

In 2008 the WG conducted a stock assessment of Pacific bluefin tuna using stock synthesis II with fishery data through 2005. Results of that stock assessment were accepted by the ISC08 Plenary, however it was requested that the WG investigate the causes of some implausible model results (e.g. large B0, low SPR and depletion level add ISC08 plenary doc).

In 2009, a different natural mortality schedule and stock synthesis III were used to reanalyze stock status using data through 2005 (the same as used in 2008). The WG concluded that the results of the 2009 reanalysis were more plausible and those results were presented to ISC09. In both the 2008 and 2009 analyses, the "current" fishing mortality rate was characterized by a 3-year average (2002-2004) with the terminal year of the model results (2005) excluded due to unreliable estimates.

In 2010 the WG conducted an update of the 2009 analysis along with a complete set of sensitivity analyses and stock projections using data through 2007. Data used in the 2010 update were compiled using the same analytical methods, and stock assessment model parameterization as the 2009 analysis. The updated "current" fishing mortality rate was calculated as a 3-year average (2004-2006) with the terminal year of the model results (2007) excluded due to unreliable estimates. The WG reviewed the results of the 2010 update with the objectives of characterizing the recent relative change in fishing mortality rate and spawning biomass. It should be noted that even the most recent estimates of fishing mortality would not yet reflect any actions in regards to the agreement of countries in response to 6th Regular Session of the Western and Central Pacific Fisheries Commission (CMM 2009-07).

Summary results of the 2010 update:

1. A number of sensitivity runs were conducted in 2010 to investigate uncertainties in biological assumptions and fishery data. Results indicate that the assumption of adult M is particularly influential to the estimate of absolute spawning biomass and fishing mortality (Fig. 1). Although absolute estimates from the stock assessment model were sensitive to different assumptions of M, relative measures were less sensitive.
2. The estimate of spawning biomass in 2008 (at the end of the 2007 fishing year) declined from 2006 and is estimated to be in the range of the 40-60 percentile of the historically observed spawning biomasses.
3. Average Fishing Mortality 2004-2006 ($F_{2004\text{-}2006}$) had increased from $F_{2002\text{-}2004}$ by 6% for age-0, approximately 30% for ages 1-4, and 6% for ages 5+.

4. 30-year projections predict that at $F_{2004-2006}$ median spawning biomass is likely to decline to levels around the 25th percentile of historical spawning biomass with approximately 5% of the projections declining to or below the lowest previously observed spawning biomass. At $F_{2002-2004}$ median spawning biomass is likely to decline in subsequent years but recover to levels near the median of the historically observed levels. In contrast to $F_{2004-2006}$, $F_{2002-2004}$ had no projections (0%) declining to the lowest observed spawning biomass. In both projections long-term average yield is expected to be lower than recent levels.

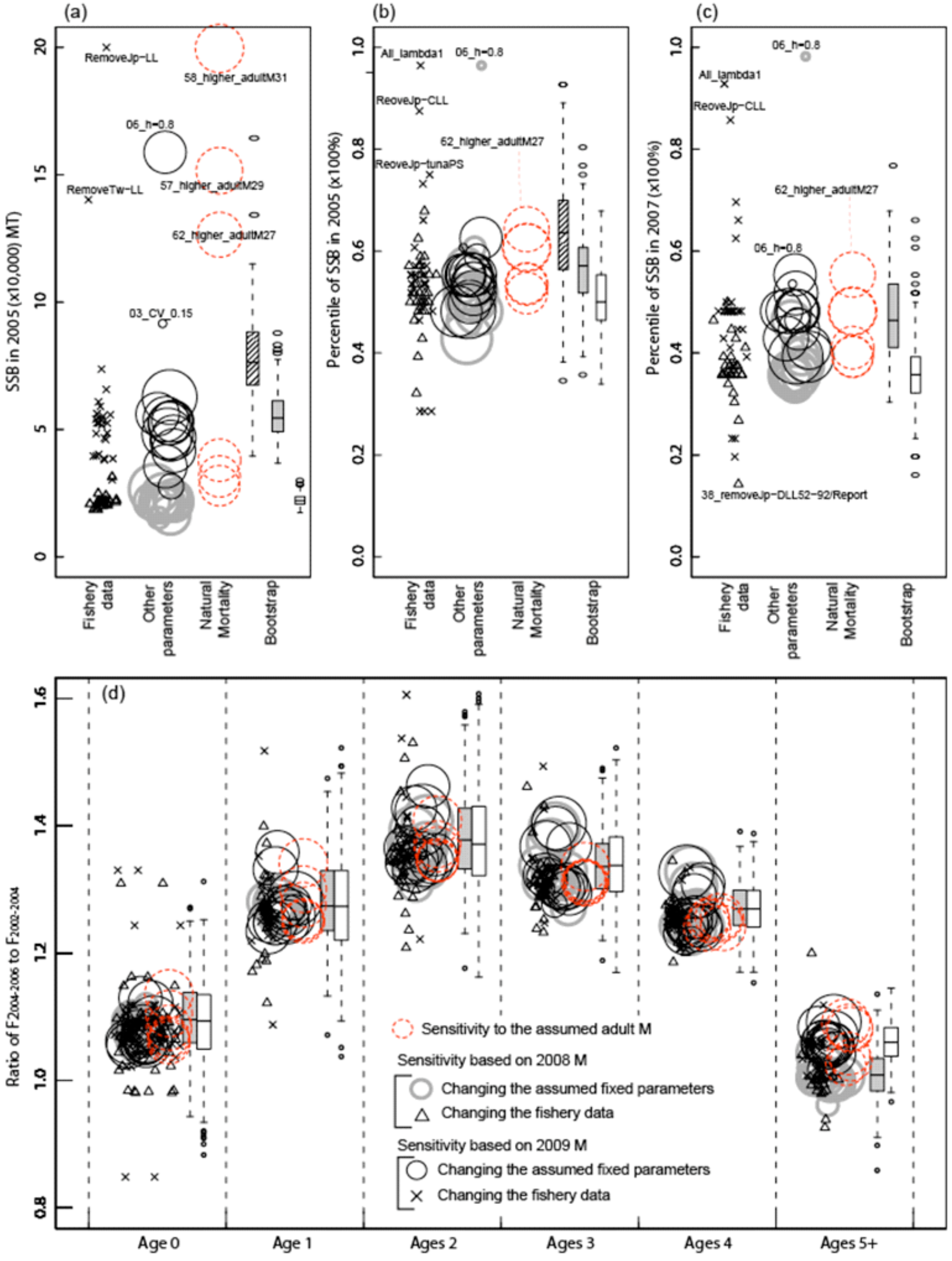
(a)
SSB in 2005 (x10,000) MT)
0
5
10
15
20
RemoveJp-LL
58_higher_adultM31
06_h=0.8
RemoveTw-LL
57_higher_adultM29
62_higher_adultM27
03_CV_0.15
Fishery data
Other parameters
Natural Mortality
Bootstrap
(b)
Percentile of SSB in 2005 (x100%)
0.0
0.2
0.4
0.6
0.8
1.0
All_lambda1
06_h=0.8
ReoveJp-CLL
62_higher_adultM27
ReoveJp-tunaPS
Fishery data
Other parameters
Natural Mortality
Bootstrap
(c)
Percentile of SSB in 2007 (x100%)
0.0
0.2
0.4
0.6
0.8
1.0
06_h=0.8
All_lambda1
ReoveJp-CLL
62_higher_adultM27
06_h=0.8
38_removeJp-DLL52-92/Report
Fishery data
Other parameters
Natural Mortality
Bootstrap
(d)
Ratio of F2004-2006 to F2002-2004
0.8
1.0
1.2
1.4
1.6
Sensitivity to the assumed adult M
Sensitivity based on 2008 M
Changing the assumed fixed parameters
Changing the fishery data
Sensitivity based on 2009 M
Changing the assumed fixed parameters
Changing the fishery data
Age 0
Age 1
Ages 2
Ages 3
Ages 4
Ages 5+

Fig. 1. Results of sensitivity analysis for the 2010 assessment assuming two types of M: 2009 M (base case) and 2008 M . Y-axis represents absolute SSB in 2005 (a), percentiles of SSB in 2005 (b) and 2007 (c) among the observed historical SSB, and F ratio of F2004-2006 to F2002-2004 by age. X-axis in a-c has no meaning. X axis in (d) represent category of ages, and x-axes within each category has no meaning. Points represented by crosses or rectangles are estimated values by sensitivity runs on the fishery data. Center of circles with different sizes are estimated values by sensitivity runs on biological parameters, and sizes of the circles is scaled likelihood. (a) Some results with SSB higher > 20, 000MT are omitted such as 13_all_lambda1, 29_removeJp-tunaPS, 35_removeJp-CLL with 2009 M and 06_h=0.8 with 2008 M. Boxplots are bootstrap results by the 2009 assessment with 2009 M (hatched box), the 2010 assessment with 2009 M (gray boxes) and the 2010 assessment with 2008 M (white boxes). Originally Figure 12 in Ichinokawa et al. (2010, ISC/10-1/PBFWG/01).

4.0. DEVELOPMENT OF ADVICE AND RECOMMENDATIONS ON BIOLOGICAL REFERENCE POINTS FOR PACIFIC BLUEFIN TUNA

4.1 Updated biological reference points (BRPs) for Pacific Bluefin tuna and the effect of uncertainties on the BRPs. Mikihiko Kai, Momoko Ichinokawa and Yukio Takeuchi, (ISC/10-1/PBFWG/02)

This paper provides a list of candidate BRPs for Pacific bluefin tuna and summarizes the effects of two additional years of data, uncertainty in the fishery data, and the configuration and parameterization of the SS3 model on estimated values of candidate BRPs. The status of the PBF stock in 2004-2006 appears to be more pessimistic than in 2002-2004, having deteriorated further since the previous update by the PBFWG in July 2009. Uncertainties in the configuration and parameterization of SS3 and in the fishery data had large impacts on the yield per recruit (YPR) and spawning biomass per recruit (SPR) based BRPs (i.e. F_{max}, $F_{0.1}$, $F_{20\%}$, $F_{30\%}$, and $F_{40\%}$). In contrast, empirical *S-R* based BRPs (i.e. F_{loss} and F_{med}) and $F_{10\%}$ are relatively insensitive to these uncertainties. F_{med} in particular was most robust for the uncertainties and is recommended as a candidate BRPs for PBF on this basis.

__Discussion:__

There was a concern by some WG members about the robustness of F_{med} to changes in productivity of the stock. The original definition of F_{med} was revisited to explain the observed robustness of F_{med} to changes in productivity. On a stock-recruitment scatterplot, F_{med} corresponds to the diagonal line S/R=1 at which the stock replaces itself. Different productivity assumptions will change the scale of estimated absolute level of spawners and recruitments, but not the relative scale (shape of the scatter plot). Since the diagonal line of S/R=1 (F_{med}) will pass through the middle of the S-R observations, the F_{med} line is expected to be robust for changes in productivity. The same rationale can be used to explain the robustness of F_{loss} to changes in productivity. Rather than passing though the middle of the S-R observations, the F_{loss} line passes through the lower range. Some WG members interpreted the robustness of F_{med} and F_{loss} as a non-desirable diagnostic rather than an indicator of the merit of these potential reference points because they believe that it may be due to a structural assumption of specifying the steepness of the Beverton-Holt S/R function as equal to 1. A different opinion was expressed by other WG members who emphasized the practical disadvantages of using a reference point that is sensitive to model parameters, referring to the example of WCPFC yellowfin tuna stock assessment where revision of the steepness resulted in different interpretations about stock status (over- or under-fishing).

4.2 Applicability of F_{loss} for Pacific Bluefin Tuna as a limit reference point (LRP). Mikihiko Kai, Momoko Ichinokawa and Yukio Takeuchi. (ISC/10-1/PBFWG/03)

This paper describes a fishing mortality (*F*)- based reference point (F_{loss}) proposed by Cook (1998) and assesses the applicability of F_{loss} as a limit reference point(LRP) for Pacific bluefin tuna (PBF), *Thunnus orientalis*. F_{loss} is the *F* which produces spawning biomass per recruit at the historically lowest observed spawning stock biomass (S_{loss}) given the expected level of recruitment (*R_{loss}*) at *S_{loss}*. Hence, *F_{loss}* is an easy concept to understand as a limit reference point for avoiding recruitment overfishing. Because of uncertainties in the estimation error of *R*, *R_{loss}* can be calculated using three different methods: (1) the *R* corresponding to *S_{loss}*, (2) a mean of *R* over the stock assessment period, and (3) a point estimate of *R* corresponding to *S_{loss}* through a nonparametric approach. Additionally, the impact of uncertainties for the estimation errors in spawning stock biomass (*S*) and recruitment (*R*) on *F_{loss}* is examined using the results from bootstrapping analysis based on pairs of *S*-*R* data, sensitivity analysis to the model structure and parameters of SS3; and bootstrapping analysis based on the fishery data of SS3. We conclude that *F_{loss}* obtained from *R_{loss}* corresponding to *S_{loss}* might be suitable for PBF as a LRP because low relative biomass levels are experienced throughout the stock assessment period (1952-2007) and the corresponding *R*s have tendency to reach historical low level on average. Since there are major uncertainties concerning *R* and *S*, it is crucial to consider the buffer zone from a point estimate, when the benchmark is applied to PBF.

Discussion:

There was a discussion with regard to the potential use of F_{loss}. Generally, Floss is interpreted as F_{crash} (point of no return) or crucial boundary beyond which the stock have never attained. Sometimes it is utilized to derive a target (or precautionary) reference point (adjusted F_{loss}, e.g. taking half of F_{loss}). However, a concern was expressed that there is no direct evidence that F_{loss} is sustainable. Also, Floss is estimated in equilibrium conditions and taking F_{loss} as a limit may be a risky choice, even though population recovery from B_{loss} has been observed sometime during the historic period of the assessment. It was pointed out that the F_{ssb} approach described in ISC/10-1/PBFWG/04 was developed to deal with this risky situation. In addition, it was noted that the Appendix in this paper (which was not discussed by the author in his presentation) shows a possible S-R relationship for which a lower number of recruits are obtained for smaller spawning biomass levels. Although the relationship cannot be parameterized by a simple 2-parameter B-H relationship, it was noted that there must be some S-R relationship for PBF.

4.3. Simulation based reference points of F_{ssb} applied to the Pacific bluefin tuna stock. Momoko Ichinokawa (ISC/10-1/PBFWG/04)

This document introduces F_{ssb} as a precautionary reference point, and provides tentative estimates of F_{ssb} under various thresholds of SSB and probabilities for the Pacific bluefin tuna (PBF) stock. In addition, sensitivity of F_{ssb} future projection methods and assumption of natural mortality are evaluated. Results show that a single value of F_{ssb} could not be determined even if a threshold level and a probability are given, because the estimation can be affected by other settings such as duration for future projections and ways to account for uncertainties of stock assessment. Structural behavior of Fssb in response to changes in its calculation procedure should be explored. Some sensitivities of Fssb to the assumption of M are observed. This sensitivity is comparable to the sensitivity observed in F_{med} or F_{loss}, and less than other reference points such as $F_{\%\mathrm{SPR}}$ and $F_{\max}$ (Kai et al. 2010). In addition, the threshold level of Average Ten Historical Lowest (ATHL) used for North Pacific albacore might not be appropriate for the PBF stock, because ATHL of PBF is very close to historically observed minimum SSB (B_{loss}). This finding demonstrates the importance of considering species-specific threshold level, which take into account appropriate uncertainties. Some people consider the large flexibility of F_{ssb} to be a weak point, but others consider it to be an advantage; F_{ssb} can account for various scientific assumptions and management objectives as well as uncertainties of the stock assessment. F_{ssb} could be one of the candidates for applying to tuna stocks such as Pacific bluefin tuna.

Discussion:

The WG discussed the potential pros and cons of F_{ssb}. The WG recognized disadvantages associated with the fact that the definition of the threshold level, probabilities and duration of the projection period in F_{ssb} are somewhat arbitrary and that this may turn into a complex decision-making process. The appropriate definition for PBF threshold level should be determined instead of using ATHL. The following were suggested as potential candidates for threshold level: average of two local minima of SSB, the average historical lower value within a period of more than 10 years, and upper percentile of the confidence interval of B_{loss}. In order to reduce complexity in the decision making process, using the probability distribution for only steady state period was suggested, but this will ignore short-term risk for SSB to fall below the threshold and uncertainties of stochastic dynamics. During discussion of the pros of F_{ssb}, it was noted that potential structures in the S-R relationship and other scenarios not included in the stock assessment model could be incorporated into this reference point. For example, the current SSB projection methodology does not account for autocorrelation in future recruitments and autocorrelation structure in the time series will affect the results; in particular, confidence intervals become larger. In addition, the assumption of larger fluctuation in recruitment (larger sigma R) or alternative steepness, which reflects more pessimistic outcomes, would result in more conservative estimates. It was noted that incorporating a wide variety of uncertainties into decision making tool is similar to the management procedure evaluation work for southern bluefin tuna (SBT). However, it was noted that the management scenarios between SBT and PBF are very different. The Working Group noted that autocorrelation in the time series will affect the width of confidence intervals because this autocorrelation is often environmentally driven. For example, the Pacific Decadal Oscillation. There was discussion of the ALBWG approach to reference points and how the percentiles (10, 25) for F_{SSB} were chosen. The Working Group also discussed the applicability of ATHL as a threshold and noted that one disadvantage is that new low biomass estimates in the future will lead to a recalculation of ATHL, i.e., the value of this threshold is more sensitive to new values than for example the lower 10th and 25th percentiles of SSB.

4.4 General discussion:

Reference points are part of a precautionary approach to fisheries management and seek to avoid serious harm to a stock while permitting maximum sustained yield or other catch scenario. Limit reference points attempt to constrain harvesting within safe biological limits for a stock. Recruitment overfishing (fishing mortality above which the recruitment to the exploitable stock becomes significantly reduced) and growth overfishing (fishing mortality at which the losses in weight from total mortality exceed the gain in weight due to growth) are often considered to be the major biological risks to the resiliency and productivity of a stock, with recruitment overfishing considered to have the more serious and potentially harmful impacts. Limit reference points are fishing mortality rates or biomass levels which must not be exceeded and are frequently implemented to avoid recruitment overfishing because when a stock falls below the threshold level associated with a LRP, there is a high probability that the resiliency and productivity of the stock will be so impaired that serious harm to the stock will occur. Target reference points are fishing mortality rates or biomass levels which permit long-term sustainable exploitation of a stock and are determined by productivity objectives for the stock, broader biological considerations, and socio-economic objectives. Typically, the biological consequences of exceeding a TRP are not as severe as those incurred if a LRP is exceeded.

The ISC was tasked with identifying potential biological reference points (BRPs) for all northern stocks of highly migratory species in the Pacific Ocean at the 5th regular session of the Northern Committee (NC) in Nagasaki, Japan, and asked to report its findings at the 6th session of the NC in September 2010. To complete this assignment, the WG created two tables to compile information on a list of potential reference points for PBF. Table 1 follows the format suggested by ISC chair, describes and characterizes a suite of potential reference points, including comments on their strengths and weaknesses, PBF-specific comments. Table 2 includes additional technical details on sensitivity, data needs and model structures. In creating the tables, there were different opinions with respect to the utility of the sensitivity of reference points as a criterion for choosing a suitable reference points. Since similar discussions have already done for the ISC/10-1/PBFWG/04, see the discussion in ISC/10-1/PBFWG/02 for details. The WG did not identify specific target or limit reference points in this list, but where WG members had such knowledge, it has been noted how the reference points in the table have been used by other RFMOs and science-advisory bodies.

5.0. REVIEW OF WORK PLANS UP TO 2012

5.1 Alternative modeling research for the next full stock assessment in 2012

5.1.1. Fundamental limitations of stock-recruitment models. Alec MacCall. (Oral presentation).

A simple production model can be constructed from a Beverton-Holt stock-recruitment relationship (BHSRR) by adding terms for fishing and natural mortality rates. This model can be parameterized either using the original BHSRR density independent and density dependent parameters α and β, or by unfished biomass *Bo* and steepness (*h*), where *h* is a function only of α/M. The value of *Bo* is inversely dependent on the natural mortality rate *M*. It can be shown that the value of *h* alone determines two important management reference points, the ratio of *Fmsy* to *M*, and the ratio of *Bmsy* to *Bo*. This is not a desirable property for use in stock assessment. Moreover, if both *M* and *h* are assigned fixed values (a common practice in data-limited assessments), important properties of the model such as the value of *Fmsy* become pre-specified independently of the data, and the only estimable parameter in the model is *Bo*. Because *Bo* is dependent on the asserted values of *M* and *h,* its estimated value is necessarily even less precise than the parameters that were fixed. The conclusion is that using fixed values of *M* and *h* gives a false sense of precision that can be dangerously misleading. The alternative is to adopt a more flexible stock-recruitment relationship with three or more parameters, and to explore the model likelihood surface. If that surface does not provide precise information about the location of MSY, we cannot gain useful information by using a more restricted stock-recruitment relationship.

Table.1 A list of candidate biological reference points and the characteristics.

BRPs	**Recent Estimate (Year) F_{04-06}/BRP**	**Range of RP by M***	**Description**	**USE (target/ Limit)**	**Pros**	**Cons**	**PBF comments**
F_{msy}			Fishing mortality rate associated with maximum sustainable yield	either	Consider both recruitment and growth overfishing; Concept of optimal yield (OY)	Difficult to estimate; Sensitive to *S*/*R* steepness and other structural assumptions	F_{msy}=F_{max} based on preliminary stock assessment because steepness of S/R is estimated to be 1
F_{max}	2.00	0.76-3.58	F corresponding to maximum yield per recruit	limit	Consider growth overfishing; Concept of maximum yield	Does not consider recruitment overfishing; Difficult to estimate if *Y*/*R* curve is asymptotically flat topped	
$F_{0.1}$	2.86	1.14-5.08	F at which slope of Y/R is 10% of value at origin	either	Consider growth overfishing; Conservative measure in contrast to the F_{max} ;Possible to estimate even if *Y*/*R* curve is flat topped.	Does not consider recruitment overfishing.	
$F_{\%SPR}$	1.33($F_{10\%}$)	0.64-1.97	F that reduces	either	Consider	Does not consider	

	1.93($F_{20\%}$) 2.60($F_{30\%}$) 3.44($F_{40\%}$)	($F_{10\%}$) 0.92-2.91 ($F_{20\%}$) 1.24-3.97 ($F_{30\%}$) 1.63-5.30 ($F_{40\%}$)	SSB/R to a certain % of unfished state		recruitment overfishing.	growth overfishing nor optimal yield.	
F_{med}	1.24	1.24-1.55	Fishing mortality rate corresponding to observed 1/SPR	target	Consider recruitment overfishing; Based on the historical time series of *S*/*R*	Assumes *S*/*R*; may not be robust if number of recruits estimated from narrow range of *S* and the relationship is negative correlation, does not consider growth overfishing	*1. It theoretically assume that there is a stock recruitment relationship, which is inconsistent with h=1 in the present assessment.
F_{loss}	0.919	0.66-1.02	Fishing mortality rate expected to keep biomass at Bloss	limit	Consider recruitment overfishing; Based on the historical time series of *S*/*R*;Ease of calculation relative to F_{SSB}; Easy to understand the concept as a limit.	Assumes S/R; may not be robust if number of recruits estimated from narrow range of S and the relationship is negative correlation, does not consider growth overfishing. Does not have any cushion so relatively risky (not	

						precautionary) compared to Fssb	
Adjusted Floss			Floss multiplied by a value (0<x<1) e.g. 0.5xFloss might be a target. Value can also be based on algorithm such as described in ISC/10-1/PBFWG/4	Target/precautionary depending on choice of multiplier	Converts Floss to a corresponding target value that may be useful for management. Easy to understand the concept as a target related to risk at Floss. Consider recruitment overfishing.	Same as above. Except there is a cushion due to multiplier.	The optimal value of the adjustment could benefit from more research, but existing PBFWG analyses provide a useful basis.
F_{SSB}	1.06 ($F_{\text{SSB-min-5\%}}$) 1.11 ($F_{\text{SSB-ATHL-5\%}}$) 1.32 ($F_{\text{SSB-25\%lower-5\%}}$) 0.88 ($F_{\text{SSB-min-}}$	0.92-1.14 ($F_{\text{SSB-min-5\%}}$) 0.98-1.20 ($F_{\text{SSB-ATHL-5\%}}$) 1.20-1.43 ($F_{\text{SSB-25\%lower-5\%}}$) 0.69-1.00 ($F_{\text{SSB-min-50\%}}$) 0.75-1.05	Fishing mortality rate that ensures future spawning stock biomass (SSB) remains above a specified threshold level with a certain probability.	Either, and precautionary depending on the choice of threshold.	Flexibility in way it's calculated; flexible based on management goals; increases need to determine risk strategy of management Consider recruitment overfishing.	Flexibility in way it's calculated; increases need to determine risk strategy of management; computer intensive; Requires specifications of: (1) threshold SSB level, (2) probability that stock remains above	

F_{SSB}	1.06 ($F_{\text{SSB-min-5\%}}$) 1.11 ($F_{\text{SSB-ATHL-5\%}}$) 1.32 ($F_{\text{SSB-25\%lower-5\%}}$) 0.88 ($F_{\text{SSB-min-50\%}}$) 0.93 ($F_{\text{SSB-ATHL-50\%}}$) 1.09 ($F_{\text{SSB-25\%lower-0.5}}$)	0.92-1.14 ($F_{\text{SSB-min-5\%}}$) 0.98-1.20 ($F_{\text{SSB-ATHL-5\%}}$) 1.20-1.43 ($F_{\text{SSB-25\%lower-5\%}}$) 0.69-1.00 ($F_{\text{SSB-min-50\%}}$) 0.75-1.05 ($F_{\text{SSB-ATHL-50\%}}$) 0.91-1.19 ($F_{\text{SSB-25\%lower-0.5}}$)	Fishing mortality rate that ensures future spawning stock biomass (SSB) remains above a specified threshold level with a certain probability.	Either, and precautionary depending on the choice of threshold.	Flexibility in way it's calculated; flexible based on management goals; increases need to determine risk strategy of management Consider recruitment overfishing. Simulation based; takes into account uncertainties as buffers by quantifying non-equilibrium dynamics, estimates of historical SSB, and parameter estimates in the terminal years.	Flexibility in way it's calculated; increases need to determine risk strategy of management; computer intensive; Requires specifications of: (1) threshold SSB level, (2) probability that stock remains above threshold, and (3) length of projection period. Sensitive to projection period used in simulation, e.g., 5 - vs 25- yr. Does not consider growth overfishing	
B_{loss}			Minimum observed stock biomass (or SSB)	limit	Ease of calculation relative to F_{SSB}; Easy to understand the concept as a limit. Consider	Uncertainty around *SSB*. Does not consider growth overfishing. Lack of cushion so relatively risky.	Wide range of *SSB* over the stock assessment period

*The ranges of BRPs are shown when changing M larger than age 1 fish from 0.19 to 0.31.

*1. There were different opinions for interpretations of importance of steepness assumption.

Table 2. Candidate biological reference points for Pacific bluefin tuna and their characteristics on sensitivity and technical data needs. Boxes filled with gray indicate that the relevant information is not available currently.

BRPs	**Sensitivity to *M*** [*1*2]	**Sensitivity to others**[*1*2]	**Data Needs**
F_{msy}			Catch, CPUE, life history parameters
F_{max}	High	High	life history parameters (length-weight, M, size at age, sex ratio)
$F_{0.1}$	High	High	life history parameters (length-weight, M, size at age, sex ratio)
$F_{\%\text{SPR}}$	High	Medium for $F_{10\%}$, high for $F_{20\%}$, $F_{30\%}$ and $F_{40\%}$	life history parameters (length-weight, M, size at age, sex ratio)
F_{med}	Low	Low	Catch, CPUE, life history parameters
F_{loss}	Medium	Medium	Catch, CPUE, life history parameters
Adjusted Floss			Same as Floss, and other data is depending on how including buffers
F_{SSB}	Medium		Configuration of stock assessment model and projection software requires discussion with managers
B_{loss}			Catch, CPUE, life history parameters
B_{msy}			Catch, CPUE, life history parameters

[*1]: Most (high), some (medium) and a few (low) of runs changed the estimates of reference points largely (based on Table 1 in ISC/10-1/PBFWG/04 for F_{ssb}, and Fig. 3-5 in ISC/10-1/PBFWG/02 for others).

[*2]: There were different opinions for interpretations of sensitivity with respect to BRP's. Some members considered insensitivity was preferable, while others considered it was an undesirable property. See discussion part for ISC/10-1/PBFWG/02.

Discussion

The WG thought that Dr MacCall's work is interesting and will help improve our stock assessments in the future. The WG encouraged Dr MacCall to continue with the work and present any future results to the WG. SS3 may be modified in the future to incorporate these ideas.

5.1.2. The result of practice based on the recommendation by simulation study using effective sample size. Ayumi Shibano, Minoru Kanaiwa, Yukio Ishihara, Ryosuke Uji, Tsuyoshi Shimura, and Yukio Takeuchi. (ISC/10-1/PBFWG/08).

The amount of catch landed at the port of Sakai-minato has increased rapidly since 2004 and sampling effort for length measurements has intensified proportionally to maintain the same sample coverage. In a previous simulation study, we demonstrated that sampling effort could be reduced without a significant loss in data precision. Three methods of reducing sampling effort were considered: certain ratio sampling, fixed number sampling and specific landing sampling. The precision of lengths was evaluated by effective sample size (ESS), $\hat{m}_{eff}$ and *f*. Based on the results, it was concluded that sampling of a fixed number of individuals in each landing is advisable and that increasing the number of landings that are sampled improves the precision of size compositions more than increasing the number of fish measured in one landing. In this paper, we suggested three types of target; the values of the mean, median and minimum of the values of ESS in 2003 and before and investigate how large fixed sample size is appropriate. We analyzed fixed number sampling further with given numbers, and compared the values of ESS with the target value. It was suggested that the value of ultimate ESS, *S*, reached the median of the value of *S* in 2003 and before at probability of 80.0 % with a fixed number of 200 fish. If the probability of 80% is acceptable, sample size per landing can be reduced to 200 individuals. This recommendation was reflected in the length measurements at Sakai-minato in 2009. It was demonstrated that the value of *S* was similar to the median with the fixed sample size of 200 by landings. This indicates that precision was maintained as the same level as before 2004.

Discussion:

The WG thought that the method suggested by this paper is important because this method may be applied to the sampling strategy for the Pacific side of the fishery and other fisheries. This will help improve the sampling strategies of these fisheries.

5.1.3. Estimating fishing mortality rates and evaluating the plausibility of assumptions about M for Pacific bluefin tuna using electronic tagging data. Rebecca Whitlock, Murdoch McAllister, and Barbara Block. (ISC/10-1/PBFWG/05)

This paper presents estimates of fishing mortality rates from a spatially and seasonally structured Bayesian mark-recapture model for electronically tagged Pacific bluefin tuna. Quarterly fishing mortality rates (F) were estimated by age, year and season and ranged between 0.10 and 0.85 quarter^{-1}; estimates of F were highly seasonal. In addition to estimating age-class specific natural mortality rates, uncertainty in the natural mortality rate (M) was addressed by fixing it at the age-specific schedules tested by ISC and computing the Deviance Information Criterion for alternative M configurations. The base case (2008) M scenario with M fixed at 0.12 for ages 4+ was estimated to produce a replicate dataset with a structure most similar to the observed recapture data, with a significantly lower DIC than the other scenarios tested (which had M fixed at 0.25 for ages 4+).

Discussion:

The WG thought that this type analysis was important for stock assessment and management of PBF. The WG agreed that it would be good to have direct estimates of M from tagging data in addition to using life-history methods. Since this presentation was a preliminary analysis on the portion of the stock in the EPO, the WG encourages further analysis of this kind. Comparing fixed M schedules (i.e. with no prior), M schedules with lower adult M (2008 base case) show a better fit (lower DIC) to the tagging data. M was also estimated for two age-classes; some WG members were concerned that the low posterior M estimates reflected the relatively informative priors. Future work will examine non-informative priors. It was also clarified that sensitivity analysis of the model suggests that M was relatively insensitive to reporting rates. In the future, auxiliary information like catch and effort, and tagging data from the western Pacific, could be integrated into the model, which would help with the analysis.

5.1.4. Integrating Movement Dynamics into the Assessment of Pelagic Fish Stocks: Lessons from Atlantic Bluefin tuna. Nathan Taylor – oral presentation only.

The author described a **M**ixed-stock **A**ge **S**tructured **T**ag integrated model (MAST) used for the assessment of Atlantic bluefin tuna. He compared diffusion and gravity parameterizations of the mixed-stock model to single-stock variants, including the existing virtual population assessment model used by the International Commission for the Conservation of Atlantic Tunas. He showed that estimated stock size and depletion levels are sensitive to both model structure as well as assumptions about reporting rate priors, age at maturity and the parameterization of movement dynamics. He identified the need to pursue alternative, self reporting tagging technologies, such as *in situ* gene tagging, and the need to purse simulation evaluation of simpler model alternatives.

Discussion

Although the talk was primarily on Atlantic bluefin tuna, the WG agreed that the ideas presented were interesting and may be useful for future research and stock assessments on Pacific bluefin tuna. In comparison with Dr. Whitlock's model in 5.1.3, which used only tagging and recapture locations, this model used the estimated daily locations from the electronic tags. The WG was interested in the pros and cons of including movement/mixing into models since some parameters are difficult to estimate. Dr. Taylor suggested that including movement/mixing was important if the management questions are spatial in nature. The WG suggested that studying the movements of PBF in relation to environmental variability may help explain the EPO abundance index better.

5.2. Work Plans Before ISC 2011

A schedule of future meetings in late 2010 and late 2011 followed by a stock assessment workshop in 2012 was developed by the Working Group at ISC09. The working group noted that an update meeting in July 2011 should be scheduled as well. The following schedule and meeting objectives was discussed and accepted by the Working Group:

1. 06-13 Jan 2011 at the National Research Institute of Far Seas Fisheries in Shimizu, Japan. The objectives of this workshop are to improve the stock assessment model by investigating issues identified in the present workshop (model structure, CPUE, other fishery data and biological parameters) and to complete the workplan for the next full stock assessment in 2012.

2. July 2011 in conjunction with ISC11. This 2-3 day workshop will update the catch table, stock status and conservation advice and recommendations.

3. Nov 2011 prior to US Thanksgiving (tentatively), location to be determined. This workshop is the data preparation meeting for the next stock assessment.

5.3. Next stock assessment in 2012

Working Group members tentatively agreed to schedule the next full stock assessment workshop for late May-June 2012. The location of this workshop has yet to be determined. The Working Group noted that it would be preferable for the IATTC that the assessment occur prior to the Scientific Advisory Committee meeting, which occurs in May, so that the SAC could review the results in 2012 rather than waiting to 2013.

5.4. On-going and Planned Biological Research Activities

5.4.1. Research activities for biology on reproduction, ageing, growth and recruitment monitoring of Pacific bluefin tuna by NRIFSF, Fisheries Research Agency of Japan. Izumi Yamasaki, Wataru Doi, Kazuhiro Oshima and Toshiyuki Tanabe. (ISC/10-1/PBFWG/10)

The National Research Institute of Far Seas Fisheries (NRIFSF) has been carrying out biological research in order to provide biological information useful for the stock assessment and management of Pacific bluefin tuna (PBF). This research is focused on reproduction, ageing, growth and recruitment of PBF and is conducted collaboratively with the Fisheries Research Agency (FRA), prefectural fisheries research laboratories and fisheries colleges of Japan. The first category is related to reproduction. The estimated major nursery areas of PBF are in the subtropical waters off the Nansei Islands and in the Sea of Japan, and the spawning season in these areas are estimated to be from April to June and from June to August, respectively. However, details of locations and environmental and/or biological factors of the spawning and nursery areas have not be specified yet. In addition, a suitable method for identifying PBF nursery areas has not been established yet, although it is considered to be one of the most important factors for improving the accuracy and precision of the stock assessment. The second one is related to ageing and growth. New growth parameters were estimated in recent years (Shimose et al, 2009) and these parameters are thought to be more representative because of wider coverage of ages and lengths than those reported in previous studies. On the other hand, the growth of age-0 to 1 remains less accurate (Ichinokawa, 2008). Therefore, a daily ageing study is needed to improve the information of the growth of young fish. Besides the information necessary to improve the stock assessment, identification of the timing of the formation of the first year ring is of interest. The daily age information may also be useful for distinguishing fish derived from different nursery areas (Itoh, 2009). The last one is related to recruitment. The estimation of recruitment levels at an earlier life history stage either from fishery independent or fishery dependent survey data may be of particular benefit for better stock assessment and management of the stock.

Discussion:

This paper was presented in part to demonstrate progress with respect to sampling and analysis of age and growth studies on PBF as recommended by the ISC Biological Research Task Force. Member countries reported on biological research in progress or in planning It was clarified that studies on small juvenile PBF (20-30 mm) are underway because Japan found that the LC net (which has a large mouth – 20 x 20 m) is more effective at capturing small juveniles than the NST Trawl, which was used previously. It was explained that the age-0 troll survey in Tosa Bay is expected to provide a quick estimate of age-0 recruitment. It occurs during the summer on the Pacific side of Japan so the fish are derived from the Nansei Islands spawning ground. Tosa Bay is considered a good place for this survey because variability in catches is lower relative to other areas that could be considered.

It was noted that the IATTC sent otoliths from PBF caught in the EPO historically to Japan in 2009. The intention was to implement radio-carbon testing for age and growth analysis but much time was spent locating a facility to do the work. A commercial facility was found but does not have much experience with otolith age and growth studies. In 2010, the facility will be provided with recently sampled otoliths for analysis and results will be used to demonstrate competence. Once the accuracy and precision of the results are satisfactory, radio-carbon analysis of the historical EPO otoliths will be conducted.

Korea is planning a survey of egg and larval PBF in April, August, and October in Korean waters. Korea is also conducting histological investigations research on gonads of adults landed in Korean ports.

Taiwan initiated three activities in 2010: (1) asked fishermen to install VMS to report position when large fish are caught, (2) port sampling of fish lengths will be made by sex, and (3) collect otoliths. Preliminary observations are available because the fishery terminates by the end of June. 2010 was the worst year for the fishery; catch was about 300 mt (a third of 2009). 844 fish (365 male, 280 female) were measured in 2010 by port samplers in Tungkang port. Males were larger than females, on average about 235 cm FL relative to 229 cm FL for females. Size ranged from 182 to 262 cm FL. Largest size fish is consistent with largest sizes observed in catch prior to 2002. Spawning occurs more than once in a season so two questions need to be answered: what is the duration, and how many batches during the spawning season. Japan has observed similar differential length-frequency distribution by sex in sampled fish.

Mexico is not planning any further biological research beyond the ongoing size sampling of PBF at harvest time in the farms.

The USA reported that a new postdoc has been brought in to work on age and growth and otolith microchemistry at the Southwest Science Center in La Jolla. At present, the USA is looking for funding to support this research. Most of the research will probably focus on age 2 and 3 fish as these ages are most common in the EPO. One potential question that could be addressed is determining the proportion of these age groups that have migrated from the western Pacific into the EPO.

5.5. Other Matters

No other matters were raised by the Working Group.

6.0 ELECTION OF WORKING GROUP CHAIR

The term of the current Chair expires at the end of ISC10. According the ISC rules and procedures for Working Groups, the nomination of a new Chair is necessary. The current Chair, Yukio Takeuchi, indicated that he was willing to stand again and was nominated by consensus of the Working Group for another term.

7.0 ADOPTION OF REPORT AND CLOSURE OF THE WORKSHOP

The Working Group adopted the report subject to editorial changes for grammar, spelling, and style by the lead rapporteur and final approval by the WG Chair.

The Chair thanked the local host, on behalf of the WG, for the meeting arrangements, which contributed to the successful completion of the meeting.

The meeting was adjourned at 16:00 on 09 July 2010.

APPENDIX 1

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APPENDIX 2

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

PACIFIC BLUEFIN TUNA WORKING GROUP
INTERSESSIONAL WORKSHOP
July 6-9, 2010, Nanaimo, Canada

REVISED AGENDA
(Names in Parentheses are Lead Rapporteurs for Each Major Section)

1.0 Introduction (Holmes and Witlock)

1.1. Welcome and introduction
1.2. Adoption of agenda
1.3. Appointment of rapporteurs

2.0. Update of fisheries statistics and review of fisheries (Piner and Oshima)

2.1. Catch by country and gear;
2.2. Reviews of recent PBF fisheries
2.3. Other matters

3.0 Review of Recent Fishing Mortality Trends with Two Additional Years of Fishery Data (2006 and 2007 Fishing Years) and Comprehensive Sensitivity Analyses (Kai and Piner)

4.0 Development of advice and recommendations on Biological Reference Points for Pacific Bluefin tuna (Ichinokawa and Aires da Silva)

5.0 Review of work plans up to 2012

5.1 Alternative modeling research for the next full stock assessment in 2012 (Teo and Iwata)
5.2 Work Plans Before ISC 2011 (Holmes and Whitlock)
5.3. Next stock assessment in 2012 (Holmes and Whitlock)
5.4. On-going and Planned Biological Research Activities (Holmes and Whitlock)
5.5 Other matters (Holmes and Whitlock)

6.0 Election of Working Group Chair (Holmes)

7.0 Adoption of Report and Closure of Meeting (Holmes)

APPENDIX 3

Document Number	Title	Authors	Availability
ISC/10-1/PBFWG/01	Stock assessment of Pacific bluefin tuna with updated fishery data until 2007	Momoko Ichinokawa, Mikihiko Kai, and Yukio Takeuchi	Abstract and contact details on website
ISC/10-1/PBFWG/02	Updated biological reference points (BRPs) for Pacific Bluefin tuna and the effect of uncertainties on the BRPs	Mikihiko Kai, Momoko Ichinokawa, and Yukio Takeuchi	Abstract and contact details on website
ISC/10-1/PBFWG/03	Applicability of Floss for Pacific bluefin tuna as a limit reference point (LRP)	Mikihiko Kai, Momoko Ichinokawa, and Yukio Takeuchi	Abstract and contact details on website
ISC/10-1/PBFWG/04	Simulation based reference points of Fssb applied to the Pacific bluefin tuna stock	Momoko Ichinokawa, and Kazuhiro Oshima	Abstract and contact details on website
ISC/10-1/PBFWG/05	Estimating fishing mortality rates and evaluating the plausibility of assumptions about M for Pacific bluefin tuna using electronic tagging data.	Rebecca Whitlock and Barbara Block	Abstract and contact details on website
ISC/10-1/PBFWG/06	Japanese catch updates for Pacific bluefin tuna.	Kazuhiro Oshima and Yukio Takeuchi	Full paper on ISC website
ISC/10-1/PBFWG/07	Withdrawn		
ISC/10-1/PBFWG/08	The result of practice based on the recommendations by simulation study using effective sample size	Ayumi Shibano, Minoru Kanaiwa, Yukio Ishihara, Ryosuke Uji, Tsuyoshi Shimura, and Yukio Takeuchi	Abstract and contact details on website
ISC/10-1/PBFWG/09	The update of input data of stock assessment of Pacific Bluefin Tuna for Stock Synthesis III	Masayuki Abe, Kazuhiro Oshima, Mikihiko Kai, Momoko Ichinokawa, Chien-Chung Hsu, Alexandre Aires-da-Silva, Izumi Yamazaki, and Yukio Takeuchi	Full paper on ISC website

APPENDIX 3

ISC/10-1/PBFWG/10	Research activities for reproductive biology and recruitment monitoring of Pacific bluefin tuna by NRIFSF, Fisheries Research Agency of Japan	Izumi Yamasaki, Wataru Doi, Kazuhiro Ohshima, and Toshiyuki Tanabe	Full paper on ISC website
ISC/10-1/PBFWG/11	Size composition of BFT in 2008. Data collected from farms from Baja California	Michel Dreyfus	Abstract and contact details on website
ISC/10-1/PBFWG/12	Recent variations in the catch of Pacific bluefin tuna by Korean domestic purse seiners	Joon-Taek Yoo, Zang Geun Kim, Jae Bong Lee, Seon-Jae Hwang, Jong-Bin Kim, Doo-Nam Kim , Kyu-Jin Seok, and Dong-Woo Lee	Full paper on ISC website
Oral only	Fundamental limitations of stock-recruitment models	Alec MacCall	
Oral only	Integrating Movement Dynamics into the Assessment of Pelagic Fish Stocks: Lessons from Atlantic Bluefin tuna	Nathan Taylor	

APPENDIX 4

Table 1 Pacific bluefin tuna catch table by fisheries (metric tones). 1952-2009.

Year	Western Pacific States																Eastern Pacific States						Out of ISC members		Grand Total
	Japan[1]									Korea[3]		Chinese Taipei				Sub Total	United States[4]			Mexico		Sub Total	NZ[5]	Others[6]	
	Purse Seine		Dist. & Off. Longline		Coastal Longline	Troll[2]	Pole and Line	Set Net	Others	Purse Seine	Trawl	Longline	Purse Seine	Distant Driftnet	Others		Purse Seine	Others	Sport	Purse Seine	Others				
	Tuna PS	Small PS	NP	SP																					
1952	7,680		2,694	9		667	2,198	2,145	1,700							17,094	2,076		2			2,078			19,172
1953	5,570		3,040	8		1,472	3,052	2,335	160							15,636	4,433		48			4,481			20,117
1954	5,366		3,088	28		1,656	3,044	5,579	266							19,027	9,537		11			9,548			28,575
1955	14,016		2,951	17		1,507	2,841	3,256	1,151							25,739	6,173		93			6,266			32,005
1956	20,979		2,672	238		1,763	4,060	4,170	385							34,268	5,727		388			6,115			40,383
1957	18,147		1,685	48		2,392	1,795	2,822	414							27,302	9,215		73			9,288			36,590
1958	8,586		818	25		1,497	2,337	1,187	215							14,666	13,934		10			13,944			28,610
1959	9,996		3,136	565		736	586	1,575	167							16,760	3,506	56	13	171	32	3,779			20,539
1960	10,541		5,910	193		1,885	600	2,032	369							21,531	4,547	0	1			4,548			26,079
1961	9,124		6,364	427		3,193	662	2,710	599							23,078	7,989	16	23	130		8,158			31,236
1962	10,657		5,769	413		1,683	747	2,545	293							22,107	10,769	0	25	294		11,088			33,195
1963	9,786		6,077	449		2,542	1,256	2,797	294							23,201	11,832	28	7	412		12,280			35,481
1964	8,973		3,140	114		2,784	1,037	1,475	1,884							19,406	9,047	39	7	131		9,224			28,631
1965	11,496		2,569	194		1,963	831	2,121	1,106			54				20,334	6,523	77	1	289		6,890			27,224
1966	10,082		1,370	174		1,614	613	1,261	129							15,243	15,450	12	20	435		15,918			31,161
1967	6,462		878	44		3,273	1,210	2,603	302			53				14,825	5,517	0	32	371		5,920			20,745
1968	9,268		500	7		1,568	983	3,058	217			33				15,634	5,773	8	12	195		5,989			21,623
1969	3,236		313	20	565	2,219	721	2,187	195			23				9,479	6,657	9	15	260		6,940			16,419
1970	2,907		181	11	426	1,198	723	1,779	224							7,448	3,873	0	19	92		3,983			11,432
1971	3,721		280	51	417	1,492	938	1,555	317			1				8,773	7,804	0	8	555		8,367			17,140
1972	4,212		107	27	405	842	944	1,107	197			14				7,854	11,656	45	15	1,646		13,362			21,216
1973	2,266		110	63	728	2,108	526	2,351	636			33				8,821	9,639	21	54	1,084		10,798			19,619
1974	4,106		108	43	1,069	1,656	1,192	6,019	754			47			15	15,010	5,243	30	58	344		5,675			20,685
1975	4,491		215	41	846	1,031	1,401	2,433	808			61			5	11,332	7,353	84	34	2,145		9,616			20,948
1976	2,148		87	83	233	830	1,082	2,996	1,237			17			2	8,716	8,652	25	21	1,968		10,666			19,381
1977	5,110		155	23	183	2,166	2,256	2,257	1,052			131			2	13,335	3,259	13	19	2,186		5,477			18,811
1978	10,427		444	7	204	4,517	1,154	2,546	2,276			66			2	21,645	4,663	6	5	545		5,218			26,863
1979	13,881		220	35	509	2,655	1,250	4,558	2,429			58				25,595	5,889	6	11	213		6,119			31,715
1980	11,327		140	40	671	1,531	1,392	2,521	1,953			114			5	19,693	2,327	24	7	582		2,940			22,634
1981	25,422		313	29	277	1,777	754	2,129	2,653			179				33,532	867	14	9	218		1,109			34,641
1982	19,234		206	20	512	864	1,777	1,667	1,709	31		207		2		26,228	2,639	2	11	506		3,159			29,387
1983	14,774		87	8	130	2,028	356	972	1,117	13		175	9	2		19,670	629	11	33	214		887			20,557
1984	4,433		57	22	85	1,874	587	2,234	868	4		477	5		8	10,655	673	29	49	166		917			11,573
1985	4,154		38	9	67	1,850	1,817	2,562	1,175	1		210	80	11		11,975	3,320	28	89	676		4,113			16,089
1986	7,412		30	14	72	1,467	1,086	2,914	719	344		70	16	13		14,157	4,851	57	12	189		5,109			19,266
1987	8,653		30	33	181	880	1,565	2,198	445	89		365	21	14		14,474	861	20	34	119		1,033			15,507
1988	3,583	22	51	30	106	1,124	907	843	498	32		108	197	37	25	7,562	923	50	6	447	1	1,427			8,989
1989	6,077	113	37	32	172	903	754	748	283	71		205	259	51	3	9,707	1,046	21	112	57		1,236			10,943
1990	2,834	155	42	27	267	1,250	536	716	455	132		189	149	299	16	7,067	1,380	92	65	50		1,587			8,653
1991	4,336	5,472	48	20	170	2,069	286	1,485	650	265		342		107	12	15,262	410	6	92	9		517	2		15,781
1992	4,255	2,907	85	16	428	915	166	1,208	1,081	288		464	73	3	5	11,896	1,928	61	110	0		2,099	0		13,995
1993	5,156	1,444	145	10	667	546	129	848	365	40		471	1		3	9,825	580	103	298			981	6		10,811
1994	7,345	786	238	20	968	4,111	162	1,158	398	50		559				15,795	906	59	89	63	2	1,118	2		16,916
1995	5,334	13,575	107	10	571	4,778	270	1,859	586	821		335			2	28,248	657	49	258	11		975	2		29,225
1996	5,540	2,104	123	9	778	3,640	94	1,149	570	102		956				15,066	4,639	70	40	3,700		8,449	4		23,519
1997	6,137	7,015	142	12	1,158	2,740	34	803	811	1,054		1,814				21,720	2,240	133	156	367		2,897	14		24,632
1998	2,715	2,676	169	10	1,086	2,865	85	874	700	188		1,910				13,277	1,771	281	413	1	0	2,466	20		15,763
1999	11,619	4,554	127	17	1,030	3,387	35	1,097	709	256		3,089				25,919	184	184	441	2,369	35	3,213	21		29,153
2000	8,193	8,293	121	7	832	5,121	102	1,125	689	1,976	0	2,780			2	29,240	693	61	342	3,019	99	4,214	21		33,475
2001	3,139	4,481	63	6	728	3,329	180	1,366	782	968	10	1,839			4	16,895	292	48	356	863		1,559	50		18,504
2002	4,171	5,102	47	5	794	2,427	99	1,100	631	767	1	1,523			4	16,672	50	12	654	1,708	2	2,427	55	10	19,164
2003	1,033	5,399	85	12	1,152	1,839	44	839	446	2,141	0	1,863			21	14,874	22	18	394	3,211	43	3,689	41	19	18,622
2004	4,844	2,577	231	9	1,616	2,182	132	896	514	636	0	1,714			3	15,353		11	49	8,880	14	8,954	67	10	24,384
2005	4,061	7,390	107	14	1,818	3,406	549	2,182	548	1,085		1,368				22,527	201	**7**	79	4,542		4,830	20	7	27,384
2006	3,962	3,272	63	11	1,058	1,544	108	1,421	777	949		1,149				14,314		**2**	96	9,806		9,904	21	3	24,242
2007	3,058	2,841	83	8	2,226	2,385	236	1,503	1,209	1,054		1,401				16,004	42	2	14	4,147		4,205	**21**[8]	**3**[8]	**20,233**
2008	2,954	6,299	19	8	1,476	2,767	64	2,358	1,192	1,536		979				19,652		**1**	93	4,392	15	4,501	**21**[8]	**3**[8]	**24,177**
2009	2,071	5,353	-[7]	-[7]	1,052	1,897	50	1,985	913	794		892				15,008	410	**5**	151	3,019		3,585	**21**[8]	**3**[8]	**18,617**

1 Part of Japanese catch is estimated by the WG from best available source for the stock assessment use.

2 The troll catch for farming estimating 10 - 20 mt since 2000, is excluded.

3 Catch statistics of Korea derived from Japanese Import statistics for 1982-1999.

APPENDIX 4

4 US in 1952-1958 contains catch from other countries - primarily Mexico. Other includes catches from gillnet, troll, pole-and-line, and longline.

5 Catches by NZ are derived from the Ministry of Fisheries, Science Group (Compilers) 2006: Report from the Fishery Assessment Plenary, May 2006: stock assessments and yield estimates. 875 p. (Unpublished report held in NIWA library, Other countries include AUS, Cooks, Palau and so on. Catches derived from Japanese Import Statistics as minimum estimates.

6 Other countries include AUS, Cooks, Palau and so on. Catches derived from Japanese Import Statistics as minimum estimates.

7 The catch for Japanese coastal longline in 2009 includes that for the distant water and offshore longliners.

8 Catches in New Zealand and Other countries since 2007 are carry-overs of those in 2006

9 Catches in shaded cells are provisional.