Annex 4

REPORT OF THE PACIFIC BLUEFIN TUNA WORKING GROUP WORKSHOP

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

December 11-18, 2007
Shimizu, Japan

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1. OPENING AND MEETING ARRANGEMENTS

The ISC Working Group (WG) on Pacific Bluefin Tuna (PBF) held the Workshop at the National Research Institutes of Far Seas Fisheries (NRIFSF), Shimizu, Japan. Mr. Yukio Takeuchi chaired the meeting. Participants were from Mexico, Japan, the U.S.A and the IATTC. (Appendix 2). Absent from this Workshop were key members from Chinese Taipei and Korea. Updated fishery data from both members were also not received

Dr. T. Kobayashi, the Director of the Institute, welcomed the participants and addressed the Group. He emphasized that the meeting is an important step for the goal of the Group, i.e. stock assessments. He wished the Group's success with good results and offered assistance for the best accommodation as possible for the meeting.

2. ADOPTION OF AGENDA AND APPOINTMENT OF RAPPORTEURS

The tentative agenda were reviewed. It was suggested that an independent Agenda item be added for discussion of CPUE series (data and model specifications and criteria for the better selection) and period of series of data to be used in the model. After some discussions and modifications, the Agenda were adopted.

Rapporteurs were appointed for each agenda items. The adopted Agenda together with the rapporteurs assigned to respective item is attached as Appendix 1. N. Miyabe supervised the contents of the reports while P. Miyake assembled and edited all the segments into one report. The list of documents presented at this meeting is attached as Appendix 3.

3. UPDATING FISHERIES INDICATORS. (Rapporteurs; H. Yamada* and A. Coan)

A catch table for Pacific Bluefin Tuna (Appendix Table 4) was introduced and revised with new information from participants.

- ***ISC/07/PBF-3/13 by A. Coan***

Quarterly U.S. catch data of bluefin tuna are available for the period 1928 to 2006 and were updated to include all changes made to annual catch estimates. Data for 1928 to 1980 are available by commercial and sport categories. Data for 1981 to 2006 are available by purse seine, pole and line, longline, troll, gillnet, other and sport categories. CPFV logbook data (catch in number of fish) are used to estimate quarterly sport fishery catches (in weight) for the period 1936 to 2006. Quarterly commercial catches for the period 1928 to 1958 (includes catches from U.S., Mexico and other countries) are from Bayliff 1991. U.S. purse seine logbook data are used to estimate quarterly commercial catches (U.S. only) for the period 1958 to 1980. During the period 1981 to 2006, U.S. purse seine logbook data are used to generate purse seine quarterly catches, a combination of U.S. longline logbook and landings data (landing date) are used to estimate quarterly longline catches and Pacific landing data are used to estimate quarterly catches for all other commercial gear categories. Most of the U.S. bluefin catch occurs in quarter 3.

Discussion

It was clarified that sport catches for the SSII model could be supplied in numbers of fish instead of converting to weight by using average weights collected by IATTC. The Workshop suggested that the availability of historical values of average weights during 1980-1990s, when sport catches were increasing, be investigated. The Workshop suggested checking past informal workshop meeting reports between the IATTC and Japan for information on the sampling of California sport fisheries in Table 1;

the numbers of fish measured by IATTC from sport fishery samples are given. The Workshop requested that IATTC supply sample sizes used to estimate average weights for fish caught by the sport fishery. This information provided is in Table 1.

- ***ISC/07/PBF-3/14 by H. Yamada***

Japanese annual catch estimates for Pacific bluefin tuna were revised for the period 1952 – 2006, based on statistics from the SID (Statistic Department of Ministry of Agriculture, Forestry and Fisheries) report, large-scale research program, the Research Program on Japanese Bluefin tuna (RJB), and Japan Fisheries information center (JAFIC). Annual catches for longline were revised for the entire time series based on the logbook data. The catch estimates for the Japanese small pelagic fish purse seine fisheries were revised for the whole time series with new conversion factors based on field sampling at the markets in northern Kyushu at which small PBF are sold (ISC/07/PBF-3/4). Catches in several coastal fisheries were also revised for 2005 and 2006, from the SID report for 2005.

Discussion

Y. Takeuchi, the co-author of this paper, provided a supplementary explanation that the ISC7 and the WCPFC requested that Working Groups provide catch tables by major fisheries and by major. Accordingly the longline data in the table were modified based on the SID report for the coastal longliners and based on logbook data for offshore and distant water longliners. The Workshop discussed the changes between the previous estimates and the updated for the longline fisheries from the 1950s and 1960s, in particular. Some discussions were concentrated on how definite the data set prepared at this time would be, since Japan is still trying to improve the data with additional information, particularly for small fish. Data for purse seine, troll, pole-and-line and handline fisheries are considered relatively final. The values for other gears may change in the future.

The Workshop was also asked to compare the revised catches with the previously estimated catches to evaluate the revisions. The comparison of the total catch between these two series is shown in Figure 1. Total catch in the figure excludes the catch by purse seines, since those estimates were the same as the previous estimates.

The Workshop revised and updated the table of Pacific bluefin tuna catches (Appendix Table 1) from information provided at the meeting. The catch data from Korea and Chinese Taipei were carried over from the July 2007 meeting. Fishery categories for reporting catches were also revised to correspond to the fishery definitions to be used in the stock assessment model.

4. REVIEW OF SSII INPUT REQUIREMENTS AND INITIAL SETTINGS (Rapporteur: Y. Takeuchi)

- ***ISC/07/PBF-3/23 by Y. Takeuchi***

The Workshop scheduled the next stock assessment in May 2008. For that assessment, the Workshop is required to make decisions regarding the biological parameters, fishery data and model. This working paper summarizes issues for decision making. This information should serve as the starting point of decision making during this meeting. In biological parameters, stock structure and spatial structure would not cause serious debate. Reproduction parameters such as age of maturity and frequency and timing of spawning can be solved easily. Age and growth must be well investigated by the documents presented at the meeting. Some decision has to be made on natural mortality to be used as well as on the length-weight relationship. For fishery data: fisheries have to be defined; CPUE series have to be examined; length bin has to be defined along with the decisions of minimum and/or maximum length; sample sizes have to be decided; and a time-step must be decided.

Discussion

The Workshop requested that a concise check list be provided of the items to be decided during the discussions in the following sections. A table of items was developed (Appendix 4). A clarification was made regarding the options in setting up minimum and/or maximum length-frequency sample sizes in relation as to how these minimum and/or maximum sample size limits would be used. The Workshop recognized that they may be useful for setting up the input of effective sample sizes or the initial value of sample sizes when an iterative reweighting method is applied to length-frequency data to prevent over-fitting to a single data point.

5. INPUT DATA FOR THE SSII (Rapporteurs; H. Honda for biology and K. Yokawa for fishery data)

5.1 Biological parameter estimates. (Rapporteurs; T.Tanabe*, Y.Aonuma, J.Childer, T. Shimose)

- ***ISC/07/PBF-3/2 by T. Shimose***

The age determination of wild captured PBF had been conducted using the sectioned otolith from 233 individuals (ranging from 97 to 260 cm in fork length). Annuli were determined according to the southern bluefin tuna ageing manuals by an external contractor. The results were re-examined by the NRIFSF staff. In addition, vertebral bones of 108 individuals (59-225 cm FL) were also used for this study. The first to fifth opaque zones in the sectioned otoliths were indistinct, but zones beyong the fifth were distinct enough to count. Distinct opaque zones were formed regularly, and appeared on the otolith edge in May and June. Therefore, these opaque zones were considered to be annual rings. On the other hand, the first to seventh rings were distinct in vertebral bone. Marginal growth index suggested that the growth rings in vertebrae were formed once a year, in April to May. The specimens of 59-260 cm in FL were aged from 1 to 20 years old, based on the two different ageing techniques (otolith rings for larger fish and vertebra rings for smaller fish). The von Bertalanffy growth formula was fitted to the ageing data set combined for otolith and vertebra. The estimated growth curve showed relatively fast growth up until about 150 cm in FL which matches very well with the growth estimated by tag-recovery data. On the other hand, it indicated considerably slower growth for the older fish than the previous growth equation.

Discussion

There was a concern expressed about the availability of an acceptable growth curve used for the stock assessment. A deadline of the end of March 2008 was set for preparing the final age data and the growth equation. It was pointed out that the precision of ring counts, the representativeness of sampled individuals of the stock, and the reliability of the age data obtained from the two different methods (using otoliths and vertebrae) should be taken into account. The decision process for determining whether specimens should be accepted or rejected in ageing should be carefully examined. There was a concern whether there is a bias introduced from the rejected readings[1].

- ***ISC/07/PBF-3/27 by Y. Aonuma***

A total of 1,061 PBF individuals landed on the Yaeyama market were measured in FL (cm) from 2001 to 2007. This area off the Yaeyama port has been known as the spawning grounds for PBF, and spawning takes place in spring time. The most of fish caught in the spawning season were larger than 150 cm FL. The FL frequency distributions showed the 220 cm FL class to be the median in 2001 to 2004 with a shift to a smaller size in 2005 to 2007, and a marked mode at 210 cm FL class observed in

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[1] The mean lengths at age of rejected samples were different from ones from accepted samples, but they were not shown during the meeting.

the 2007 distribution. This result suggests that smaller sized PBF tend to be landed at the Yaeyama market.

In the 2007 survey using a research vessel, 357 larvae were collected from twelve larval sampling stations. In the northeast area of the Miyako Island, more than 200 larvae identified as PBF by DNA test (5.6-7.4 mm TL) were collected on the 9th of June, while none were collected the next day This suggests a patchy or discontinued distributional pattern of PBF larvae.

Discussion

It was pointed out that the sample size for length-weight data needs special attention, because the fishing vessels in this area usually target spawning adults. In order to understand spawning activities of PBF, larval surveys could supply basic information including spawning period, area and relative degree of abundance of the spawning stock. A survey carried out in the region off Taiwan and Philippine waters besides in the Miyako Isand area would cover the main area of the spawning ground. Additional information about the relationship between larval distribution and environmental condition (water temperatures at 20 m and 200m depths) was described by a Japanese colleague.

The CLIOTOP symposium was convened in La Paz, Mexico recently and discussed early life history of tunas. The summary of the results of that group's discussion was presented.

- **I*SC/07/PBF-3/7 by M. Kai***

A single best W-L relationship for use in the SSII model was estimated from data including a wide fork length range and a large number of weight measurements (either in round or eviscerated weight) collect4ed in the RJB survey. The new formula was compared to the W-L relationship by Shingu *et al* (1974). The author used allometric model based on an equation in SS2 model. Both additive and multiplicative error structures were investigated to estimate the W-L relationship of PBF, and a comparison of AIC values was used to select the better relationship. The relationship with the additive error was chosen, and the parameters estimated by using data sets including eviscerated weight were adopted. Selected single best round weight-fork length relationship of PBF was $W = 1.7117 \times 10^{-5} \times L^{3.0382}$. Comparison of this W-L relationship to that of Shingu *et al.* (1974) demonstrated very little or no difference.

Discussion

Using eviscerated weight rather than round weight shows a much better L-W relationship. It was pointed that our choice of L-W relationship should take into account the different formulas proposed by several studies. Differences are due to the ranges in size of fish used, and regions or seasons of when samples were collected. Comparisons were made to L-W equations from the Atlantic and from a study in the South Western Pacific (Hsu et. al. 2000) which demonstrated the need for a valid L-W relation for large fish (250-300cm). The Workshop decided to use the new L-W relationship from Kai's study, but this would not be applicable to the large-sized fish in the Chinese-Taipei catches. From the Chinese-Taipei catches, investigation is necessary to determine if catch in number of fish is available if only a few very large fish are involved.

5.2. Fishery data

5.2.1 Principal Eastern Pacific Ocean fisheries (Rapporteurs; M. Dreyfus*, A. Aires-da-Silva, J. Childers)

- ***ISC/07/PBF-3/13 by A. Coan***

This paper gave quarterly and annual catch data for U.S. by fishery categories as already summarized under the Agenda Item 3.

- ***ISC/07/PBF-3/1 by A. Aires-da-Silva***

This study presented a new method for selecting purse seine catch and effort data to be used to obtain standardized catch rates for PBF in the eastern Pacific Ocean (EPO). The data selection is made with constraints for the PBF optimal habitat (Bayliff, 1996) and a vessel-based criterion.

Historically, PBF catches in the EPO were predominantly taken by US and Mexican purse seiners operating west of Baja California and California. Two major events occurred in the fishery which likely resulted in strong changes of PBF catchability. The first was the gradual abandoning of traditional PBF fishing grounds along the coast of Baja California by US purse-seine vessels, which began in the early 1980s. The second was the emergence of a Mexican target fishery for farming purposes in 1999.

Indices of abundance were presented for four fisheries: (1) the developed phase of the US targeted fishery (1960-1982); (2) the extinction phase of the US fishery (post-1982); (3) the Mexican opportunistic fishery (1960-1998); and (4) the Mexican targeted fishery for PBF pen-rearing operations (post-1999). The reliability of the different indices and their use in the north Pacific-wide stock assessment were discussed.

Concerns were presented by the authors about the meaning of the PBF indices for the 1-3 year old fish in the EPO. It is very unlikely that the proportion of migrants from the WPO to the EPO is constant over time. These may change due to the habitat and environmental conditions in the EPO. In addition, the spatial extent of the study area (mainly Baja California) is very small.

Discussion

Discussions were concentrated on the PBF season-vessel selection criteria. It was pointed out that the EPO purse seine fishery is mainly targeted at tropical tuna species and therefore some selection criteria are needed to extract the PBF targeted effort from the IATTC databases. The current method is believed to provide a reasonable PBF catch and effort data selection for the estimation of indices of abundance. However, non-targeted effort is still contained in the PBF data, in particular for the Mexican fishery which historically mainly targeted yellowfin tuna (YFT).

The authors recognized that further improvements of the indices of abundance of PBF in the EPO could be made in future work. Specifically, the quantification of PBF-search-time may be improved. A large number of the vessels with PBF-targeted effort have relied on aerial sighting support, and this factor was not included in the current models. Future developments will include aerial support variables (presence/absence and type) as explanatory factors. The use of environmental indices such as the Northern Oscillation Index should be continued.

Suggestions were made by the Workshop for improving the PBF data selection. One of these was to use criteria based on the proportions of PBF catch by trip rather than proportions of PBF positive trips by vessel. It was noted that preliminary analyses using trip criteria were made but not considered in the final work due to the lack of data to discriminate the PBF trips for the whole time series. The authors noted that future analyses will explore the alternative trip-based criteria for the Mexican PBF-targeted fishery.

It was suggested that the EPO's western limit of the PBF analysis could be moved closer to the coast to eliminate YFT targeted effort. The authors commented that the activity of the fleet above 22°N is mainly restricted to the PBF fishing grounds. It was also suggested that an analysis of the change in species composition (PBF, YFT, SKJ) over time would help to understand the PBF fishery dynamics.

A clarification was asked about the low values of the proportions of positive observations for the binomial GLMs. These values were corrected and the indices updated. Additional diagnostic plots and plots with nominal and standardized CPUE were provided. The diagnostic plots showed no major departures from model assumptions. A question was made about the large differences between the nominal and standardized CPUE for the US PBF-targeted fishery. It was noted that all the explanatory variables included in the GLM were significant, and that these reflect changes in catchability. Due to the large computational time required for Jackknife, it was not possible to provide the precision estimates for the indices at the meeting. Coefficients of Variation (CVs) of the indices will be provided before the assessment in May 2008.

A request was made for an update on the status of the Mexican PBF target fishery and data collection. In the case of the Mexican fishery in 1996 a first attempt of fattening PBF in holding pens took place on a small scale. Starting in 1999, this activity can be considered fully developed in the west coast of Baja California peninsula. The number of companies is limited and in many cases a limit on the amount of farming was imposed. All the effort devoted to this activity is performed by the traditional purse seine fishery. No new vessels have entered the fishery for farming purposes. Some companies also have fishing vessels while others have to rely on an agreement with boat owners to provide PBF.

The Workshop was informed that the observer coverage of the Mexican fishery is 100% (50% by Mexico and 50% by IATTC). Most of the PBF catches are brought to pens for farming, and catch data submissions are mandatory. The Mexican observer program initiated PBF onboard size measuring in 2005. However, samples of PBF are very small since most of the catch is destined for pen-rearing. There is a possibility of size selectivity towards the market fish bias for farming; therefore the size composition of PBF that were actually measured could be underestimated.

Mexico and IATTC staff are working cooperatively on obtaining data (catch and size composition) from the farming companies. Size data collected during the processing of pen-raised fish for the Japanese market could be used for back-calculating the BFT size compositions at the time of capture and removal from the population.

- ***ISC/07/PBF-3/19 by K. Piner.***

An index of juvenile bluefin tuna abundance from waters off Southern California (USA) and Baja California (Mexico) was created from the for-hire recreational fleet logbooks. The index spans 1995-2006 and was created using a delta-GLM approach. This improved upon an earlier version as it eliminates ground fish trips through the use of individual trip data. This analysis also eliminates reporting rate changes by constraining the analysis to the years of consistent logbook structure and investigated a season*area interaction. The final index reflects variable bluefin tuna abundance. The jackknifed estimates of CPUE SE are quite large.

Discussion

The same concerns presented for the EPO purse seine indices as indicators of abundance were noted for the US sport index. The high variability and short time series of the sport index raises issues about its use in the SS2 model.

Discussion was also related to the use of sport fishery size data to represent the purse seine fishery. This was considered as a possibility. It was noted that the EPO data is available and complete for the assessment, data from different flags in the EPO should be considered altogether and the sport fishery is in number of fish not in weight. Mexico provided as the US did, catch data in quarters, during this meeting.

Discussions were also related to the use of sport fishery size data to represent the purse seine fishery data for the pens. The limitations of the short temporal coverage were recognized.

5.2.2.. Principal Western Pacific Ocean Fisheries

5.2.2.1.. Catch data (Rapporteurs; K. Oshima*, H. Yamada, O. Sakai)

- ***ISC/07/PBF-3/15 by Y. Takeuchi***

Quarterly catch table for the stock assessment was updated and reviewed. There are several fisheries whose fishing season is unclear, even though the quantities for such catch are minor. The fishing season needs to be specified for these fisheries before the next Workshop meeting in May 2008.

Discussion

The Workshop discussed the allocation of catch among quarters of the year for troll fishery before 1981, when monthly catch was not available. It was agreed to use quarterly catch ratio obtained by averaging catch ratios during 1981 – 1994. This average ratio will be applied for the years before 1981. Sensitivity analysis was suggested to be carried out using another ratio from different years (e.g. 1981-2006). Availability of the quarterly catches for Korean and Chinese Taipei fisheries as well as catches in the South Pacific was discussed. The annual Chinese Taipei longline catches could be assigned to the 2nd quarter. However, there was no information on how to assign the Chinese Taipei purse seine catches. Chinese Taipei driftnet catches could be assigned by applying the quarterly catch ratio of the Japanese driftnet catches. It was also agreed that the Korean purse seine catches are combined with the Japanese Small Pelagic purse seine catches. Monthly catches for this Korean fishery are provided since 2002. The catches before 2002 have to be broken down into quarters applying the similar method used for the Japanese troll fishery. In order to estimate the quarterly catches in the South Pacific, the information on fishing season (around August ?) in New Zealand might be useful.

- ***ISC/07/PBF-3/6 by M. Kai***

Based on PBF length frequencies from set-net fishery, Kai (ISC/07/PBF-1/07) showed that the number of fish and proportion of fish larger than 100cm in fork length (FL) had apparently increased since 2003 (referred to as "unusual phenomenon" in this document). This paper examined whether this phenomenon was caused by the changes in the fishing selectivity of set-net. The number and characteristics of set-nets had not significantly changed from 1994 to 2006. This suggests that such possibility is low, due to the changes in gear selectivity. It is not known if these changes were related to the oceanographic conditions or stock size.

Discussion

The author demonstrated a low possibility of artificial effect generated by the change in gear selectivity. The Workshop recognized that there is not gear driven size selectivity in the catches by set-net fishery. The Workshop recommended to investigate the relationships between the catch of large PBF by set-net fishery and the sea environmental conditions in order to understand the mechanism of large PBF catch.

- ***ISC/07/PBF-3/04 by H. Yamada***

The quarterly catches of small Pacific bluefin tuna by Japanese small-pelagic purse seine fishery in the East China Sea were estimated for 1988 – 2006. The landing data for 1997–2006 by JAFIC (Japan Fisheries Information Center) in Kyusyu were re-examined by field sampling of the weight of fish in boxes of different fish size categories for auctions. As pointed out by (ISC/07/PBF-2/01), the JAFIC estimates significantly under-estimated the PBF catches, especially when landings were mostly composed of fish smaller than 5 kg in body weight (BW). As fish larger than 5 kg are all measured individually, this underestimation was mostly due to the use of smaller average weight per box in which fish are stored. As a result of this study, the landing data of small purse seine which had been reported by JAFIC should be increased by averages of 24 to 26 % depending on estimation procedures. Such adjustments were applied to the landing data before 1998.

Discussion

It was clarified that there were two kinds of purse seine fisheries in the East China Sea and Sea of Japan; one is the small-pelagic purse seine (small PS) and the other is the tuna purse seine (tuna PS). The study was carried on the small PS fishery. The Workshop agreed that the conversion factor of Op.1 (using an average weight per box for all the Number-Of-Box categories 3-20) was appropriate for estimation of the quarterly catch by the Japanese small PS fishery.

5.2.2.2. Size data (Rapporteurs; M. Abe*, M. Kai)

- ***ISC/07/PBF-3/03 by H. Yamada***

The quarterly size frequencies of PBF caught by the small pelagic purse seine fishery in the East China Sea were estimated using the summary report of sales slip, which are published as the landing information at the three fish markets in the northern Kyushu (ISC/07/PBF-1/7). The summary reports describe the number of boxes categorized according to the weight of fish contained in a box for the landings of small fish, mostly under 5 kg in body weight (BW i.e. round weight). For the landings of relatively large fish (mostly of fish over 5 kg), individual fish are weighted and reported by size classes. ISC/07/PBF-3/04 estimated the length compositions, using the number of boxes by size category and measurement of size frequencies within each size category used in the summary report. However, there are still some weight categories which lack measurement data. For these data, weight-length conversion was used as an ad hoc way. In this paper, a part of size data was collected from the fish larger than 5 kg, and updated the quarterly size frequencies for this fishery using these newly updated size data.

Discussion

The Workshop suggested to investigate the seasonal change in length frequencies within each size category.

- ***ISC/07/PBF-3/05 by A. Shibano***

The length data of PBF landed in Sakai-minato fishing port were analyzed to evaluate its accuracy and precision. It was demonstrated that the range of the error distributions of each length bin is narrow using single-stage bootstrap method. It was suggested that there were little bias in Sakai-minato data and have high precision in evaluating PBF sampling methods and strategies. The authors intend to use multi-stage bootstrap with more realistic assumptions in future analysis and to compare the results with the current ones. Also it is planned to evaluate sampling methods in other ports, and provide which method is the best to reduce the variance and bias of length frequency data. The final goal of this analysis is to provide advices or suggestions in improving size samplings PBF. It is also an important subject to evaluate the effective sample size used in the PBF assessment.

Discussion

The Workshop noted that the size data taken from the landings in Sakai-minato fishing port had high accuracy and precision. The Workshop suggested to evaluate the variance of sampling by the multi-stage bootstrap method results from the higher accuracy and precision of size data than by the single-stage bootstrap methods.

- ***ISC/07/PBF-3/8 by M. Abe***

Newly prepared size data for stock assessment purpose (SSII model) by each Japanese fishery were examined as to how they were prepared and how different from the previous ones. The range for segmenting length-bin classes was expanded from 20 to 290 cm to 16 to 298 cm. The difference from the previous data base is due to the addition of data for 2005-2006. At the July 2007 meeting, it was recommended not to use the pole-and-line fishery data for 1952 to 1992. The comparisons of the highest and lowest length reported for each fishery and means showed for the new data are not much different from the previous frequencies, except for the last two years.

Discussion

The Workshop suggested that the size data for all the fleets should be analyzed in details. (i.e. the range of F.?L.?) before using as input for the model. The Workshop pointed out to use the number of boxes sampled rather than the total number of boxes in sale in order to decide the sample size from the Small Pelagic purse seine fishery.

- ***ISC/07/PBF-3/9 by M. Abe***

The size data for SSII were analyzed as to the effect of change in the length bins and cut-off points (the minimum sample size to be accepted). Various types of size classes adopted for each bin were evaluated, using the AIC. The combination of length class intervals which provided the largest amount of data was different according to fleets. However, the data included in each combination of length class intervals were not affected greatly by adopting different cut-off point in sample size.

The number of available data decreases when data cut-off points are increased according to the sample sizes, for all the fleets. Especially, the amount of data for Japanese longline and EPO fisheries decrease significantly, when a higher cut-off point in sample size is adopted. The degree of decrease in the number of data by raising the cut-off points in sample size varies between fleets.

A better result might be obtained from the complexity of the stock analysis model, by wider combinations of data format for each fleet.

Discussion

The Workshop suggested that the followings should be provided in follow-up of this study:
1. Difference of size distribution by year from use of different cut-off points in sample sizes.
2. Comparison of the sum of AIC by fleet-year-quarter.
3. Validity of size data on condition of length class intervals and cut-off points in effective sample size.

- ***ISC/07/PBF-3/10 by F. Muto***

This paper explained the catch record of PBF by Japanese distant water vessels of 20 tons or larger for years 1946-1951. They are available in publications by the Federation of Japan Tuna Fisheries Associations & Society of Japan Tuna Fisheries. At present, these are the best available catch data for Japan’s distant water tuna fisheries in those days. The catch rapidly increased yearly since 1946 to 1950.Catch for 1951 could be underestimated and its reason is being investigated.

- ***ISC/07/PBF-3/11 by F. Muto***

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This paper explained the catches for 9 years from 1935 to 1943 landed in Taiwan. They were estimated by using official and non official statistic records. The catch increased almost yearly, and exceeded 3,000 metric tons in 1943. At that time, the fishing season generally started in April in the South China Sea of western part of Bashi Channel with larger fish over 300kg in weight. The fishing grounds moved and expanded to the east as time progressed and the fish sizes decreased to about 150-200 kg in weight.

- ***ISC/07/PBF-3/12 by F. Muto***

This paper reported the catches by set net in South Sakhalin and Hokkaido. The catches in the South Sakhalin were 195 - 7,857 kg for years 1928–1934, but about 250 metric tons (250,000 kg) were taken in 1945. Fish were taken by salmon set nets, which had been sometimes broken by big catch of large tuna in the nets. Also the catches in Hokkaido by set nets were 1,200 to 3,300 mt for years 1928–1933, and the numbers of the set-nets seems to have been almost stable during that period. The catch trend in Sakhalin was similar to that in Hokkaido, and the schools were considered to migrate to Sakhalin passing through off the west coast of Hokkaido in the Sea of Japan. Feeding of PBF on the northern pelagic baits was observed.

Discussions

The availability of biological information for PBF around Taiwan Island was questioned. It was explained that the fishing season started generally in March, and closed in July. The availability of the fishing area, season, and fish size were also explained. It was also mentioned about non-official information of catch around Luzon Island. Explanation was provided on the general weakness of biological information PBF catch reported from Chinese Taipei in the early days after the Second World War, but also recognized that some literature contains good information that should be examined.

A table summarizing all these early year estimates of catches from these studies was requested, although the Workshop recognized that such a table would contain data of unknown level of accuracy.

- ***ISC/07/PBF-3/28 by F. Muto***

In response to requests from the Workshop, appropriate total catch of Pacific bluefin tuna for years 1894-1950 were tabulated from available data sources from Japan's sources. The approach is the same as Muto et al. (ISC/07/PBF-1/12), using species composition information from SID report for year 1951.

Discussion

Explanation was given that the species composition table is considered the best available one, but covers only one year. Therefore there is some possibility of under- or overestimating catches. Also explained was that the data were restricted to cover only 7 prefectures for early years. Therefore there is a high possibility of under estimation.

5.2.2.3. CPUE (Rapporteurs; K. Yokawa*, H. Yamada, M. Ichinokawa)

- ***ISC/07/PBF-3/18 by M. Ichinokawa***

This paper updated standardized CPUE of PBF caught by Japanese coastal longliners as an abundance index for the use in the stock assessments of PBF. This paper used the data of Japanese coastal longline logbook, and the data set used in the previous analysis of ISC PBF-WG/07-1/15. The method used for the standardization is the same as that used in the previous analysis: delta-type two-step model, and incorporation of ship name as random effect in the 1st step. The estimated annual trend of standardized

CPUE is constant or slightly fluctuated during 1994-1998, followed by decreases from 1999 to 2001, then increased by 2005, and dropped in 2006. The updated trend of PBF CPUE was very similar with that presented in the previous analysis. Although rapid drop of CPUE in 2006 became slightly moderate in the updated CPUE, the value in 2006 is still a half of that in 2005. Nominal CPUE of PBF in 2006 was decreased in the nearly whole area of the main fishing ground for the spawning population of PBF. Weight and length composition indicated that smaller sized fish were especially decreased in 2006 catch, compared with that in 2005. The cause for the changes of size compositions from 2005 to 2006 and the sudden drop in CPUE in 2006 should be further investigated in relation to the current status of the spawning population of PBF.

Discussion

This analysis used the ratio of total catch in number of PBF to that of bigeye tuna catch as a factor to define target species for individual vessel-trip, but the threshold to distinguish targeting or non-targeting was subjectively determined. Although species compositions of catch by vessel-trip might be useful information providing some clues for revealing target species of each ship, it should be used after careful examination of the definition of the threshold. A suggestion was made that an objective ratio might be sought using sensitivities by changing different criteria for separations

Possible use of albacore catch for determination of target species was also discussed, but Workshop agreed that albacore catch would not appropriate because spatial distributions of PBF and albacore are different especially in the 2nd quarter. In addition, there was the discussion about the fact that the interaction effect of year and area was significant in the binomial model. It was addressed that the previous analysis (ISC/07/ PBF-1/16) showed the possibility that annual CPUEs from different two areas (south-west and north-east of the main fishing ground) represent abundance trends of PBF in different age classes. Referring to the previous document (submitted in the previous Workshop), a rapid drop in CPUE in 2006 was observed in the trends from both areas. Workshop suggested comparing annual trends of CPUE derived from other fishery data such as Mexico, for the validation of those CPUE.

- ***ISC/07/PBF-3/16 by K. Oshima***

ISC/07/PBF-1/17 indicated that significant operational changes have occurred after 1960’s in the fishing ground of PBF by the Japanese longline fishery. Therefore, in this study the shorter-term CPUE was estimated rather than long term, since a reasonable consistency of the operational pattern was recognized for the shorter-term series. Two segments of CPUE series for 1960-1980 and 1988-2002 were estimated using logbook data obtained from the fishing operations in the main fishing grounds of PBF. The logbook data by the gear configuration of 5-12 and 13-22 hooks per basket (HPB) were used for standardizing CPUE. Delta-type two-step method was applied for standardizing CPUE. Stepwise model selection was conducted based on AIC and BIC. For 1960-1980, year trends of standardized CPUE did not differed from that of nominal CPUE. Additionally, annual change of CPUE estimated in this study differed markedly from that estimated by the previous study, especially after 1975. Regarding CPUE of 1988-2002, there were no obvious differences in year trends between standardized CPUE and nominal CPUE. After the late 1980’s, operations by the HPB of 13-22, as called “deep longline”, became main operational configuration in main fishing grounds of PBF. Therefore, CPUE derived from that type of operations might be available as an index of adult PBF after the late 1980’s, but the number of operations has significantly decreased since 2000.

Discussion

Some participants asked clarifications on differences of the database currently used from that used in ISC/07/PBF-2/18. It was noted that ISC/07/PBF-2/16 used the logbook data by offshore and distant-water longliners of over 20 GRT, while ISC/07/PBF-2/18 used logbook by coastal longliners of 10-20 GRT which started logbook system only from 1994. The difference between the results from AIC and BIC was also questioned. It is difficult to determine the best one between the two models from AIC and BIC because the two models have different structures. The procedure for determining the definition of area strata is also questioned. Considering differences between species compositions during 1960's and 1970's, it is suggested that CPUE series during 1960s and 1970s is standardized separately. Information paper 1 was prepared and presented in response to this query.

- ***ISC/07/PBF-3/25 by K.Yokawa***

Abundance index was estimated using the logbook data of Japanese offshore and distant-water longliners in the major fishing season of the Kuroshio frontal area, which is the second largest fishing ground of PBF for the Japanese longliners. The indices were estimated for the period of 1952 – 1975 and 1975 – 2006 separately, as the information about hooks per basket is lacking until 1974. Though the data coverage used in this study was relatively low, the stable pattern of the species compositions in the selected areas and seasons used in this study appears to warrant the reliability of the estimated abundance indices, especially in the period before 1975 when the data has no information about target species.

The yearly trend of the estimated indices was quite comparable in the period of 1994–2006 with the one estimated using data of Japanese coastal longliners targeting PBF spawning aggregation. The higher CPUE for shallow sets than deep sets were reasonably comparative, when compared with the vertical distribution probability of PBF. These are possibly due to the recent increase in data coverage used in this study, and probably indicating that the trend of the indices estimated in this study reflects the dynamics of the adult bluefin tuna.

Discussion

There were discussions whether or not the relatively lower coverage of set records (areas 3 and 4, quarters 1 and 4), used in this study, gives better indices than larger sample from the fisheries (areas 1 and 2, quarters 2 and 3, inclusive), which varies in target species. It was recognized that choice is a kind of trade off and have to be considered with much care.

Later, some additional analysis was presented (Information paper No. 4). Trends of CPUEs included comparisons of the runs where areas 1-4 and all quarters were included, with the current study, i.e. only areas 3 and 4 for 4th and 1st quarters are used. The results of comparisons showed that there are very little differences in tendencies but there are some significant differences in magnitude of fluctuations.

In order to evaluate the usefulness of various CPUE series, it was suggested to list some diagnostics, e.g. what strata are adopted and how many strata for which data are available, catch and effort in strata and sample sizes etc. for the series. Also the comparisons between indices and nominal CPUE might be one criterion to judge the use. In order to do all these, it was proposed to provide the standardized CPUE series in value in a regular basis (see Appendix 5 for summary check list and Appendix 7 for diagnostics).

- ***ISC/07/PBF-3/26 by K. Yokawa***

The dynamics of PBF stock implied by the historical trends of the abundance index estimated by ISC/07/PBF-3/25 is investigated. Analysis of the catch and effort data of Japanese offshore and distant-water longliners indicates that they conducted fishing operations actively in the major fishing ground of the PBF in the period well before the1958 in which year the abundance index increased sharply. Also, no drastic change in the operation pattern of Japanese longliners was observed during the 1950s. The bluefin tuna catch by Japanese longliners showed general increasing trend in the period between 1948 and 1952, and leveled off thereafter in spite of the increase of the effort amount in the northwest Pacific. These facts strongly indicates that catch and effort data of Japanese offshore and distant-water longliners already had enough amount of information to estimate the level of abundance in the early 1950s and hence the high CPUE recorded in 1958 is not a high value of the initial exploitation of virgin stock when the fishery started but reflecting the temporal fluctuation of the abundance of the stock.

Length compositions of the bluefin tuna caught by Japanese longliners in the 1st and 4th quarters in the Kuroshio frontal area had changed, in the years when the increase of the abundance level was observed, but these returned to normal the years thereafter. The length compositions in the high abundance years were characterized by the narrower range of fish size and the dominance of the relatively large sized individuals. The unusual fluctuations of abundance in such a short period and the unique change in the length compositions during this period seemed to indicate that the temporal increase of the abundance in 1959–1962 had been caused by the very strong year classes that passed through this period.

Even if the strong year classes had occurred, the relationship between the estimated abundance index and the trend of total catch suggests that these strong year classes had not contributed to the increase in the consequent recruitments so much. Because current stock assessment did not take into account the spawner-recruitment relationship, it is possible that this is the cause of failure in showing such phenomena. Therefore, new abundance index was estimated by eliminating the data in the temporal high CPUE period (1958 through 1962, inclusive).

Discussion

The time series of data presented by the fishing year and calendar year were mixed in this documented, and it should be clarified. In response, revised figures were provided later.

- ***ISC/07/PBF-3/24 by M. Kanaiwa***

Changes in logbook formats and information on target species can affect on error distributions of catch data and may vary the trend of indices of stock abundance estimated from standardized CPUE even if the level of true stock abundance does not change. It is very difficult to identify which change of logbook format and/or target species affect on error distributions. Therefore, some method is required to seek for clustering a time series data with the similar level of error distributions.

A simple cluster analysis for the time series data of the Japanese distant water and offshore longline was attempted to explore such clustering by year. Coefficients of variations in logarithm of nominal CPUE of albacore and PBF were used as distance factors. This method could find clusters of data with classification in some effective points of the years when changes in data were caused by modification of logbook format. Especially, the early 1970s and 1990 seemed to be such years of classification. However, more evaluation of performance and comparisons with other models which have more statistical advantage are required to investigate more detail.

Discussion

The Workshop recognized that such kind of objective classification method be used to determine appropriate segmentation of time series. A suggestion was made that variance or standard errors are used instead of CV, if log-transformed CPUE is analyzed.

- ***ISC/07/PBF-3/17 by H. Yamada***

The standardized CPUEs of age-0 PBF from Japanese troll fisheries data in the previous PBF Workshop were updated with additional data of 2006. However, those from Kami-Tsushima in Nagasaki Prefecture were eliminated because data were no longer available. Two CPUE series were estimated for the East China Sea and the Pacific Ocean. Large yearly fluctuations of CPUE were observed in both waters. Higher CPUEs in 1994 were observed in the both areas, although there was no consistency in both CPUE trends after 1997, but showed almost mirror reflections for 1997–2001 and 2004-2006. These differences may be due to the oceanographic conditions affecting juvenile transportation to the East China Sea and the Pacific Ocean from the spawning ground around Ryukyu Islands. It was discussed that the possible effect of changing target species may require some investigation especially in the Pacific Ocean where fishermen tend to change their target species depending on the fishing conditions of PBF and other fishes.

Discussion

The Workshop discussed that if the high CPUE in 1984 can be also found in the results of the VPA estimation of stock size made in previous analysis in 2006, It seems that there were co-incidence in 1994 year class which is known to be one of the historically strongest year class of PBF to CPUE but there was no signal of a strong year class for 1984 from VPA results of 2006.

5.3 Criteria and decisions

5.3.1. Biological information (Rapporteurs: H. Honda*, T. Tanabe, J. Childer, Y. Aonuma)

- ***Stock structure***: Single stock is assumed for the entire Pacific stock.
- ***Spatial structure***: Single area structure should be used for spatial structure because quantitative data are not fully available to estimate spatial structure.
- ***Recruitment***: Single Recruitment to occur once a year on July 1st (beginning of the 3rd quarter)
- ***Maturity at age or length***: Maturity at age or length is continuously assumed that 20% maturity at age 3, 50% at age 4 and 100% at age 5. Some spawning of age 3 fish in the Sea of Japan are observed but no information on the relative size of stock between the Pacific and the Japan Sea is available.
- ***Timing of spawning***: Spawning is assumed to occur once a year in 2nd Quarter. Specification of the timing of the spawning is not specified by the lack of data and information.
- ***Age and growth***, Growth curve parameters should be fixed or estimated and agreed before it is used in the assessment: The Workshop noted that more discussions would be needed for the selection of a growth curve in May, 2008 meeting.

The growth formula presented at this time, combining the results of otolith and vertebrae ring counts appear to estimate a better growth curve than the previous ones. Additional specimens are available and it is intended that at least those otolith specimens will be analyzed before the end of March, 2008, to see if the curve can be further improved. A provisional schedule for further sampling and processing of age structure was proposed by the NRIFSF. NRIFSF will try to use only otolith ageing, but when the results for younger ages are not consistent with the other studies, then it will consider the use of the supplemental data from vertebral ageing. There are some vertebrae taken from the same specimens from which otolith were taken. These can be used to make evaluation of two kinds of aging accuracy. However, the analysis of these data will be left for future studies.

The Workshop decided that the conceptual smallest size individual (L_0) is set at 30cm at the beginning of the 3rd Quarter (July 1st).

- ***Natural mortality***: For detailed discussion, see Appendix 7.

The following PBF natural mortality vector (M) should be used:

a. Age 0; M=1.6 yr^{-1} based on PBF tagging data (Takeuchi and Takahashi 2006)
b. Age 1; M=0.46 yr^{-1} based on SBT tagging data (Polacheck et al. 1997)
c. Age 2; M=0.27 yr^{-1} based on SBT tagging data (Polacheck et al. 1997)

d. Age 3; M=0.2 yr^{-1} based on linear interpolation between ages 2 and 4+
e. Age 4+; M=0.12 yr^{-1} based on the mean adult M used for SBT
f. Sensitivity runs about the above M vector are encouraged.

- ***Length-weight relationship***: For the weight-length relationship, the equation shown in document ISC/07/PMF. 3/07 (Table 2 case A additive error structure model) will be used as follows. $W(kg)=1.7117 \times 10^{-5} FL(cm)^{3.0382}$ As input data, this will be used conditionally. For Chinese Taipei fisheries data, the Workshop noted that only catch in number at age data are available and that the above length-weight relationship will be used to estimate the catch in weight of Taiwanese fisheries if the updated catch in number of Taiwanese fisheries are made available, otherwise the subject on the length-weight relationship will be reconsidered.

5.3.2. Fisheries Data (Rapporteurs; N. Miyabe, K. Yokawa, R. Conser, Y.Takeuchi)*

Definition of fishery: The quarterly catches were updated for Japanese, US and Mexician fisheries. It was confirmed that these quarterly catches are consistent with the annual catches in Appendix Table 1. List of fisheries and catalogue of data be used in the SSII model are provided in Table 3.

- ***CPUE series to be used:*** A table was prepared that list all CPUE data series identified by the participants (Appendix 5). For each series, characteristics were also documented (Appendix 6). The checklists for the quality and reliability of each index were prepared by authors of the series. Figures 2a, 2b and 2c compares the various series of indices.

5.3.3. Conclusion

The Workshop reviewed the data, results of analyses and available fishery information and drew the following conclusions:

- **The EPO fisheries**: US purse seine fishery targeting PBF (1960-1982) is selected as the preferred index and Mexican opportunistic purse seine fishery (1960-1998) is selected as the secondary. All other fisheries are used only for the sensitivity analysis.

- **The Western Pacific: I**ndex for the small PBF fisheries selection should be made between Japanese troll fishery indices data set for the East China Sea alone or those for both in the East China Sea and northwestern Pacific. The selection should be left for model to decide based on the consistencies of these series with series for other fisheries.

  ✓ **Longline fishery (large PBF)**
  There were separate opinions as to which CPUE series would be the best to use. As no definite criteria for decision can be found, the preferred index series was selected as follows, based on the technical reason of the applicability as input data to the SSII model

  1952-1993 period: the Japanese offshore and distant-water longline indices in the major fishing ground (Info 1 Japan LL/offshore and distant-water in the Appendix Table). The CPUEs for the periods of 1952-1974 and 1975-1993 should be used as two separate series.

  1994 and later; the Japanese coastal longline data series will be used (ISC/07/PBF-3/18 Japan LL/Coastal/set-by-set)

  ✓ **As the secondary index:** For second quarter 1993 and earlier, the series from the Japanese offshore and distant-water longline in spawning area & season (ISC/07/PBF-3/16 Japan LL/offshore and distant-water/set-by-set)

For second quarter, 1994 and later; Japanese coastal LL.

For other quarters for all years: Japanese offshore and distant-water longline in Kuroshio frontal area (ISC/07/PBF-3/25 Japan LL/offshore and distant-water/5o-month)

Chinese Taipei longline indices will be used.

“Preferred index” and “secondary index” are tentative categories used in the selection process and do not refer to the real significance of the series.

It was recognized that significant efforts by all Workshop members went into developing the CPUE index series and the indices are the best available.

- **Length bin definitions** A proposal was made to use the bin as defined previously by Piner (ISC/06/PBF/19), but start minimum length bin from 16 cm instead of 20 cm to better incorporate the growth of small fish. Maximum length was 290 cm but the length bins are set by 2 cm, 4 cm and 6 cm for the length of 16-58 cm, 58-110 cm and 110-290 cm. 2 cm length interval was used in the preparation of all the size data so that different length interval can be easily prepared.

- **Effective sample size (maximum and minimum)** It was agreed that for the Japanese fisheries maximum and minimum sample sizes were set at 200 and 100, respectively. This means size samples less than 100 measurements would be excluded from the analysis, while for more than 200 measurements the maximum number would be reduced and set at 200. It was noted that there are some Japanese fisheries for which size data are not directly used (e.g. set net fishery and other fisheries whose size data are separately raised by commercial categories). However, for the EPO PS fishery, as an effective sample size, the number of wells from which size samples are taken was suggested to be used. For the recreational fishery, catch per trip can be considered as sample size. Minimum sample size for these fisheries should be specified as well. For Japanese small pelagic purse seine fishery, minimum of 100 and maximum of 200 was suggested. In the case of longline data during 1970’s and 1980’s when size samples are very scarce, these sample size requirements need to be relaxed.

- **Time step** The quarterly time step will be used for the next assessment.

6. NON-DATA RELATED SS II SPECIFICATIONS AND ISSUES

6.1 Stock projection methodology (Rapporteurs; M.Ichinokawa*, R.Conser, M.Kanaiwa)

- ***ISC/07/PBF-3/21 by M. Ichinokawa***

The paper presented brief review of the methods for future projections potentially available for the application of stock assessment of PBF by SS II. While PBF Workshop agreed to use SS II rather than tuned VPA in the next stock assessment, projection methods that can carry uncertainties of parameters estimated from SS II are limited because of the limitation of time and computer resources. This document compared the results of future projections produced from normal approximation based on delta-method by SS II with those from stochastic projections similar with that used in the previous stock assessment. Sample data for test-run of SS II and future projection was derived from that submitted in the previous analysis, and model configurations were from ISC/07/PBF-3/22. While average values of future statistics generated from SS II and stochastic projections were same, statistics calculated from probability distributions of the focused future values (such as percentiles of SSB and F_{ssb}) were different. This result suggested that SS II projections might not be appropriate to deal with the reference point based on future probability distributions. It is noted that future statistics available for future projections are depending on the methods for future projections. In addition, considering possible overestimation of the terminal F in SSII with the current sample data, definition of 'current F' should be carefully done after enough evaluation of error structures of the model and discussion. The assumption for future recruitments also affected results of future projections with this sample data, which is another issue to be determined.

Discussion

Before determining specifications for the projection runs and evaluation, some technical terms used in the document were clarified. The method used for future projections in the next stock assessment would be practically depending on the time schedule of the stock assessment work because the presented document showed trade-off between the time for calculations and accuracies for estimating probability distributions of statistics. A participant suggested an idea that stochastic projections from parameter uncertainty estimated with normal approximation and delta-method to save the time for estimating uncertainty of parameters in SSII with MCMC or bootstrap. However, it is impossible because approximate variance of catch and numbers at age, which are needed for conducting stochastic projections, were not calculated in the current version of SSII. Other discussion about specifications for future projection runs were listed below.

Conclusion

- **Assumption for the current F**
  1. Postpone the issues to the next meeting after detailed examination of error structure:
     - ✓Bootstrap and retrospective analysis can provide the clue to evaluate uncertainty of the estimates in the end year
     - ✓The updated data for the stock assessment may produce reasonable and unbiased F in the terminal year (because sample data will be updated and improved)
     - ✓Setting F ballpark may make F at the end year smaller (and less biased)

  2. Determine the following issues during this meeting:
     - ✓How many of the recent F will be removed from the analysis; how many should be averaged as the current F, etc?
     - ✓What program will be used for projections with the defined current F? Note that projections with arbitrary defined current F are difficult to handle in SS II.

Decisions

"Drop the terminal year and average the 3 previous years" will be used for the default option. In addition, "average F from last 3 years" and "drop last 3 years and average the 3 previous years" will be tried as options. This decision is only preliminary, and the final decision will be made after retrospective analysis and/or other evaluation of uncertainty of parameters. Future projections from retrospective results might be also useful to determine the definition of current F.

- **Assumption for recruitment**
  1. Lognormal random recruitment (because no spawner recruitment relationship can be observed in the current model)
  2. Random sampling from the historical number of recruitments
  3. Any spawner recruitment relationships (even if the relationship can't be observed in the stock assessment model) * lognormal deviation of recruitments

Decisions

All scenarios may be tried. Estimated recruitment in the terminal year should be dropped for all "current F" options. Investigation of the years to be dropped will be needed. When dropping the most recent F, the actual catch and estimated recruitment during the dropped years will be incorporated into the future projections

- **Statistics required for status evaluation**
  1. Projection average values and their SD for spawning biomass, recruitments, depletion, total catch, catch by fishery, total F, F by fishery.

2. Some benchmarks
3. Reference points involving probability distribution of future statistics (such as F_{ssb}, Pr(SSB_{future}<$SSB_{observed}$))for some scenarios of F
4. Any other statistics to be referenced for evaluation of current status of the stock?

[Decisions]
In addition to the above lists, point estimates and SD of candidate F reference points should be considered. Basic information such as future average catch, SSB, future F and their associated standard errors and catch by fleets should be shown. In addition, age structure and SS II output statistics will also be informative.

- **Capacity to explore harvest scenarios**
  Constant F, constant catch, combination of constant F and catch, etc.

Decisions
Combination of constant catch (during the period when actual catch is known) and constant F (for future) was recommended as a default setting. In addition, the scenarios of constant catch might be another way. It was also suggested to allocate future catch by fleet. The scenario where some fleets are assumed to have constant catch and the others have constant F may also be desirable.

- **Methodology of future projections (estimated time for calculation)**
  1. SS II & MCMC (more than 1 week)
  2. SSII, simple delta-method (10-20 min including SSII runs with sample data in doc ISC/07/PBF-3/21)
  3. Stochastic projections from point estimates (10-20 min for 1000 replications in addition of the time for SSII runs with sample data in ISC/07/PBF-3/21)
  4. Stochastic projections after bootstrap (48 hours for 150 bootstrap run + about 1 hours for 1000 replications with sample data in doc ISC/07/PBF-3/21)

Decisions
Stochastic projections from point estimates might be realistic, but it is more desirable to explore the practicality of MCMC. If MCMC is not practical due to length runtimes, parametric bootstrapping follow by stochastic projection will be carried out. SS II with the delta-method was not recommended.

- **Others**
  Future projections will be conducted in 20 or 30 years after the terminal year of the stock assessment or until equilibrium is achieved. Methods for evaluating and summarizing future projection results should also be investigated.

6.2 Incorporation of ageing data into the model (Rapporteurs; K. Piner*, M. Kai)

- ***ISC/07/PBF-3/20. K. Piner***

Three methods are available to incorporate age data in SSII. The method of sampling and the model process to be informed are the main considerations in the choice of method. The methods are as follows:

1. Age composition: observation of the proportional numbers of fish at age taken by a fleet/survey time step gender
   - ✓ samples should be drawn randomly from fishery catch
   - ✓ useful to estimate selectivity parameters and relative recruitment strength

2. Mean length-at-age: observation of the average size of fish taken by a fleet/survey time step gender at age
   - ✓ samples should be random from catch or stratified by age (not length)
   - ✓ useful to estimate growth parameters

3. Conditional age-at-length: observation of the distribution of ages at length taken by a fleet/survey time step

gender
✓samples should be random from catch or stratified by length
✓useful to estimate growth and variation in growth
✓useful if size and age information from same fish included in the model

Discussion
The working group considered the method of incorporating age data directly into the SSII model base upon recommendations of the ISC/07/PBF-3/20 working paper. Conditional age-at-length observations will probably be the most appropriate method to model this data internally in the assessment model because samples chosen for ageing were not random samples of the fishery catch. Inclusion of this data will be the most useful if parameters of the length-at-age are estimated internally in the model. It will require investigation of the assessment model to determine if estimation of growth by the assessment model is feasible.

6.3. Changes to initial settings (Rapporteurs; R. Conser*, H. Kurota, M. Kai)

- ***ISC/07/PBF-3/22 By M. Kai***

The paper presented that the effect of the selectivity on estimates of the absolute stock size of Pacific bluefin tuna was investigated using SS2 (version2.0). The authors focused on selectivity of Japanese longline and Japanese tuna purse seine fleets. Both fisheries target relatively large size fish and the length data from 1952 until present are available. A double normal (option 24) was used as a basic selectivity parameterization for both fisheries. The following three scenarios were examined: (A) selectivity of both fisheries are estimated without fixing any selectivity parameters, (B) selectivity of the Japanese longline fleet is estimated with fixing one parameter to produce a flat top selectivity, and the selectivity of Japanese tuna purse seine is estimated under the same assumption as (A), (C) selectivity of Japanese longline and Japanese tuna purse seine fleets are estimated as flat top selectivity by fixing the same parameter as scenario (B). Consequently, domed shape selectivity was estimated for the Japanese longline and Japanese tuna purse seine fleets in scenario (A), and flat-top and domed shape selectivity was estimated for Japanese longline and Japanese tuna purse seine fleets, respectively in scenario (B), and flat-top selectivity was estimated for the Japanese longline and Japanese tuna purse seine fleets in scenario (C). It was clear that the difference in selectivity at large size caused quite different values of the fishing mortality resulted in the different estimates of absolute biomass. This result suggested that the selectively at large size has a strong influence on the estimates of absolute stock size of PBF.

Discussion
A proposal was made to use an asymptotic (flat topped) selectivity for fisheries; which target large sized fish such as longline fishery to the spawning grounds (e.g. Japanese coastal longline) as there were no small fish in the catches.

After completing discussion of all of the fisheries and biological data as well as the general aspects of the modeling, the Workshop focused on the specific structure of the SS II model configuration that best captures the Workshop consensus. Collectively, these settings form the starting point for joint analysis of the Pacific bluefin resource that will begin in January 2008 and culminate at the next ISC Bluefin Workshop meeting in May 2008.

Initial settings
The decisions reached by the Workshop are provided in brief form below.

- **Calendar year or Fishing year:**

Either a calendar year or a fishing year may be used in SS II. The fishing year (FY) will be used for the initial modeling. The FY begins in July and ends in June the following year, e.g. FY06 covers 1 July 2005 and ends 30 June 2006. While in the case of
Mexican fishery, fishing starts in Quarter 2 and ends in Quarter 3. Therefore, for the EPO fishing year would be consi dered to starts in Q2. A calendar year presentation of results may be useful to mangers, but this will only be pursued outside of the main modeling.

- **Terminal year**

The final or terminal year in the assessment will be FY06 (as defined above).

- **Ages**

The model will be structured using 20 distinct ages (ages 0-19) and an age 20+ group. Other age also will be considered for sensitivity run.

- **Weighting**

It was generally recognized it must be avoided to overweight any single data set (size frequency and/or CPUE). It was also recognized reweighting by changing variance is not effective means if there is a conflict of data.

- **Effective sample size**

The effective sample size (*n*) for the fisheries with consistent sampling over time will be set to reflect average effective *n* overall years. When significant changes in the sampling programs have occurred, it may be necessary to establish time blocks with associated effective *n* for each block. Effective *n* for the EPO PS fishery will be set to the number of wells sampled and will not be modified using iterative re-weighting. All other fisheries will likely benefit from a limited number of re-weighting iterations. The iterative reweighting of effective sample size will be conducted by each size data for fisheries other than EPO commercial fishery. the linear regression procedure of MacCall et al(1999) linking observed and effective *n* may be an effective means to simplify the re-weighting.

- **CV for CPUE index**

CVs for each CPUE index should be provided to the Chair by the respective WP author before 15 January 2008. Indices with CV > 0.2 will initially enter the model using the CV from the standardization procedure. When CV<0.2, set CV=0.2. If the CV for any index is not provided, set CV=0.2. Iterative re-weighting should be done for the CPUE indices. Use SS II's "extra variance" option assuming additive errors. Great care should be taken not to overweight the size sampling data such that all indices are poorly fit.

- **Selectivity pattern**

Use the SS II length-based selectivity option. The number of parameters used for each selectivity may vary but asymptotic (flat topped) selectivity should be used for both the Japan fisheries.

- **Catch equation approximation**

Pope's approximation of the Baranov catch equation should be used as it dramatically reduces SS II run times. However, some exploration regarding the effect of the approximation would be useful.

- **MCMC.**

MCMC is the best means to fully capture uncertainty in the results from any given model configuration. However, MCMC run times may be prohibitively long for Pacific bluefin modeling. If so, parametric bootstrapping should be carried out. 200 replications should be sufficient for standard error estimation but considerably more replications (perhaps more than 1000) will be needed to estimate 90% or 95%CIs for parameters. Likelihood profiles should also be estimated for important management parameters (e.g. SSB). However, the delta method approximation appears to produce biased estimates (ISC/07/PBF-3/21) and should not be used.

- **S/R relationship assumption**

For estimation of recruitment (R), the Beverton-Holt S/R option with *h*=1 should be used. For a sensitivity run, use *h*=0.8. It may also be useful to test the SS II (CAGEAN-like) option for estimating R without imposing any S/R assumption. It was suggested that Sigma *r* initially be set at 0.6 and that 1-pass re-weighting be done.

- **Estimation of initial age structure**

Begin estimating recruitment deviations in 1952 or several years earlier if the initial age composition is to be estimated in the model (see next item). Do not use the recruitment dev estimate in the terminal year (FY06).

- **Start year**

The starting year for the model should be 1952. Given the historically large catches (ISC/07/PBF-3/28), it will be desirable not to assume the bluefin population was in equilibrium prior to 1952. It may be possible to simply estimate the population numbers at age in 1952 (without assuming equilibrium). Should this prove problematic, however, it will be necessary to model the early population with some equilibrium catch level prior to 1952. Appropriate catch levels for the 5-yr and 10-yr period prior to 1952 should be developed for both the EPO and the WPO.

- **Exploitation rate penalty**

The SS II maximum exploitation rate penalty should be set at 0.9. However, if this penalty is engaged frequently, the "F Ballpark" should be explored as an alternative.

- **National mortality. See Appendix 7 for Workshop discussion and decision for natural mortality**

The following Pacific bluefin natural mortality vector (M) in annual basis should be used:

- ✓ Age 0; M=1.6 yr^{-1} based on PBF tagging data (Takeuchi 2006)
- ✓ Age 1; M=0.46 yr^{-1} based on SBT tagging data (Polacheck et al. 1997)
- ✓ Age 2; M=0.27 yr^{-1} based on SBT tagging data (Polacheck et al. 1997)
- ✓ Age 3; M=0.2 yr^{-1} based on linear interpolation between ages 2 and 4+
- ✓ Age 4+; M=0.12 yr^{-1} based on the mean adult M used for SBT
- ✓ Unless SSII becomes capable to use age specific M vector, a back-up M vector be used(see 5.3.1)
- ✓ Sensitivity runs about the above M vector are encouraged. In the sensitivity run, CVs (and confidence intervals) of the estimated Ms at age 1 and 2 should be referred from Polacheck et al. (1997), which are 23% (0.26-0.66) and 44-46% (0.04-0.5), respcetively. CV of the M at 0 age is approximately 7.5 to 18 % depending on the different tagging experiments according to Takeuchi and Takahashi(2006)[2].

7. RECOMMENDATIONS, REVIEW OF SCHEDULE AND ASSIGNMENTS (Rapporteurs; K.Yokawa)

The Workshop made various recommendations and suggestions for research items, which can be found in the sections of this report Recommendations for the future medium and long term research are listed as follows: :

7.1 Fishery data:

- Effort to sample size of fish from the U.S. sport fishery to be made by not only the IATTC staff but also by NMFS..

- Investigate the relationships between the catch of large sized PBF caught by Japanese set-net fishery and ocean environmental conditions in order to understand evironmental factors contributing to PBF catches.

- Investigate factors causing changes of size composition of the Japanese coastal longline catch from 2005 to 2006 and the sudden drop of its CPUE in 2006. This could contribute to r evaluating current status of the spawning population of PBF.

- Upgrade the accuracy of estimation of PBF catch for years before 1952 for Japanese waters possibly using old literatures.

- Continue the search and analyze especially old literature and other information in Japan and other areas of data on pre-1951 fisheries.

- Continue and possibly intensify the biological researches which are being carried out in Yaeyama Archipelago on adult and larvae of PBF.

[2] CVs were not originally shown in Takeuchi and Takahashi (2006). They were provided by the authors.

- Estimate the quarterly catches in the South Pacific, for example, the information on fishing season (around August?) in New Zealand should be obtained.

7.2 CPUE related issues:

- Explore criteria based on the proportions of PBF catch by trip to select the PBF target data. for EPO fisheries.

- Use aerial spottier pilot support information (presence/absence and type) to better quantify the PBF targeted effort in EPO fisheries

- Standardize CPUE series for the Japanese longline fisheries during the 1960s and 1970s separately, considering differences between species compositions for those periods in the main fishing ground of offshore longliners in the 2^{nd} quarter.

- Conduct sensitivity analysis on the criterion to discriminate target and non-target cruise/ship for both EPO and Japanese longline.

For the Japanese offshore-distant-water longliner, improve the abundance/biomass indices, from the view points of selecting most representative data set, time/area, model for standardization. One of the criteria in selection should be on the consistency to the assumptions made in the stock assessment model.

- To collect size data separately from the Japanese coastal longliners and offshore and distant-water longliners.

7.3 SSII related issues:

- Introduce ageing information into SSII

- If the ageing information is included in the assessment model as a likelihood component, it should be used as conditional age-at-length observations.

- Try more detailed (complex?) future harvest scenarios, such as allocation of future catch by fleet, and constant catch for some fleets and constant F for the others, since the currently available projection software is not capable to do so.

8. OTHER MATTERS (Rapporteurs; O. Sakai*, Y. Takeuchi)

8.1 FTP site and real-time exchange of information

It was announced that a wiki website for exchange of information of the next stock assessment was created at a server in NRIFSF. Current wiki website is not capable to facilitate assessment data exchange for ISC PBF Workshop. This website will have limited and secured access. The Chair indicated his plan to upgrade wiki website to allow assessment data exchange soon. The Chair requested each party to provide global IP address of address of each institute to set up access permission from each institute. The wiki website is scheduled to be accessible around Jan. 15, 2008. The US delegation indicated that they already established a FTP site for assessment data exchange for PBF Workshop in case assessment data exchange at the wiki website is unavailable. NRIFSF also indicated that they established SFTP site for a backup plan of assessment data exchange at wiki website.

8.2 Arrangement for May 2008 Workshop

It was decided that an informal style meeting of the Workshop to deal with stock assessment model issue will be held on 21 to 27 of May, 2008 and the Workshop meeting will be held on 28 of May to 4th of June. 2007. The meeting venue was agreed to be again at the NRIFSF in Shimizu. It was agreed that the Chair will appoint a group of scientists in the Workshop to formulate the task group for the meeting from May 21 to 28 with his explanation of the formulation of the task group when the announcement of May 2008 Workshop are circulated.

8.3 Other matters

Some participants requested that working papers should not be placed where the public can have access to them since some of them would be submitted for official publication at a later time. In response to this request, the ISC Chairman explained that there is already a rule on this point and suggest to refer to that rule.

9. ADOPTION OF REPORTS AND CLOSURE (Rapporteurs; Y. Takeuchi)

The draft report was adopted with the understanding that the Chairman and Head Rapporteur would work on editing the draft before distributing a final version. The meeting was adjourned on December 18 with acknowledgement of thanks from participants to Y. Takeuchi and the NRIFSF for hosting a successful Workshop.

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Figure 1 Comparison of the Japanese total Pacific bluefin tuna catches between revised and previously estimated catches by the PBF Workshop. Tuna purse seine catch are excluded.

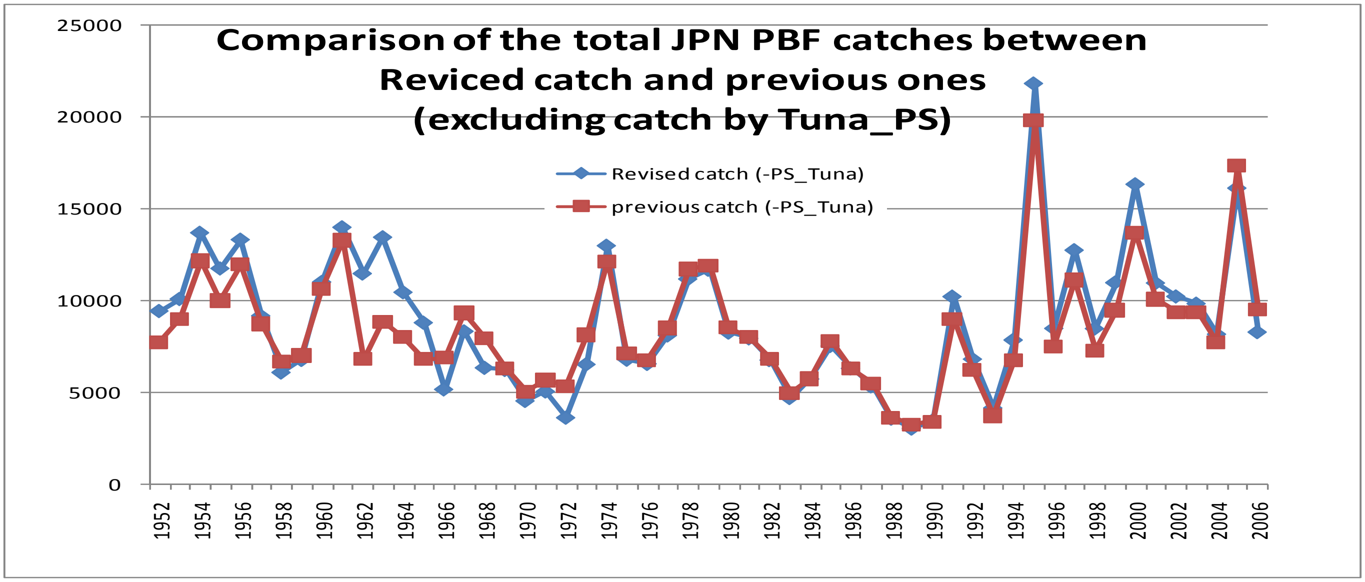

Figure 2a. CPUE series developed by participants.

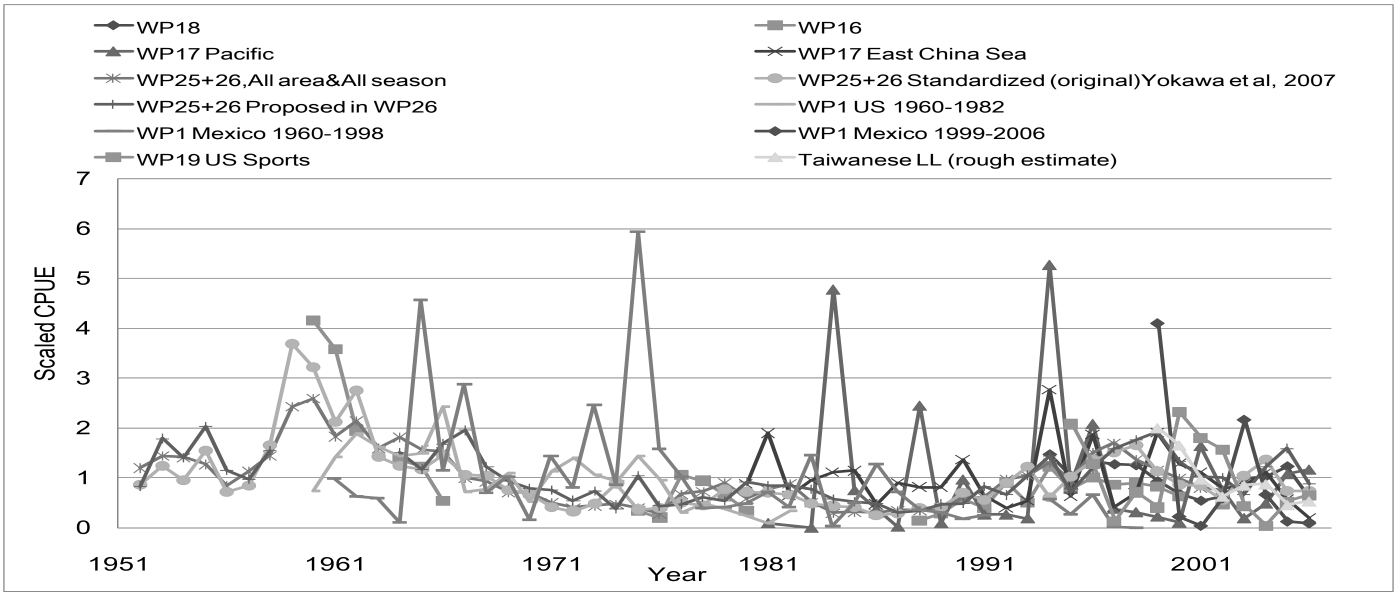

Figure 2b. Comparison of CPUE series for longline fisheries.

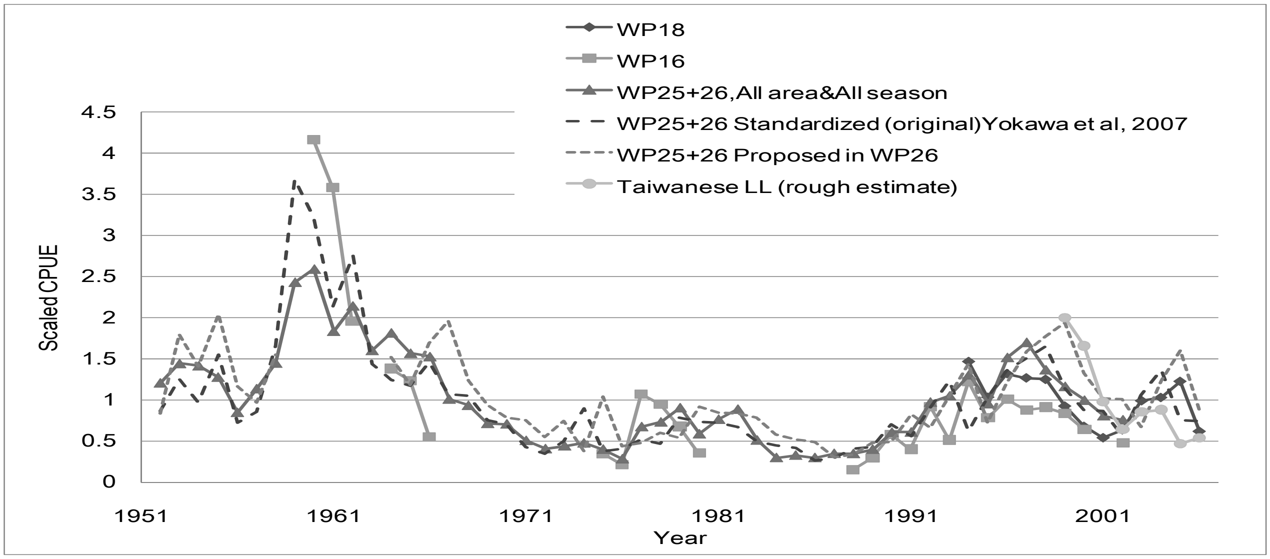

Figure 2c Comparison of CPUE series for surface fisheries, western and eastern Pacific.

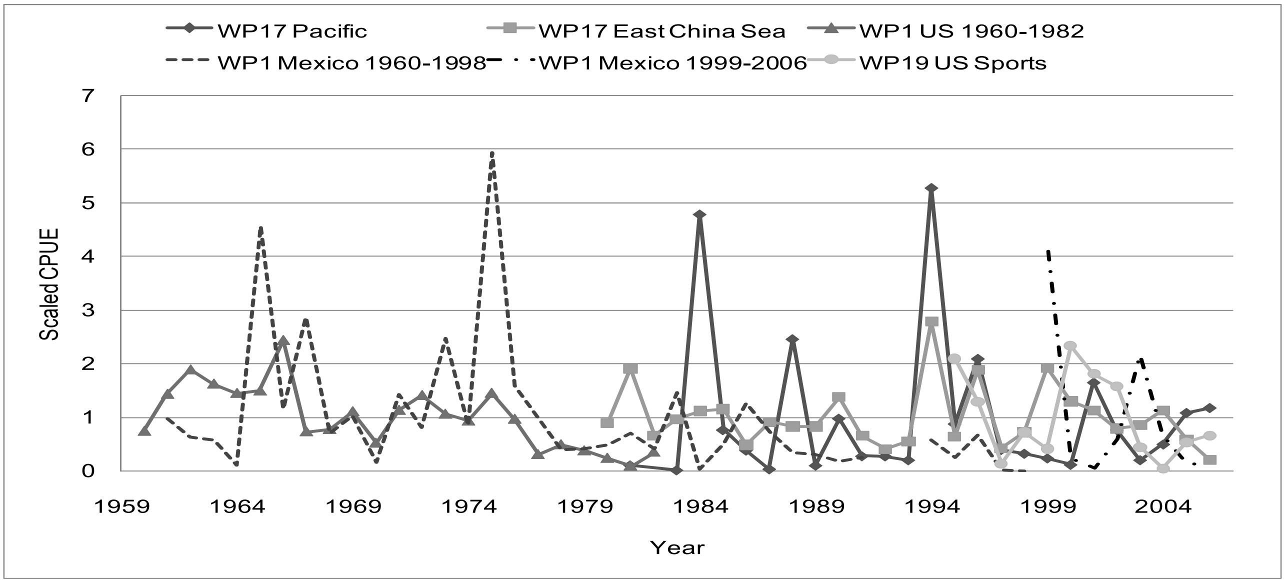

Table 1, Number of fish measured by IATTC in sport fishery samples

Sum of fish measured	
Year	Total
1992	40
1993	1260
1994	293
1995	750
1996	240
1997	409
1998	683
1999	723
2000	3968
2001	6578
2002	2713
2004	255
2005	109
2006	670

Table 2 Annual basis natural mortality vector to be used in the next stock assessment
"Age specific" vector should be used if SSII becomes capable to use annual age specific natural mortality vector. If SSII remains capable of M vector of two linearly interpolated line, the "back-up plan" vector will be used

Ages	0	1	2	3	4	5	6	7	8	9	10+
Age Specific	1.6	0.46	0.27	0.2	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Back-up plan	1.1	0.8	0.5	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12

Table 3 Summary of available catch and size frequency data by fisheries to be used in the SSII assessment model

Country	Fleet	Temporal Coverage of annual catch data	Temporal coverage of q. catch data	Quality of q. catch estimates	(Unit Number or weigh)t	Size data weighted by catch	Temporal coverage of size data	Initial SSII fleet	**Updated SS**	Assigned Season	Note
Japan	longline (Distant &offshore)	1952-	1952-	good	Weight	N	W(1953-1993) L(1994-)	FL1(JLL)	**FL1(JLL)**		_There is no distinct size sampling between distant & offshore LL and coastal LL
	longline (coastal)	1969-	1994-	good	Weight	N		FL1(JLL)	**FL1(JLL)**		
	small pelagic fish purse seine	1981-	1994-	good	Weight	Y	L(1997-)	FL2(SPPS)	**FL2(SPPS)**		
	Tuna purse seine	1952-	1952-	good	Weight	N	W(1952-1993), L(1994-)	FL3(TPS)	**FL3(TPS)**		
	Troll	1952-	1981-	fair	Weight	N	L(1994-)	FL4(TR)	**FL4(TR)**		
	Set net	1952-	1994-	fair	Weight	N	L/W (1994-)	FL6(SN)	**FL6(SN)**		
	Pole & line	1952-	1994-	fair	Weight	N	W(1953-1993), L(1994-)	FL5(PL)	**FL5(PL)**		
	Drift net	1952-	-1993		Weight	N		FL9(Other)	**Fl5(PL)**	Q3	Size data are available for 1980 3rd qtr and 2000 4th qtr.
	Angling	1952-	N		Weight	N	L/W (1994-)	FL9(Other)	**FL10(Other)**	Q4	
	trawl	1952-	N		Weight				**FL10(Other)**	Q4	
	Other longline	1952-	N	Good	Weight	N	L/W (1994-)	FL9(Other)	**FL10(Other)**	Q4	
	Unclassified	1952-	N		Weight				**FL6(SN)**	Apply seasonal proportion of Jpn SN	

Korea	Purse seine	1982-	2002-	Y	Weight				**FL2(SPPS)**		Information of quarterly catch from Japanese import statistics is available since 1988
	Trawl	2000-	N	N	Weight				**FL2(SPPS)**	Apply seasonal proportion of Korean PS(2002-2006)	
Chinese-Taipei	longline	1965-	Y	good	Number (if available)	close to Y	L(1993-2004)	FL8(TWLL)	**FL7(TWLL)**		
	Purse seine	1983-1993	N		Weight			FL8(TWLL)	**FL3(TPS)**	Q2	
	distant drift net	1982-1992	N		Weight			FL8(TWLL)	**FL5(PL)**	Q3	
	others	1974-2002	N		Weight			FL8(TWLL)	**FL5(PL)**	Q2	
United States	Purse seine	1952-	Y	good	Weight	Y	See note	FL7(EPO)	**FL8(EPO COM)**		_ Size data of EPO sports fishery is available since 1992 _ Country specific EPO commercial catch until 1958 were not available
	Others	1952-	Y	good	Weight	Y	See note	FL7(EPO)	**FL8(EPO COM)**		
	Sport	1952-	Y	good	Number or weight	N		FL7(EPO)	**FL9(EPO SP)**		
Mexico	Purse seine	1952-	Y	good	Weight	Y	See note	FL7(EPO)	**FL8(EPO COM)**		
	Others	1952-	Y	good	Weight	Y	See note	FL7(EPO)	**FL8(EPO COM)**		
EPO Other		1952-	Y from IATTC	good	weight	Y	See note		**FL8(EPO COM)**		
Other	NZ	1991-	?	?	Weight				**FL7(TWLL)**	Q3	
	Other	2002-	?	?	Weight				**FL7(TWLL)**	Q3	

Table 4. *Catch (m tons) of Pacific Bluefin Tuna country and gear*

Unit:Metric ton

Year	Western Pacific States															
	Japan									Korea***		Chinese Taipei				Sub Total
	Purse Seine		Dist. & Off. LL		Coastal Longline	Troll **	Pole and Line	Set Net	Others	Purse Seine	Trawl	Longline ****	Purse Seine	Distant Driftnet	Others	
	Tuna PS	Small PS	NP*	SP*												
1952	7,680		2,694	9		667	2,198	2,145	1,700							17,094
1953	5,570		3,040	8		1,472	3,052	2,335	160							15,636
1954	5,366		3,088	28		1,656	3,044	5,579	266							19,027
1955	14,016		2,951	17		1,507	2,841	3,256	1,151							25,739
1956	20,979		2,672	238		1,763	4,060	4,170	385							34,268
1957	18,147		1,685	48		2,392	1,795	2,822	414							27,302
1958	8,586		818	25		1,497	2,337	1,187	215							14,666
1959	9,996		3,136	565		736	586	1,575	167							16,760
1960	10,541		5,910	193		1,885	600	2,032	369							21,531
1961	9,124		6,364	427		3,193	662	2,710	599							23,078
1962	10,657		5,769	413		1,683	747	2,545	293							22,107
1963	9,786		6,077	449		2,542	1,256	2,797	294							23,201
1964	8,973		3,140	114		2,784	1,037	1,475	1,884							19,406
1965	11,496		2,569	194		1,963	831	2,121	1,106			54				20,334
1966	10,082		1,370	174		1,614	613	1,261	129							15,243
1967	6,462		878	44		3,273	1,210	2,603	302			53				14,825
1968	9,268		500	7		1,568	983	3,058	217			33				15,634
1969	3,236		313	20	565	2,219	721	2,187	195			23				9,479
1970	2,907		181	11	426	1,198	723	1,779	224							7,448
1971	3,721		280	51	417	1,492	938	1,555	317			1				8,773
1972	4,212		107	27	405	842	944	1,107	197			14				7,854
1973	2,266		110	63	728	2,108	526	2,351	636			33				8,821
1974	4,106		108	43	3,183	1,656	1,192	6,019	754			47			15	17,124
1975	4,491		215	41	846	1,031	1,401	2,433	808			61			5	11,332
1976	2,148		87	83	233	830	1,082	2,996	1,237			17			2	8,716
1977	5,110		155	23	183	2,166	2,256	2,257	1,052			131			2	13,335
1978	10,424		444	7	204	4,517	1,154	2,546	2,276			66			2	21,642
1979	13,881		220	35	509	2,655	1,250	4,558	2,429			58				25,595
1980	11,327		140	40	671	1,531	1,392	2,521	1,953			114			5	19,693
1981	25,422		313	29	277	1,777	754	2,129	2,653			179				33,532
1982	19,234		206	20	512	864	1,777	1,667	1,709	31		207		2		26,228
1983	14,774		87	8	130	2,028	356	972	1,117	13		175	9	2		19,670
1984	4,433		57	22	85	1,874	587	2,234	868	4		477	5	0	8	10,655
1985	4,154		38	9	67	1,850	1,817	2,562	1,175	1		210	80	11		11,975
1986	7,412		30	14	72	1,467	1,086	2,914	719	344		70	16	13		14,157
1987	8,653		30	33	181	880	1,565	2,198	445	89		365	21	14		14,474
1988	3,583	22	51	30	106	1,124	907	843	498	32		108	197	37	25	7,562
1989	6,077	113	37	32	172	903	754	748	283	71		205	259	51	3	9,707
1990	2,834	155	42	27	267	1,250	536	716	455	132		189	149	299	16	7,067
1991	4,336	5,472	48	20	170	2,069	286	1,485	650	265		342	0	107	12	15,262
1992	4,255	2,907	85	16	428	915	166	1,208	1,081	288		464	73	3	5	11,896
1993	5,156	1,444	145	10	667	546	129	848	365	40		471	1		3	9,825
1994	7,345	786	238	20	968	4,111	162	1,158	398	50		559				15,795
1995	5,334	13,575	107	10	571	4,778	270	1,859	586	821		335			2	28,248
1996	5,540	2,104	123	9	778	3,640	94	1,149	570	102		956				15,066
1997	6,137	7,015	142	12	1,158	2,740	34	803	811	1,054		1,814				21,720
1998	2,715	2,676	169	10	1,086	2,865	85	874	700	188		1,910				13,277
1999	11,619	4,554	127	17	1,030	3,387	35	1,097	709	256		3,089				25,919
2000	8,193	8,293	121	7	832	5,121	102	1,125	689	794	0	2,780			2	28,058
2001	3,139	4,481	63	6	728	3,329	180	1,366	782	995	10	1,839			4	16,922
2002	4,171	5,102	47	5	794	2,427	99	1,100	631	674	1	1,523			4	16,579
2003	945	5,399	85	12	1,152	1,839	44	839	446	591	0	1,863			21	13,236
2004	4,792	2,577	231	9	1,616	2,182	132	896	514	636	0	1,714			3	15,301
2005	3,871	7,389	117	14	1,818	3,406	606	2,182	548	594		1,368				21,914
2006	3,889	3,272	77	16	1,058	1,544	108	1,421	777	949		1,148				14,259

Table 4 (cont'd)

Unit : Metric ton

Year	Eastern Pacific States					Sub Total	out of ISC members		Grand Total
	United States******			Mexico			NZ ******	Others *******	
	Purse Seine	Others	Sport	Purse Seine	Others				
1952	2,076		2			2,078			19,172
1953	4,433		48			4,481			20,117
1954	9,537		11			9,548			28,575
1955	6,173		93			6,266			32,005
1956	5,727		388			6,115			40,383
1957	9,215		73			9,288			36,590
1958	13,934		10			13,944			28,610
1959	3,506	56	13	171	32	3,779			20,539
1960	4,547	0	1			4,548			26,079
1961	7,989	16	23	130		8,158			31,236
1962	10,769	0	25	294		11,088			33,195
1963	11,832	28	7	412		12,280			35,481
1964	9,047	39	7	131		9,224			28,631
1965	6,523	77	1	289		6,890			27,224
1966	15,450	12	20	435		15,918			31,161
1967	5,517	0	32	371		5,920			20,745
1968	5,773	8	12	195		5,989			21,623
1969	6,657	9	15	260		6,940			16,419
1970	3,873	0	19	92		3,983			11,432
1971	7,804	0	8	555		8,367			17,140
1972	11,656	45	15	1,646		13,362			21,216
1973	9,639	21	54	1,084		10,798			19,619
1974	5,243	30	58	344		5,675			22,799
1975	7,353	84	34	2,145		9,616			20,948
1976	8,652	25	21	1,968		10,666			19,381
1977	3,259	13	19	2,186		5,477			18,811
1978	4,663	6	5	545		5,218			26,860
1979	5,889	6	11	213		6,119			31,715
1980	2,327	24	7	582		2,940			22,634
1981	867	14	9	218		1,109			34,641
1982	2,639	2	11	506		3,159			29,387
1983	629	11	33	214		887			20,557
1984	673	29	49	166		917			11,573
1985	3,320	28	89	676		4,113			16,089
1986	4,851	57	12	189		5,109			19,266
1987	861	20	34	119		1,033			15,507
1988	923	50	6	447	1	1,427			8,989
1989	1,046	21	112	57		1,236			10,943
1990	1,380	92	65	50		1,587			8,653
1991	410	6	92	9		517	2		15,781
1992	1,928	61	110	0		2,099	0		13,995
1993	580					981	6		10,811
1994	906	59	89	63	2	1,118	2		16,916
1995	657	49	258	11		975	2		29,225
1996	4,639	70	40	3,700		8,449	4		23,519
1997	2,240	133	156	367		2,897	14		24,632
1998	1,771	281	413	1	0	2,466	20		15,764
1999	184	184	441	2,369	35	3,213	21		29,153
2000	693	61	342	3,019	99	4,214	21		32,293
2001	292	48	356	863		1,559	50		18,531
2002	50	12	654	1,708	2	2,427	55	10	19,071
2003	22	18	394	3,211	43	3,689	41	19	16,984
2004	0	11	49	8,880	14	8,954	67	10	24,333
2005	201	6	79	4,542		4,828	20	7	26,770
2006	0	1	96	9,816		9,913	21	3	24,196

* NP and SP represent the catch in North and South Pacific, respectively.
** The troll catch for farming estimating 10 - 20 mt since 2000, is excluded.
*** Catch statistics of Korea derived from Japanese Import statistics for 1982-1999.
**** Catches of Chinese Taipei's longline for 2005 and 2006 are preliminary.
***** US purse seine catches in 1952-1958 contains catch from other countries (mainly Mexico), and most of catch is from purse seine.
****** 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, Wellington), but for catch in 2006 is personal com. by S. Herley. NZ catches exclude the recreational catches.
******* Other countries include AUS, Cooks, Palau and so on. Catches derived from Japanese Import Statistics as minimum estimates.

Appendix 1

Agenda

Pacific Bluefin Tuna Working Group Workshop
December 11 - 18, 2007
Shimizu, Japan

Agenda with designated Rapporteurs (*indicates lead)

Head rapporteur: Miyake (supervised by Miyabe)

1. Opening and meeting arrangements (Takeuchi)
2. Adoption of agenda and appointment of Rapporteurs(Takeuchi)
3. Updating of fisheries indicators (Yamada*, Coan)
4. Review of SSII input requirements and initial settings (Takeuchi)
5. Input data for the SSII (Honda* for biology, Yokawa* for fishery)
   - Biological parameter estimates
     (Tanabe*, Aonuma, Childer, Shimose)

   - Fishery data
     a) Principal Eastern Pacific Ocean fisheries
        (Dreyfus*,Alex, Childer)
     b) Principal Western Pacific Ocean fisheries
        1. Catch data (Oshima*, Yamada, Sakai)
        2. Size data (Abe*, Kai)
        3. CPUE (Yokawa*, Yamada, Ichinokawa)
     c) Others (Oshima*, Muto)
   - Criteria and decisions
     Biological information (Honda*, Tanabe, Childer, Aonuma)
     Fisheries Data (Miyabe*, Yokawa, Conser, Takeuchi)
6. SSII specifications and issues not covered by data inventory
   - Stock projection methodology (Ichinokawa*, Conser, Kanaiwa)
   - Incorporation of ageing data into the model (Piner*, Kai)
   - Changes to initial settings (Conser*, Kurota, Kai)
7. Recommendations, Review of schedule and assignments (Yokawa)
8. Other matters (Sakai*, Takeuchi)
   - FTP site and real-time exchange of information
   - Arrangement for May 2008 Workshop
9. Adoption of reports and closure (Takeuchi)

Appendix 2
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Appendix 3

List of Documents

ISC/07/PBF-3/1	Standardized Catch rates for Pacific Bluefin Tuna caught by the US and Mexican Purse Seine Fisheries in the Eastern Pacific Ocean (1960-2006) (A. Silva [alexdasilva@iattc.org], M. Hinton and M. Dreyfus)
ISC/07/PBF-3/2	Age determination of Pacific bluefin tuna, *Thunnus orientalis*, using sectioned otolith and vertebral bone (T. Shimose [shimose@affrc.go.jp] and T. Tanabe)
ISC/07/PBF-3/3	Updated estimation of the quarterly size of small PBF by Japanese small pelagic purse seine fishery in the East China Sea in 1997 - 2007 (H. Yamada [hyamada@fra.affrc.go.jp] and K. Oshima)
ISC/07/PBF-3/4	Re-examination of the quarterly catch of small PBF by Japanese small pelagic purse seine fishery in the East China Sea in 1988 - 2007 (H. Yamada [hyamada@fra.affrc.go.jp])
ISC/07/PBF-3/5	The estimation of error distribution about the length frequency in Pacific bluefin tuna (*Thunnus orientalis*) from market samples using bootstrap method (A. Shibano [18040056@cp.bioindustry.nodai.ac.jp], M. Kanaiwa and H. Yamada)
ISC/07/PBF-3/6	Review of sharp increase in large PBF in sampling data from the set-net fishery since 2003 (M. Kai [kaim@fra.affrc.go.jp])
ISC/07/PBF-3/7	Weight-length relationship of North Western Pacific bluefin tuna (M. Kai [kaim@fra.affrc.go.jp])
ISC/07/PBF-3/8	An update of input size data of Stock Synthesis for Pacific bluefin tuna, *Thunnus orientalis* (M. Abe [abemasa@affrc.go.jp], K. Yokawa, H. Yamada and Y. Takeuchi)
ISC/07/PBF-3/9	Analysis of setting of input data of Stock Synthesis (M. Abe [abemasa@affrc.go.jp])
ISC/07/PBF-3/10	Supplementary catch data of Pacific bluefin tuna by Japan in 1940's and 1950's (F. Muto [mtf@affrc.go.jp], Y. Takeuchi and K. Yokawa)
ISC/07/PBF-3/11	Catch information for Pacific bluefin tuna in Taiwan waters before the end of World War II (F. Muto [mtf@affrc.go.jp], Y. Takeuchi and K. Yokawa)
ISC/07/PBF-3/12	Catch of Pacific bluefin tuna by set net in Sakhalin and Hokkaido waters in 1920's and 1930's (F. Muto [mtf@affrc.go.jp], Y. Takeuchi and K. Yokawa)
ISC/07/PBF-3/13	United States Catch Time Series for Pacific Bluefin Tuna in the North Pacific Ocean (A. Coan Jr. [Al.Coan@noaa.gov] and J. Childers)
ISC/07/PBF-3/14	Japanese catch statistics and catch estimation for Pacific bluefin tuna (H. Yamada [hyamada@fra.affrc.go.jp] and Y. Takeuchi)

ISC/07/PBF-3/15	Pacific bluefin quarterly catch table updates (Y. Takeuchi [yukiot@fra.affrc.go.jp], K. Oshima, H. Yamada and M. Kai)
ISC/07/PBF-3/16	Short-term CPUE standardization of Pacific bluefin tuna caught by Japanese longline fisheries (K. Oshima [oshimaka@affrc.go.jp] and K. Yokawa)
ISC/07/PBF-3/17	An updated standardized CPUE of age-0 Pacific bluefin tuna by Japanese troll fisheries (H. Yamada [hyamada@fra.affrc.go.jp], K. Oshima)
ISC/07/PBF-3/18	An update of standardized CPUE for Pacific bluefin tuna caught by Japanese coastal longliners (M. Ichinokawa [ichimomo@affrc.go.jp])
ISC/07/PBF-3/19	Re-investigation of the Bluefin Tuna CPUE index derived from Commercial Passenger Fishing Vessel logbooks 1995-2006 (K. Piner [Kevin.Piner@noaa.gov])
ISC/07/PBF-3/20	Options to Introduce Age data into SSII (K. Piner [Kevin.Piner@noaa.gov])
ISC/07/PBF-3/21	Brief review of the methods for the future projections of Pacific bluefin tuna stock assessment (M. Ichinokawa [ichimomo@affrc.go.jp], M. Kai, Y. Takeuchi and R. Conser)
ISC/07/PBF-3/22	Reliability of stock size estimates from SS2 - A case study of Pacific bluefin tuna (M. Kai [kaim@fra.affrc.go.jp], M. Ichinokawa and Y. Takeuchi)
ISC/07/PBF-3/23	SSII input requirements and initial settings (Y. Takeuchi [yukiot@fra.affrc.go.jp])
ISC/07/PBF-3/24	A preliminary trial of cluster analysis for time series data in Japanese distant and offshore longline fishery (M. Kanaiwa [mk3kanawiw@bioindustory.nodai.ac.jp], Y. Takeuchi and K. Yokawa)
ISC/07/PBF-3/25	Estimation of the abundance indices of Pacific bluefin tuna using data of Japanese offshore and distant-water longliners (K. Yokawa [yokawa@fra.affrc.go.jp], M. Ichinokawa and K. Ohshima)
ISC/07/PBF-3/26	Some considerations of the abundance index of Pacific bluefin tuna estimated by the data of Japanese offshore and distant-water longliners (K. Yokawa [yokawa@fra.affrc.go.jp])
ISC/07/PBF-3/27	A preliminary report on larval and mature Pacific bluefin tuna occurring around the Yaeyama archipelago (Y. Aonuma [aonuma@fra.affrc.go.jp], N. Suzuki and K. Yoseda)
ISC/07/PBF-3/28	Preliminary Estimated Catches of Pacific Bluefin Tuna in Japan and Adjacent Area for Years 1894 to 1950 (F. Muto [mtf@affrc.go.jp], Y. Takeuchi and K. Yokawa)

Information Papers

ISC/07/PBF-3/Info-1	Additional analysis on Japanese longline CPUE related to ISC/07/PBF-3/16 (K. Oshima)

ISC/07/PBF-3/Info-2	A comparison on the Natural Mortality Rates used for Pacific Bluefin, Atlantic Bluefin and Southern Bluefin Tunas and suggestion for modification of the Pacific bluefin tuna natural morality rates (R. Conser)
ISC/07/PBF-3/Info-3	Updated estimates of mortality rates for juvenile SBT from multi-year tagging cohorts (Polacheck et. al. 1997)
ISC/07/PBF-3/Info-4	Workshop CPUE analysis - response to questions and extending the standardization of WP-25 (K. Yokawa)

Appendix 4

Check list

A check list of data and requirements for the stocks assessment model

Biological Parameters

- ✓ Stock structure
- ✓ Spatial structure
- ✓ Reproduction
- ✓ Maturity at age or length
- ✓ Frequency and timing of spawning
- ✓ Age and growth
- ✓ Fix or estimate growth curve parameters
- ✓ Use otolith data? And how?
- ✓ Natural mortality
- ✓ Length weight relationship

Fishery data

- ✓ Definition of fishery
- ✓ CPUE
- ✓ Length bin definition
- ✓ Max and Min length sample size
- ✓ Time step

Basic Model structure

- ✓ Calendar or fishing year
- ✓ Last year
- ✓ Last age
- ✓ Length data weighting
- ✓ CPUE weighting
- ✓ Selectivity
- ✓ Catch equation or Pope's approximation
- ✓ Evaluation of uncertainty
- ✓ Stock recruitment
    - ➢ Steepness
    - ➢ Recruitment dev
- ✓ Initial Population
    - ➢ Equilibrium catch lambda
    - ➢ Equilibrium catch
    - ➢ R-dev before starting year
- ✓ Constraints
    - ➢ F-ballpark
    - ➢ Max F/Exploitation rate

Appendix 5 Summary information on abundance indices (estimated from fishery catch and effort data).

DATA OR ANALYSIS NEEDED	WP1	WP 16	WP 17 (Eastern china sea)	WP17 (Pacific)	WP 18	WP19	WP 25+26	Info1	ISC/07/PBF-1/25
CPUE index values and std error in the paper	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Proportion catch and number used in CPUE analysis	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Size composition related to the index available for estimating selectivity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size range	80-120cm	100-200kg	Smaller than 3-4kg	Smaller than 3-4kg	100-200kg	80-120cm	young adult	young/matured adult	largest adult
Time-area strata used in analysis	Month, 1x1 degree by vessel	2qt, 1x1 degree square	Sept-April, 4 area	Qt 1,3,4 4 fishing ports	2qt, 1x1 degree square	By season, off the southern California and northern Mexico	1,4qt 5x5 degree square	All quarter 5x5 degree square	2qt, no fishing position info.
Standard diagnostic output (residual patterns, etc.)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Other analysis issues (kind of GLM used)	Delta-lognormal	Delta-lognormal	Lognormal + constant	Lognormal + constant	Delta-lognormal	Delta-gamma	Lognormal + constant	Lognormal + constant	Lognormal + constant
Nominal CPUE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Author's comments	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes

WP 1 EPS PS/US target, US extinction, Mexico opp., Mexico target (da Silva)
WP 16 Japan LL/offshore and distant-water/set-by-set (Oshima)
WP 17 Japan Troll (Yamada)
WP 18 Japan LL/Coastal/set-by-set (Ichinokawa)
WP 19 USA CPFV/area-quarter (Piner)
WP 25+26 Japan LL/offshore and distant-water/5o-month (Yokawa)
Info 1 Japan LL/offshore and distant-water/5x5 month - 1974, 5x5 month HPB 1975
ISC/07/PBF-1/25 Taiwan LL/coastal/set-by-set

Appendix 6

Check list of the reported CPUE

WP 1 EPS PS/US target, US extinction, Mexico opp., Mexico target (daSilva)

· Targeting – PBF targeting for US (1960-1982), PBF opportunistic for Mexico (1960-1998), PBF targeting for Mexico (1999-2006)
· Diagnostics – No major departures from model assumptions
· Spatial coverage – Restricted in EPO (Baja California)
· Temporal coverage (1960-2006). US PBF-target (1960-1982), Mexico PBF-opportunistic (1960-1998), · Mexico PBF-target (1999-2006)
· Zeros: included (delta-lognormal)
· Size-age – 1-2 year old fish
· Data quality: US PBF-target (good), Mexican PBF-opportunistic (fair), Mexican-target (fair, could be improved)
· Unit of CPUE – weight
· Possibility of updating CPUE before May 2008 – No
· Common sense

WP 16 Japan LL/offshore and distant-water/set-by-set (Oshima)

· Targeting – not always PBF. Main targets of operation were changed remarkably after 1960's.
· Diagnostics –Residual patterns especially in log-normal was skewed.
· Spatial coverage – Part of and north to the main spawning ground of PBF.
· Temporal coverage – 2nd quarter, 1960-1980, 1988-2002.
· Zeros – includes zero catch sets
· Size/age – Ichinokawa (2007) published in the previous meeting in April showed general size distribution of PBF catch by JLL.
· Data quality – good for the most part. Coverage of data including information on HPB was not so high before 1963.
· Unit of CPUE – number
· Possibility of updating CPUE before May 2008, if yes, when? - no
· Common sense –

WP 17 Japan Troll (Yamada)

· Targeting - mainly PBF in the East China Sea, not always PBF in the Pacific Ocean
· Diagnostics - reasonable in both waters
· Spatial coverage - limited coverage only in fishing ground by Nagasaki and Kochi prefectures
· Temporal coverage - Sep. – Apr. in the East China Sea and 3rd – 1st qt in the Pacific Ocean, high season for PBF from 1980 – 2006 in fishing year
· Zeros - include zero catch sets (1.0% of the observations in Nagasaki and 10.0 % in Kochi)
· Size/age - smaller than 3 – 4 kg BW, corresponding to age 0
· Data quality - probably good
· Unit of CPUE - weight in kg
· Possibility of updating CPUE before May 2008, if yes, when? No
· Common sense :

WP 18 Japan LL/Coastal/set-by-set (Ichinokawa)

· Targeting – not always PBF. Although the effect of targeting is included by ship identification as random effect or the effect of 'targeting' determined from species composition by ship, it is difficult to distinguish targeting ship from not-targeting ship

· Diagnostics – GLM model can't explain most part of catch of PBF. Residual patterns especially in log-normal is skewed (see fig. 4 & 12 in ISC PBF-WG/07-1/16)
· Spatial coverage – Part of and north to the main spawning ground of PBF
· Temporal coverage – 2nd quarter from 1994 to 2006
· Zeros – includes zero catch sets
· Size/age – PBF with body sizes ranging approximately 100-200 kg (fig. 4). Not cover PBF with larger body size.
· Data quality – reasonably good. However, the percentages of total catch weight recorded by logbook to the total catch by coastal longliners reported by SI report are seems to be decreasing recently (from 70-80% to <40%).
· Unit of CPUE – number
· Possibility of updating CPUE before May 2008, if yes, when? - no
· Common sense –

WP 19 USA CPFV/area-quarter (Piner)

• Targeting - targeted tuna trips/ elimination of groundfish trips-not exactly a targeted fishery (?)
• Diagnostics - reasonable statistical diagnostics (model performance)- in paper
• Nominal (found in data/cpue/epo_indices.xls-sport) and standardized CPUE similar (Table 2. in paper)
• Spatial Coverage - limited coverage in EPO S. California and N. Mexico- in paper
• Temporal Coverage - limited coverage 1994-2006 (not diagnostic of good index but information)
• Zeros - includes a measure of zero catch/search time (issue of hyper-stability)
• Size/age - we have measures of size composition from recreational catch but relatively few young age-classes ~80cm
• Data quality – but limited sample size (high variance) aggregated observations (Table 1. in paper) number of fish/year (1000-3000 fish) (Table in data/cpue/epo_indices.xls-sport)
• common sense – This work done by Texan.

WP 25+26 Japan LL/offshore and distant-water/5o-month (Yokawa)

• Targeting - Mostly by-catch, partially in the period around 1960
• Diagnostics - residual pattern skewed
• Spatial and temporal coverage - Second major fishing ground (Kuroshio frontal area)
• Temporal coverage - only 1st and 4th quarters, 1952 - 2006
• Zeros - Included into the aggregated data
• Size/age - "pre-adult and young adult
• Size data - available"
• Data quality - very good (selected data)
• Unit of CPUE - number / 1,000 hooks
• Possibility of up-date - no
• Commonsense - Recent trend can be comparable with the one by Japanese coastal longliners in recent years

Info 1 Japan LL/offshore and distant-water/5x5 month - 1974, 5x5 month HPB 1975 -
• Targeting - Targeted in the period before the mid 1960s, by-catch there after
• Diagnostics - residual pattern skewed
• Spatial and temporal coverage - Major distribution area in the northwest Pacific
• Temporal coverage - all quarters, 1952 - 2002
• Zeros - Included into the aggregated data
• Size/age – wide range of adult, larger adult dominant in 1950s - 1960s, but gradually shifted to the pre/young adult
• Size data - available
• Data quality - Good but these are some problems such as; estimation of the gear effect is

unrealistic, which would cause underestimate of the current level of the stock, number of set records in the coastal area is limited in recent years
- Unit of CPUE - number / 1,000 hooks
- Possibility of up-date - no
- Commonsense - cannot be up-date in future without increase the number of observation

ISC/07/PBF-1/25 Taiwan LL/coastal/set-by-set

- Targeting - mixture of directed and non-directed operation
- Diagnostics - No so bad
- Spatial coverage - Southern part of PBF spawning ground (east of Taiwan)
- Temporal coverage - May - June, 1999 - 2006
- Zeros - Included
- Size/age - larger and largest size of matured adult
- Size data - available
- Data quality - good but information about position of catch is poor
- Unit of CPUE - number / 1,000 hooks
- Possibility of up-date -
- Commonsense - Check list created by Workshop member not by author

Appendix 7

Discussion of Natural Mortality

In the 2006 ISC PBF stock assessment, the age-specific natural mortality rate (annual M) was assumed to be 1.6 for age 0; 0.8 for age 1; 0.4 for age 2; and 0.25 for ages 3 and older. This estimate of 1.6 for age 0 fish is the only estimate in the schedule empirically determined from PBF data (tagging). The other estimates were assumed.

The Group performed an in-depth review of M estimates and schedules used for southern bluefin tuna (*Thunnus maccoi*) and Atlantic bluefin tuna (*Thunnus Thynnus*) stock assessments. The review also included analyses of cohort survival schedules with different longevity assumptions and with no fishing mortality (Information Paper 2). The review indicated that there are very few empirical estimates of M for the three bluefin tuna species. Available empirical estimates are: 1.6 for age O for PBF and 0.456-0.474 for age 1 and 0.253-0.295 for ages 2 and older for southern bluefin tuna (Polacheck et al. 1997). An assumed M of 0.14 for all ages is used for Atlantic bluefin tuna and M of 0.12 for ages 4 and older for southern bluefin tuna..

Results of the analyses indicated that there were less survivors of old fish with the PBF M schedule than with the northern bluefin tuna or southern bluefin tuna schedules used in stock assessments. For example, the PBF schedule would require a reduction of 0.541 with the existing age-specific pattern to match results from the southern bluefin tuna M schedule. Estimates of M with the Pauly (1980) approach and using growth parameter estimates from an on-going age and growth study for PBF also suggests that the assumed M for ages 3 and older for PBF is too high.

The Group decided to create a new age-specific M schedule for PBF based primarily on best empirical estimates of M from any of the bluefin tuna species. The new schedule and source of estimates are as follows:

Age	M	Source and explanation
0	1.6	Empirical estimate, PBF tagging experiment
1	0.46	Empirical estimate, SBT tagging experiment (average of range)
2	0.27	Empirical estimate, SBT tagging experiment (average of range)
3	0.20	Assumed estimate, linear interpolation from age 2 and age 4 estimates
4+	0.12	Assumed estimate, adopted from SBT

The Group also noted that because there is a scarcity of information on natural mortality for PBF and wide CVs for the available estimates of M from empirical data, this new schedule should be considered as a starting schedule for the process of stock analysis.