ISC/15/PBFWG-1/02

Status and Response to the CIE Review of the 2012 Pacific Bluefin Tuna Stock Assessment

Pacific Bluefin Tuna Working Group
International Scientific Committee for Tuna and Tuna-Like Species
In the North Pacific Ocean (ISC)

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National Research Institute of Far Seas Fisheries, Shimizu, Shizuoka, Japan

1. Review the assessment methods to provide recommendations on how to improve its application, and/or recommend other methods that would also be appropriate for the species, fisheries, and available data

#	Recommendations	Comment	Reviewer	Related Agenda & Responses
1	Include a more comprehensive evaluation of structural uncertainty (p.22)	It would be desirable to see a greater range of alternative model structures in sensitivity runs. For example, by including fewer fleets, removing the seasonal structure or attempting a simple two area (EPO - WPO) population dynamics model. Surplus production, delay-difference and VPA assessments are simple and quick to apply and would provide an interesting context for the results of the more complex statistical catch-at-age analysis of the representative run. These sensitivity runs are likely to better communicate to decision makers the considerable structural uncertainties that may be otherwise masked by presenting the results of a single model structure. (p.22)	Tom Carruthers	D. Model Structure Improvements Working paper on "Simulation of methods to incorporate spatial effects into the stock assessment of Pacific bluefin tuna" by Lee et al. will partly respond to this recommendation. Working paper on "A sensitivity analysis of the 2014 stock assessment for Pacific bluefin tuna" by Kumegai et al. will also partly respond to this recommendation.
2	Compare the results of the current assessment with other simple stock assessment frameworks (p.15)	Given the data, the available information about the fisheries and PBF life history and biology, very similar results could be obtained with a “simpler” approach, such as ADAPT (VPA-2BOX Gavaris, 1988). (i.e., a surplus production model and a classical VPA) (p.6)	Sylvain Bonhommeau	
3	Consider a simpler model with more complex spatial characteristics (p.23)	It may be possible to use the electronic tagging data that are available to derive priors for movement to support a simple two area (EPO, WPO) population dynamics model that could provide a valuable comparison to the predictions of the spatially aggregated representative run of this assessment. (p.23)	Tom Carruthers	B. Biological Parameters Improvement 4. Migration Presentation on electronic tagging data by Fujioka et al. will partly respond to this recommendation.
4	Conduct a Bayesian analysis (p.23)	The MCMC run of the representative assessment took 15 hours to conduct 200,000 iterations on my rather dated laptop. This is a small cost relative to the benefits in terms of quantifying uncertainty in outputs (including skew) and understanding parameter confounding. The outputs are also intuitive unlike frequentist confidence intervals which are routinely misinterpreted. (p.23)	Tom Carruthers	Convergence of MCMC of representative run might be difficult to confirm. This is a future work.

5	Use the Bayesian possibilities offered by SS; and (p.15)	To provide uncertainties about the results, the PBFWG could apply Bayesian estimation using the Monte Carlo Markov Chain algorithm from SS, if informative priors can be derived from the data. (p.6)	Sylvain Bonhommeau	
6	Provide the likelihood profiles as in Teo and Piner (2012); (p.15)	This base-case model should be used for the next assessment to analyze the impact of the updated data and before establishing the new Representative Run. The likelihood profiles, such as those given in Teo and Piner (2012, Fig. 2), are very useful and should be included in the report. (p.6)	Sylvain Bonhommeau	DONE. This was done in the 2014 Stock Assessment.

#	Recommendations	Comment	Reviewer	Related Agenda & Responses
7	Develop a MSE to assess the SS model. (p.16)	I would also strongly suggest the PBFWG to develop a Management Strategy Evaluation (MSE) framework to evaluate the performance of the SS model as it has been done for the southern bluefin tuna (Polacheck et al., 1999) and is underway for the Atlantic bluefin tuna. The MSE framework could include (i) an operating model that represents alternative plausible hypotheses about stock and fishery dynamics, (ii) management procedures or a management strategy that is the combination of the available pseudo-data, the stock assessment used to derive estimates of stock status and the management model or Harvest Control Rule, and (iii) an observation error model that describes how simulated fisheries data, or pseudo-data, are sampled from the operating model. (p.6-7)	Sylvain Bonhommeau	This work would be done more effectively after the full stock assessment in 2016, although we have to deal with MSE.
8	Evaluate natural mortality rates of Age 0 including density-dependent relationships (p.8)	The assessment assumes that all density-dependence occurs prior to fishing in the April-June quarter. However, we have a rather large F on Age 0. So how the timing occurs relative to the mortality rates implied by the stock-recruitment relationship can make a difference. Is fishing occurring during periods of density dependence? The current assumption is that all the density-dependence occurs from April-June. There are options to include density-dependence during periods when F occurs (Forest et al. 2013, Powers and Brooks 2005, Brooks and Powers 2007). I believe that this sort of evaluation should be a standard practice when there are large catches of Age 0. This might have improved S-R fits and the selection of a density-dependent model, but who knows. Catches occurring during density dependence make a difference in benchmarks. But alas, the density-dependent discussion becomes moot, once steepness is specified as 0.999 (p.4)	Joseph E. Powers	B. Biological Parameters Improvement 1. Natural Mortality Working paper on "The seasonality of natural mortality for age-0 fish of the Pacific bluefin tuna using 1996-2012 mark-recapture data in Tosa bay" by Iwata et al. will partly respond to this recommendation.

9	Integrate tagging data into the assessment model (p.8)	The Iwata et al. (ISC/12-1/PBFWG/13) study derives the estimate of M 0 based on an entire year with all the released tags in July, August and September. This report is an update of earlier work, adjusting the tag-shedding rates. This Iwata et al. study indicates that fishing mortality rates are included in the estimation model, but there is no discussion of their values. I could not access the previous report, so I am not sure what significance of the F's in the tagging model has. For future use, I recommend that the tagging model should be integrated directly into the assessment as another likelihood component. (p.4)	Joseph E. Powers	The same as above.

2. Evaluate the assessment model configuration, assumptions, and input parameters (fishery, life history, and spawner recruit relationships) to provide recommendations on how to improve: the use of data, specification of fixed input parameters, and specification of model configuration				
#	**Recommendations**	**Comment**	**Reviewer**	**Related Agenda & Responses**
10	Greater detail in description of CPUE standardization methods (p.22)	There are a number of statistical considerations when standardizing CPUE data that were not addressed by any of the standardizations used in this assessment. Where possible, future standardization papers should account for differences in the number of observations among areas (Campbell 2004), different sizes of areas (CPUE is a measure of density) and provide an equation of the form It=, where I is the index and the subscript t is the year. These inclusions reassure the reader that the index was calculated correctly, may not be seriously biased and also ensures that the method is reproducible. It would also be desirable for index standardization papers to include a range of sensitivity analyses that could allow several trends to be used in alternative stock assessment runs. (p.22)	Tom Carruthers	A. Fishery Data Improvement 2. CPUE Data Working paper on "Standardized CPUE for Pacific bluefin tuna caught by Japanese coastal longliners, by zero-inflated negative binomial model using cruise aggregated data" by Hiraoka et al. will partly respond to this recommendation. CPUE standardization methods are reported by several working papers. So we will cite these papers.
11	Greater transparency in the derivation of critical assessment inputs (p.22)	Relative abundance indices, inputs for steepness and natural mortality rate are generally derived prior to the assessment. Since they are so critical to assessment outputs it makes sense that the methods used to derive inputs for these inputs should be subject to peer-review. (p.22)	Tom Carruthers	Partly DONE. These indices and input data are reported in ISC working papers to keep transparency. This comments are need to be discussed with ISC Chair.
12	Provide a much clearer description of the derivation of natural mortality rate (p.23)	The assessment document includes a cursory reference to the method of Pauly (presumably Pauly 1980) as a basis for deriving natural mortality rate of individuals age 2 and older. This method should be described in greater detail in future assessments and subjected to peer-review. (p.23)	Tom Carruthers	DONE. A description of the derivation of natural mortality rate was incorporated in the 2014 Stock Assessment.

13	analyze all sources of information available to reduce the uncertainty of the natural mortality vector, especially for the age-2+; (p.16)	I would suggest that the PBFWG discuss this issue in the report (and the results of Whitlock et al. (2012)) and include the results of Teo (2011). Substantial effort should be made to account for the uncertainty around natural mortality vectors and its impact on BRPs. (p.8)	Sylvain Bonhommeau	B. Biological Parameters Improvement 1. Natural Mortality Working paper on "A sensitivity analysis of the 2014 stock assessment for Pacific bluefin tuna" by Kumegai et al. will also partly respond to this recommendation. The results of Whitlock et al.(2012) were discussed at the past WG and also reviewed at this WS, if necessary.
14	Consider a simpler assessment model (p.23)	The assessment document does not fully explain the reason for explicitly modelling seasonal population dynamics. I would recommend an annual assessment model and where necessary disaggregation of fleets by season. I would also suggest the alternative fleet disaggregation highlighted in Table R2 (which identifies 8 fleets) as the most detailed fleet structure that should be considered in this analysis. It should be noted that in many settings reliable management decisions can be made using an assessment model containing a very simple fishery structure (2 or 3 fleets of varying vulnerabilities). On top of the annual, coarser fleet approach I would recommend using only the Japanese longline indices and including the indices of other fleets (only those of good spatio-temporal coverage) as sensitivity analyses. I would not recommend using relative abundance indices from regional fisheries (given a single area population dynamics model) and those derived from purse seine	Tom Carruthers	C. Model Improvement 1. Fisheries Definition The growth of PBT is very rapid, so seasonal data analysis is necessary. Using relative abundance indices from regional fisheries is important, because they affect population dynamics of PBT.

15	Avoid using regional abundance indices to infer population-wide stock dynamics. (p.23)	I recommend fitting the base-case model to a single index of abundance derived from a fleet with good spatial-temporal coverage (in this case this may be the Japanese longline fleet) and use other indices for sensitivity analysis. (p.23)	Tom Carruthers	DONE. This was done in the 2014 Stock Assessment. A. Fishery Data Improvement 2. CPUE Data This comment is partly due to misunderstanding. Abundance indices by Japanese troll, Japanese longline and Taiwanese longline are meaningful and used in the 2014 stock assessment, even if their available periods are different.
16	Include a prior probability distribution for steepness (p.23)	I strongly recommend the use of a biologically derived prior for steepness (alluded to by Iwata 2012 and published by Mangel et al. 2010) which, in a Bayesian analysis, can be used to account for uncertainty in this critical input. This is particularly important given the relatively large effect of this parameter on estimates of current stock size and exploitation rate. (p.23)	Tom Carruthers	This is a future work. Convergence of MCMC of representative run is doubtful.

#	**Recommendations**	**Comment**	**Reviewer**	**Related Agenda & Responses**
17	solve the problem of the growth curve at age-0; (p.16)		Sylvain Bonhommeau	B. Biological Parameters Improvement 2. Age and Growth Presentation on growth by Fukuda et al. will partly respond to this recommendation.
18	investigate the effect of setting the maximum age at age-10; and (p.16)		Sylvain Bonhommeau	B. Biological Parameters Improvement 2. Age and Growth Working paper on "A sensitivity analysis of the 2014 stock assessment for Pacific bluefin tuna" by Kumegai et al. will partly respond to this recommendation. The maximum age at age-15 was examined in WP.

19	• investigate the failure of the run with a steepness of 0.8. (p.16)	For an h of 0.8, the model did not converge. It would be informative to have some explanations about this non-convergence. Given the low SSB for the recent period, the 0.8 value for h would imply a low recruitment, which does not fit with the data (i.e., the CPUE index of the troll fisheries). I think it is important to discuss (or solve) this issue since h is very influential on the outcome. (p.11)	Sylvain Bonhommeau	DONE When we use an h of 0.8, recruitment decreased and catch could not be explained.
3. Provide recommendations on improving the treatment of assumptions (e.g. sensitivity analyses) and description of uncertainty in estimates of stock dynamics and management quantities (e.g. reference points)				
20	Present results using more conventional reference points for stock status and exploitation rate. (p.22)	The assessment report describes the Pacific bluefin stock as overfished and subject to overfishing. However, the report does not make use of standard measures of exploitation and stock status. It was relatively difficult to gain an intuition about how far current estimates of stock size and exploitation rate are from those associated with a productive stock size. In addition to reference points such as depletion and fishing mortality rate relative to Fmax, it would be desirable for future assessment to include MSY reference points (B/BMSY, F/FMSY). These are often the basis for standard stock assessment outputs such as the Kobe plot in which the model predicted historical stock status (B/BMSY) and exploitation rate (F/FMSY) are plotted against one another (i.e. Figure R2). (p.22)	Tom Carruthers	E. Stock Status Determinations 1. Reference Points and Harvest Control Rules NC is working on BRP of PBF. This issue will highly depend on their conclusions.
21	follow the general agreement between Tuna Regional Fisheries Management Organisations in using phase plots (F/Ftarget against SSB/SSBtarget). (p.17)		Sylvain Bonhommeau	DONE. Two type of "Kobe" plots are presented in the 2014 stock.

22	Include S-R plots as a standard diagnostic as with “Kobe” plots (p.8)	While the current Fs are well above standard benchmarks, perusal of the figure raises important questions. There appears to be adequate historical bases for why the SPRs in the 1950s were not higher than 0.3 (periods of very high catch, primarily of age 0 prior to 1952). However, even though SPRs were very low and Fs were very high in the 1970s-80s, the stock still responded relatively rapidly once mortalities decreased. Was this just luck or are our perceptions of acceptable F’s wrong? These are important questions which arise from examining the S-R plots. I recommend that they be included in assessment reports. (p.5)	Joseph E. Powers	DONE. The reference points are not yet decided by the Northern Committee, so two type of "Kobe" plots are presented in the 2014 Stock Assessment Report. S-R plot is also included in the 2014 report.

#	Recommendations	Comment	Reviewer	Related Agenda & Responses
23	Identification of clear management objectives including target and limit reference points (p.22)	More clearly defined management objectives for the Pacific bluefin stock would enable future assessment to be presented in a meaningful framework and support the development of quantitative tools for decision making (e.g. MSE). (p.22)	Tom Carruthers	E. Stock Status Determinations 1. Reference Points and Harvest Control Rules NC is working on BRP of PBF. This issue will highly depend on their conclusions.
24	Develop a sensitivity analysis using a large range of combinations of data and parameters. This could be achieved using cluster computers with an appropriate design and specific methods such as Gauchi et al. (2010) (p.16)		Sylvain Bonhommeau	C. Model Improvement Working paper on "A sensitivity analysis of the 2014 stock assessment for Pacific bluefin tuna" by Kumegai et al. will partly respond to this recommendation.
25	Evaluate and discuss the residuals patterns with respect to the distribution hypotheses and discuss whether the different parameters are significant with respect to their CVs; (p.16)	For instance, the residual patterns of the size composition of the different fleets do not seem randomly distributed. (p.11)	Sylvain Bonhommeau	C. Model Improvement Working paper on "A sensitivity analysis of the 2014 stock assessment for Pacific bluefin tuna" by Kumegai et al. will partly respond to this recommendation.
26	Include Fs-at-age and total biomass as an assessment of the sensitivity analyses; (p.16)		Sylvain Bonhommeau	We will conduct these sensitivity analyses, but the priority of this work is very low.

27	Include reference points based on SSB in addition to F; and (p.16)	Sylvain Bonhommeau	DONE. This comment may be based on mis-understanding, because B-based reference points such as SSBf0.1 and SSBfmax are reported in the previous and 2014 Stock Assessment Report.
28	When target or limit benchmarks are chosen, the probability density functions be generated of current status relative to benchmarks and catch over the ensuing 2-3 years at the benchmarks, under various levels of management risk-taking. (p.8)	Joseph E. Powers	Partly DONE. The point estimates of current status relative to reference points are given in the 2014 stock assessment. It is a future work to indicate the probability density of these ratio.

4. Provide recommendations on improving the adequacy, appropriateness, and application of the methods used to project future population status

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29	Clarify why SSB and catch remain constant for scenario 1, even though the fishing mortalities are particularly high and should lead to a decline in the population. (p.17)	the projections using the current fishing mortality levels and no catch limitations, i.e., “status quo”, predict that SSB will be constant and at the same current level up to 2030. Given the very high current fishing mortalities, it seems odd that the SSB and catch could be maintained without any sign of decline in the total stock biomass. (p.13)	Sylvain Bonhommeau	This is due to the recruitment scenario essentially assumes steepness of 0.999.
30	Emphasize that none of the scenarios lead to a recovery in 2030 and illustrate that even when projecting with the most conservative scenario, the SSB would be less than one third of SSBMSY (p.17)	Using the simple rule of thumb: SSBMSY=40% of unfished SSB, it means that SSBMSY=253,000 mt. This means that SSB2030/SSBMSY=0.33. The SSB in 2030 would be only 33% of the SSB at MSY for the most conservative scenario proposed by PBFWG. These numbers are very alarming and I think the PBFWG should clearly state this issue in the report. (p.13)	Sylvain Bonhommeau	DONE. No target or limit reference points have been established for the PBF stock by NC, but the initial goal of rebuilding the SSB to the historical median was adopted by NC. Therefore, the historical median was used to evaluate the stock recovery.
31	Investigate for illustrative purposes the time-to-recovery with Fs at age 0-3 equal to zero for the projections. (p.17)	I am aware that the fisheries are targeting these ages and of the potential economic issues linked with this kind of conservation measures, but it could be informative for managers to have information on the recovery time of stocks with Fs at age 0-3 equal to zero for projections. (p.13)	Sylvain Bonhommeau	E. Stock Status Determinations 2. Others Some similar harvesting scenario reducing juvenile F may be needed for the stock assessment in relation to the discussion at NC.

32	The projection methodology is adequate, it being a standard part of the software. I might note that one can see the general effects of alternative F's by simply examining the S-R plots without doing projections. (p.9)	The 2007-09 equilibrium SPR was close to the lowest on record, although it increased in the last two years. Interestingly, there was an extended period of low equilibrium SPRs in the 1970s and 1980s and after reductions in mortality the SSB responded to near the historical high. (p.5)	Joseph E. Powers	Partly DONE. The projection methodology was reported at 5.4 Future Projection in the 2014 stock assessment report. More detailed methodology description will be given in the 2016.
33	Evaluate alternative error structures (ecosystem effect) for future projections	As with most projections in stock assessments, recruitment process error and measurement error are assumed to be constant. This is a "best practice" in stock assessments and perfectly acceptable. However, in the context of integrating ecosystem effects into stock assessments, one effect might occur through the stock-recruitment process.(p.6-7)	Joseph E. Powers	PBF WG will examine alternative scenario prior to the stock assessment in 2016.

5. Suggest research priorities to improve the stock assessment including data, life history and modeling

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34	Estimate the fishing effort of the purse seiner fisheries that represent most of the catch; (p.16)	state-space models using semi-hidden Markov chains could be developed to discriminate the route, the search and the catch states from geolocation of fishing vessels and log-book data. (p.7)	Sylvain Bonhommeau	A. Fishery Data Improvement 2. CPUE Data Working paper on "Estimation of annual stock indices for Pacific bluefin tuna using catch data at Sakai-minato Port" by Kanaiwa et al. will partly respond to this recommendation.
35	Develop a fisheries-independent index; (p.17)		Sylvain Bonhommeau	Egg and larval research are conducted by JFR research vessels. So these data might be used to develop a fisheries-independent index. But there is no specific information.
36	Develop a substantial effort to estimate the natural mortality vector; (p.17)		Sylvain Bonhommeau	B. Biological Parameters Improvement 1. Natural Mortality Working paper on "The seasonality of natural mortality for age-0 fish of the Pacific bluefin tuna using 1996-2012 mark-recapture data in Tosa bay" by Iwata et al. will partly respond to this recommendation.
37	Estimation of natural mortality rates (perhaps through continued tagging) (p.9)	Same as No.8 & 9	Joseph E. Powers	
38	collect data to investigate the potential population structure of PBF (p.17)		Sylvain Bonhommeau	D. Model Structure Improvements Working paper on "Simulation of methods to incorporate spatial effects into the stock assessment of Pacific bluefin tuna" by Lee et al. will partly respond to this recommendation.

39	use the MSE framework to evaluate the performance of the SS model developed for the PBF stock assessment (p.17)	Sylvain Bonhommeau	E. Stock Status Determinations 1. Reference Points and Harvest Control Rules ISC Chair will provide a summary of MSE-WS in Yokohama from April 16-17, 2015.
40	Direct aging of bluefin (p.9)	Joseph E. Powers	B. Biological Parameters Improvement 2. Age and Growth Presentation on aging of Pacific bluefin tuna by Ishihara et al. will partly respond to this recommendation.
41	Improved size sampling (p.9)	Joseph E. Powers	A. Fishery Data Improvement 3. Length Composition Data Working paper on "Revision of catch in weight from the US sports fishery" by Teo, S. et al. will respond to this recommendation. Presentation on body size of Pacific bluefin tuna caught by Japanese purse seine off the Pacific coast of Japan by Ishida et al. will respond to this recommendation.
42	Estimation of reproductive behavior (fecundity/maturity/spawning) (p.9)	Joseph E. Powers	B. Biological Parameters Improvement 3. Reproduction Presentation on reproduction of Pacific bluefin tuna by Ohkouchi will partly respond to this recommendation.

43	Continued evaluation of CPUE standardization. (p.9)	Joseph E. Powers	A. Fishery Data Improvement 2. CPUE Data Working paper on "Estimation of annual stock indices for Pacific bluefin tuna using catch data at Sakai-minato Port" by Kanaiwa et al. will partly respond to this recommendation. Working paper on "Standardized CPUE for Pacific bluefin tuna caught by Japanese coastal longliners, by zero-inflated negative binomial model using cruise aggregated data" by Hiraoka et al. will partly respond to this recommendation.