CCSBT CPUE Modeling Group 16th /17th June 2015 Web Meeting

The web meeting was conducted at the following local times

Seattle:	3:30pm, Tue 16 June
London:	11:30pm, Tue 16 June
Cape Town, Copenhagen & Paris:	12:30am, Wed 17 June
Jakarta	5:30am, Wed 17 June
Taipei:	6:30am, Wed 17 June
Seoul & Tokyo:	7:30am, Wed 17 June
Canberra:	8:30am, Wed 17 June
Wellington:	10:30am, Wed 17 June

With the agenda:-

1. Welcome members and agree agenda.
2. To check that the current base series continues to behave adequately.
3. To develop and encourage new work on CPUE series. See Papers #2,#3,#4.
4. Any Other Business.
5. Closure

Agenda 1. Welcome members and agree agenda.

The chair welcomed participants and asked members to help non English speakers to follow the proceedings by speaking clearly or by typing. The agenda was agreed. To assist members the chair had provided his usual power point summary of the agenda items and available papers (Paper #5).

Agenda 2. To check that the current base series continues to behave adequately.

This is a standard item since a key responsibility of the group is to check that the Base CPUE series used in OMMP and assessment work is behaving consistently and adequately and to advise the OMMP meeting and ESC if there are any concerns. The Chair reviewed the available CPUE monitoring series. He showed a figure that showed little divergence between them and the Base CPUE series. The reduced base model did deviate in recent years but since we consider the interaction terms important(the reduced base model is without interactions) this might not be too concerning.

It was noted that similar trends between Korea's and Japan's catch rates in Areas 8 and 9 is encouraging.

T. Itoh will provide 2 papers for the September meeting (ESC) – Core vessel CPUE and Japanese longline operational patterns.

The Chair formally asked the meeting if they had any concerns. No concerns were expressed and the meeting was happy to endorse the Base series at this stage.

Agenda item 3. To develop and encourage new work on CPUE series.

Verbal reports on progress with alternative CPUE series.

The Chair asked for verbal reports on progress in developing Taiwan's, Korea's and Indonesia's CPUE series. Taiwan have done work on core vessel CPUE analysis and CPUE standardization (Area specific and Age-specific) to be presented at the ESC meeting. The Taiwan results seem to be correlated in Area 8 with Japans age 5-6 indices and in Area 9 with a 2 year lag. It was noted that Taiwan's CPUE is perhaps most likely to be useful as an indicator of recruitment. Consequently, it was also noted that it may well be helpful to have Taiwan's CPUE broken down by either age or size of catch and to compare it with other recruitment indices. However, it is important to understand the characteristics of Taiwan's CPUE , for example SBT is not always the main target species.

Korea will prepare a standardised CPUE series analysis and present it at the ESC. Characteristics of Korea's CPUE need to be defined as an initial step.

Indonesia is collecting data on catch and effort, but analysis is a work in progress.

The possibility of combining all CPUEs series was suggested but the first step must be check their mutual consistency.

Development of Size or Age based CPUE indices.

Figures prepared by Simon Hoyle were presented showing the differential areal/seasonal distribution of SBT by size. Size data were standardised separately by 5-degree square by quarter through time. Simon's slide demonstrates differences in the size distributions between quarters. For example, large fish are seen on spawning grounds in Q1 while smaller fish are off South Africa and SW Australia in Q1. The chair suggested that changing size distributions might cause some of the area year interactions that are found in the General Linear Model used to fit the Base CPUE series. Hence understanding CPUE changes by size might reduce or eliminate these interactions and might provide other benefits. One thought was could the areas be (re)defined spatially for consistent sizes.

Paper #2 by J.Pope. In this paper the author outlined four ways that size or age might possibly be included in CPUE analyses. These were

1. Model by discrete size groups. For this model we would split the CPUE data into CPUE for fish of different size ranges. Paper #3 by Itou and Takahashi (see below) follows this approach. This approach has the plus that it might decrease year interactions but the minus that it might possibly reduce the number of cells depending on how zeros were handled.
2. Model by biomass as well as by number. In this approach the existing base model would be fitted to numbers as now but also separately fitted to the sum of numbers *Length^3 in each cell. This approach has the plus that it is simple and also causes no reduction in positive cells but has the minus that the two CPUE series would not be fully independent.
3. Model by moments of the length distribution. This would extend the idea of model 2 by fitting CPUE for each of the 0:4 moments of the size distribution in cells. I.e. separate series

for Sum(n), Sum(n*L), Sum(n*L^2) etc. Up to Sum(n*L^4) in each cell. A possible plus would be that moments can be used in delay difference population model and the disadvantages are the same as model 2.

4. Model CPUE using size information as an additional explanatory variable. Since we suspect that some of the year to year changes in the spatial/temporal distribution of SBT are due to changes in size distribution, it might it be possible to use size distribution as an explanatory variable? However, the author could not presently suggest how to do this but offered it out as a challenge.

There was a lively discussion around these ideas.

On the plus side it was noted that including size might clarify trends in the CPUE by reducing year interaction terms. Moreover, it was also noted that CPUE broken down by size or age tends to be more informative and is quite commonly used in assessment methods adopted elsewhere. However, in the case of the SBT where the catch is dominated by a few fleets the length data would be used both in the catch at age data and the CPUE data and there would be a lack of independence of the two data sets. Most of the length based CPUE proposals (1-3) would require the OM to be redefined to adopt them though possibly the 4th approach might be accommodated in a retuned version of the existing OM model. In the longer run this might be worthwhile and it was suggested that perhaps somebody should try to make the necessary changes to accommodate such series.

It was thought that a tree-based regression approach might be a way of modelling non-linearities in the effects of size. This might be a possible solution to the analytical puzzle posed by Pope's model 4. A member advocated Pope's model 4 for development if someone else has time.

Another issue was the extent that CPUE might be driven by fleets following the most abundant yearclasses as they grew through the fishery. How would this affect CPUE? How would this effect be best accommodated in CPUE models?

The availability of Japan's CPUE data by size was clarified. This is already available for all vessels on the CCSBT website but there might be restrictions on the availability of size data for more restricted fleet components such as the core fleets used in the Base CPUE series.T. Itou would explore the general availability of such data with the Japanese Fishery agency.

Paper #3 by T. Itou and N. Takahashi. This paper adopted Pope model 1 approach for sizes of fish aged 4-6, 7-10, 11+ . It also used the age 5-6 group. Size was converted to age using the regular CCSBT cohort slicing approach with the usual cut points and age was assigned by 5 degree square and month. The ANOVA Model used was as the same as the base model.

The results of this approach appeared promising. Trends of the separate age series are a useful diagnostic. In general they seemed to show appropriate lags as large year-classes moved through the fishery. It was noted in discussion that in itself this is useful since it gives confidence that the large increases in CPUE in recent years are explained by year class changes rather than catchability changes. By contrast the increase

around 2002 seen simultaneously in all four age series appears to have been due to an overall change in catchability, perhaps due to environmental factors.

Strong lagged correlations are observed between the aged 4-6 and 7-10 and between the aged 5-6 and 7-10 CPUE series that peaked at a lag of 2 years. These were clearly year-class effects. Less clearly explained correlations were seen between the 11+ group and the younger age groups, some lagged correlations were seen at a lag of 7 or 8 year. These might be due to year class effects. Even more intriguing were the negative correlations noted at shorter lags between the 11+ and the younger age groups. One suggestion made in discussion was that this might result from predation since similar negative lagged correlations have been noted in stocks where inter-age group predation occurs (e.g. Barents Sea cod).

The authors showed that trends in the age 4-6 CPUE and the age 5-6 CPUE were almost identical in some years but diverged in others particularly recent years. It was thought that this might result from changes in discarding practice. It was noted in discussion that a practical consequence of this was that it might be better to fit the Base CPUE series to age 5 and older fish rather than to age 4 plus fish as at present.

The discussion concluded that this was a useful and insightful paper. Work is still needed to decide how or if to include such age based CPUE series in to future OMs and to investigate whether breaking CPUE down by age reduced the year interaction terms in the linear model compared to the age aggregated Base model.

Using CPUE results to predict non member catches of SBT.

Paper #4 by M. Chambers. This paper shows a way to use member states CPUE data to estimate non-member SBT catch in the Indian Ocean. The approach uses the technique of 'random forests' to model SBT CPUE on longitude, latitude, month, year & CPUEs of bigeye, albacore, yellowfin and swordfish. An additional explanatory variable HISTORY is also defined (total historic catch of SBT in the fished 5-degree square). The model is fitted to Taiwan's and Korea's data since Japan's catch is provided in numbers but not in weight. Then the fitted random forest model is used to estimate CPUE of SBT for each non-member observation in the IOTC database and hence to calculate catch for each monthly 5-degree observation as predicted CPUE x number of hooks set. In practice it might be useful to consider the proportion of declared catch since member catch is restricted by the quota while non-member countries are not (but are related to abundance). If there is a lot of effort south of 35 degrees south there might be considerable non-member catch of SBT. Estimates of non member catches were provided which were over 500 tonnes in 2012. Error ranges were also provided on these estimates. The author intends to obtain additional data from other Oceans. Attempts are being made to extend work to the Pacific Ocean, but data is required.

The author was thanked for an interesting paper and a clear explanation of the random forests method.In discussion, with respect to estimating non member catch ICCAT effort in the Atlantic might also require examination. The possibility of including Japan's CPUE data in the analysis by first converting to weight by cell was also raised. S Hoyle noted that he and the author are doing some additional work on unaccounted mortality with different methods. This is not ready to present yet but will be provided at the September meeting.

Agenda 4. Any Other Business.

The chair asked for a group discussion to gain new ideas on how to improve CPUE series or use CPUE data in innovative ways? One suggestion was that presently we average CPUE over the quarters. It would be worth checking if the trends by individual quarters are consistent.

It was suggested that in producing the report it might be useful to pick out highlighted issues for future work. The Chair will produce a CPUE to do list at the ESC with additional input from members.

Agenda 5. Closure.

The Chair thanked the members and in particular the authors of papers and Mark Chambers who had taken on the role of running and annotating the desk top during the meeting. The meeting closed in a little less than two hours from the regional start times.