Annex 8

REPORT OF THE BILLFISH WORKING GROUP WORKSHOP

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

24 May – 1 June 2011
Chinese Taipei, ROC

1.0 INTRODUCTION

An intercessional workshop of the Billfish Working Group (BILLWG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was convened in Chinese Taipei, ROC from 24 May – 1 June 2011. The goals of this workshop were: (1) finalize the North Pacific striped marlin (*Kajikia audax*) data and stock assessment work plan, (2) develop a work plan for completing a blue marlin assessment, and (3) elect a new Chairperson of the ISC BILLWG working group.

Gerard DiNardo, Chairman of the BILLWG, welcomed participants from China, Chinese Taipei, Japan, the Secretariat of the Pacific Community (SPC), and the United States of America (USA) (Attachment 1). Dr. Chin-Lau Kuo, Deputy Director-General of the Fisheries Agency, Council of Agriculture, provided the welcoming remarks. Rapporteuring duties were assigned to Jon Brodziak, Yi-Jay Chang, Shelton Harley, Minoru Kanaiwa, Ai Kimoto, Hui-Hua Lee, Kevin Piner, Tim Sippel, Nan-Jay Su, Chi-Lu Sun, Darryl Tagami, and Lyn Wagatsuma. Wagatsuma served as the lead rapporteur with overall responsibility of assembling the workshop report. Working papers were distributed and numbered (Attachment 2), and the meeting agenda was adopted (Attachment 3). The working papers that were agreed to be posted on the ISC website where they will be available to the public were: ISC/11/BILLWG-2/01, ISC/11/BILLWG-2/03, ISC/11/BILLWG-2/07, ISC/11/BILLWG-2/08, and ISC/11/BILLWG-2/12. The working papers that will not be posted on the ISC website were: ISC/11/BILLWG-2/04, ISC/11/BILLWG-2/05, ISC/11/BILLWG-2/09, and ISC/11/BILLWG-2/11 (Attachment 2).

2.0 STATUS OF WORK ASSIGNMENTS

The assignments that stemmed from the January 2011 ISC BILLWG workshop were as follows:

- Finalize all working papers submitted at this meeting by February 28, 2011.

- Submit late striped marlin Category I, II, and III data to Kevin Piner by February 15, 2011.

- Finalize data tables for distribution by February 28, 2011.

- Update striped marlin data for the most recent year by May 15, 2011.
- Continue to submit Category I data for all billfish (marlins and swordfish) species.

The ISC Chair reported that the catch tables were completed at the meeting and that the working papers submitted at the last intercessional BILLWG workshop were finalized. The deadline for the rest of the assignments, which included submission of standardized CPUE and quarterly fishery size composition data, was rescheduled to be June 30, 2011.

3.0 ANNUAL BILLFISH CATCH AND EFFORT

Prior to the presentations of annual billfish catch and effort data, the WG discussed a few important issues. First, it was noted that the Billfish WG needed regular, timely, and reliable reporting of catch data from all ISC members in order to conduct stock assessments that would be useful for fisheries management. Second, the WG Chair emphasized that it was essential that the WG receive complete datasets for the striped marlin stock assessment by the end of the current meeting.

3.1 Striped Marlin Catches in the North Pacific from WCPFC Data presented by Darryl Tagami (ISC/11/BILLWG-2/01)

This working paper presented catch summaries and distribution plots of striped marlin in the North Pacific from non-ISC member countries. The data were provided by the WCPFC for longline catches of striped marlin only. The purpose was to provide the ISC Billfish Working Group with billfish catch data that were not available to the ISC or were not part of the ISC Working Groups data holdings. This represented the first time that striped marlin catch data submitted to the WCPFC from non-ISC countries were made available to the ISC for stock assessment purposes.

<u>Discussion</u>

The WG noted that it would be useful to check the catch data values from the ISC catch tables for the WCPO and compare these to the reported WCPFC data submitted by ISC countries. It was also agreed to include reported WCPFC catches of striped marlin from non-ISC countries in the assessment. For Chinese catches, it was noted that there was one year where the catch appeared to be anomalously high (124 t in 2008) and that this value would be checked and confirmed by China in discussion with SPC prior to its inclusion in the ISC striped marlin catch data table.

The summaries of reported WCPFC catches of striped marlin were aggregated across all years in the working paper. The WG requested that a table of annual catch values be provided for the reported WCPFC striped marlin catches. This was accomplished and the table was presented to the WG. This table provided necessary documentation and the WG agreed to include it as an appendix in the meeting report (Appendix).

It was noted that the striped marlin catches reported to the WCPFC by some countries had missing values. It was also suggested that Indonesia and Philippines catches were probably not reliably estimated on an annual basis. That is, it appeared that long-term averages of striped marlin catches were being reported instead of annual estimates. The WG considered the likely effect of such catches on the stock assessment and noted that the reported catches were not large enough to drive the stock assessment results in comparison to the large catches of other countries. Nevertheless, SPC would also determine if improved catch estimates could be attained for the Philippines and Indonesian longline fleets.

The WG requested that the missing values of striped marlin catches by non-ISC countries be filled in, or estimated, to produce a complete catch table. It was also agreed that the missing catch values would only be filled in after the first appearance of a positive catch value for the non-ISC reported catches by country. The WG considered this important because it did not want to inflate catches in years where it was unlikely that striped marlin were caught by non-ISC countries based on their self-reported data.

Brodziak and Tagami produced a method to fill in the catches of non-ISC countries in years after their first positive catch report of striped marlin. The method was applied sequentially to the annual rows in the WCPFC catch table and had two steps for filling in values of the current year. In the first step, the proportions of total reported catch by country were calculated in the previous year. The produced a set of proportions for all countries (ISC and non-ISC) of striped marlin catch proportion by weight in the previous year. In the second step, the missing values of catch for the non-ISC countries in the current year were estimated. The estimates of missing catch for the non-ISC countries were calculated by multiplying the catch proportions in the previous year by the total reported catch in the current year. This produced a new total reported catch in the current year that included the estimates of unreported catch from non-ISC countries. The two steps were then repeated for all successive years and the results were summarized (Table 1, Figure 1).

The WG discussed the method of estimating unreported catches and concluded that it was a viable approach. The WG noted that the approach was based on a simple assumption that the previous year's information on catch provided a reasonable estimate of the current year's catch patterns; this assumed that the estimation of catch could be approximated by a one-step ahead Markov process. The WG agreed to adopt the approach for estimating unreported catches of non-ISC countries. Overall, the WG concluded that that the reported WCPFC data for the North Pacific would be included in the current North Pacific striped marlin stock assessment where such data filled in gaps in the ISC catch table.

3.2 Biological information and catch rate of striped marlin captured by Chinese observer programme in the Pacific Ocean (ISC/11/BILLWG-2/10)

This report summarized the biological information and nominal catch rate (CPUE) data for striped marlin *Tetrapturus audax* collected in the Chinese longline observer programs in the tropical central-eastern Pacific Ocean from 2003 to 2010. The minimum size of captured striped marlin was 121 cm LJFL. The sex ratios of captured striped marlin seemed to be temporally and spatially dependent. The CPUEs of striped marlin were lower than 0.001 individuals per 1000 hooks.

Discussion

The WG noted that the historical Chinese billfish data were broken down by species beginning in 2008, reported in Table 1 of the WP. As a result, the WG noted that the Chinese catches of billfishes reported striped marlin catches from 2008-2010 and reported aggregate billfish catches reported from 2002-2007. The WG was interested in how the WCPFC estimates of Chinese striped marlin catches were determined using fishery sampling information. It was requested of China that data prior to 2002 be provided but it was clarified that there was no data collection system established prior to 2002. The WCPFC-based estimates of Chinese striped marlin catch prior to 2008 were derived by the SPC from log sheet, observer, and port sampling data from Chinese vessels fishing in Pacific Island EEZs. The WG concluded that the best available information on Chinese catches reported to the WCPFC would be included in the striped marlin stock assessment.

The WG also discussed the lack of catch data for striped marlin from some ISC countries in the ISC Billfish WG catch data tables for recent years. It was noted that these ISC countries had already submitted striped marlin catch data for the recent missing years in their catch data submitted to the WCPFC. It was recognized that these data may not be fully complete for a variety of reasons but that the catch data submitted to WCPFC represented the best available data for the current striped marlin stock assessment. As a result, the WG considered the catch data for striped marlin submitted to WCPFC for recent years where the ISC Billfish WG data were not reported would be the best available data.

3.3 Update of USA Billfish Catches in the North Pacific for 2008-2010 presented by Darryl Tagami (ISC/11/BILLWG-2/03)

This working paper provided data updates to the USA catch of swordfish, striped marlin, and blue marlin in the North Pacific for 2008 to 2010. The USA catch summaries were based on longline, troll, and handline fisheries for Hawaii, and the longline, gillnet, harpoon and sport fisheries for California. Catch estimates prior to 2005 were also corrected when necessary.

Discussion

This WP provided an update of USA catches of striped marlin and other billfishes for inclusion in the ISC catch tables. The WG noted that these catch data were the same as that submitted to the WCPFC for 2008-2010. For the EPO, it was noted that the data were most likely the same as that submitted to IATTC, but that it would be useful to check and verify this. The WG requested further information on some Hawaii fisheries for striped marlin. In this context, it was reported that the Hawaii troll fishery represented commercial fishing effort. It was also reported that the Hawaii recreational fishery caught some striped marlin but the amount was likely very small and was currently unknown. The WG also requested information on catches of striped marlin in the California gillnet fishery. In this case, it was noted that it is illegal to land striped marlin in all USA states except Hawaii. As a result, any striped marlin catches in the gillnet fishery would be discarded although such catches would be expected to be very low. Overall, the WG accepted the updated catch data from the USA for inclusion in the Billfish WG catch tables and the North Pacific striped marlin stock assessment.

4.0 STRIPED MARLIN CPUE TIME SERIES

4.1 Japanese Longline

4.1.1 CPUE standardization of Japanese offshore and long-distance longline fishery between 1975 and 2009 in North Central Pacific Ocean

Analyses were conducted to standardize Japanese offshore and long-distance longline CPUE during 1975-2009 in the North Central Pacific Ocean. The structural model used to standardize CPUE was based on the GLM equation, log(cpue + min(positive cpue) / 10) ~ year * area + year * s(hpb) + qt * area + normally distributed error term and this model was used for all analyses. The GLM-tree model applied to CPUE trend estimation was used to estimate an optimal area stratification for the North Central Pacific Ocean. The iterative algorithm to separate areas was stopped after nine steps and the ten separated areas were adopted for analysis because further separations would have required additional computing resources. Two optimal time separation points were detected by applying the GLM-tree to the predictor year. The time periods 1975 - 1992 and 1993 - 2009 were put forward as separate time strata. Thus there were two initial recommended CPUE indices for this fishery and these indices covered all areas. By following the WG recommendations about considering the totality of information on changes of operational, HPB distribution, targeted fish and length distribution of catch, the analyses of CPUE trend led to the selection of three separate areas and nine subareas to be used for CPUE standardization. Time separation points in 1986 and 1999 were also adopted based on similar information. As a result, there were 9 time series of CPUE stock indices by area and these were provided to the WG as alternatives to the original set of recommended indices.

<u>Discussion</u>

The working group discussed the appropriate stratification for developing fishery CPUE series to describe the Japanese Longline fleet. Discussion focused on two alternatives: 1) a single WCPO index and 2) three area-based fishery indices. Initial results of the CPUE standardization showed that developing CPUE for 3 areas resulted in residual patterns that were not normally distributed. Residual patterns for a single WCPO CPUE index were noticeably better but were also not normally distributed. However, the working group noted that there was some indication of smaller fish in the southern areas and that trends in CPUE were different by area. The working group also noted that changes in targeting sharks in recent years may have caused some of the residual patterns in the CPUE analysis. The working group recommended using 3 areas to characterize the longline fishery. The working group also endorsed a proposal for 3 temporally separate indices in each area defined as years: 1975-1986, 1987-1999 and 2000-2009. The WG agreed to the consideration of these CPUE time series for use in the striped marlin stock assessment. The WG also noted that it would be important to conduct a sensitivity analysis for the stock assessment that used a single area-combined CPUE index.

Four requests for additional information were made to the authors during the meeting and are listed below:

Request 1: Consider the use of three areas and three time periods for CPUE standardization.
Reason: Spatial and temporal heterogeneity was evident in the Japanese fishery data.
Outcome: This request was completed with analyses conducted during the meeting.

Request 2: Present an ANOVA table of model results for each model.
Reason: The ANOVA table is important for understanding and interpreting the results of the CPUE modeling.
Outcome: ANOVA tables were provided for all model runs.

Request 3: Perform sensitivity analyses with smaller (one-half) and larger (double) additive constants for the observed CPUE.
Reason: This request was made to better understand the effect of the additive constant on the estimated CPUE trend.
Outcome: Trends in the recent CPUE were examined and the estimated trends were nearly identical using different additive constants. The WG agreed that the additive constant did not have an important effect on the results of this analysis.

Request 4: Include smaller subareas as spatial factors in the GLM analyses for CPUE standardization.
Reason: It was hypothesized that the fishery may have switched targets and that this switching may have been responsible for some of the residual patterns. It was thought that using subareas may better account for this effect.
Outcome: Although finer-scale spatial information could not be included in the model, the authors proposed to change the time strata from 1987-1994 and 1995-2009 to 1987-1999 and 2000-2009 to account for operational changes (i.e., some new shark targeting as well as changes in the frequency of albacore versus bigeye tuna targeting). It was noted that the spatial structure in the GLM may have already accounted for this effect to some extent. The WG agreed to use the proposed temporal stratification for developing indices for the stock assessment.

4.1.2 CPUE standardization of Japanese offshore and long-distance longline fishery between 1952 and 1974 in North Central Pacific Ocean

Analyses were conducted to standardize CPUE of the Japanese offshore and long-distance longline fishery between 1952 and 1974 in North Central Pacific Ocean. The structural model used to standardize CPUE was based on the GLM equation, log(cpue + min(positive cpue) / 10) ~ year * area + qt * area + normally distributed error term; this model was used for all analyses. The GLM-tree model applied to CPUE trend was used to estimate a set of optimal area strata for the CPUE standardization. A total of nine separate fishery strata were estimated from this analysis. The set of optimal strata were applied to estimate a single standardized CPUE index and this was presented to the WG for consideration.

Discussion

The working group focused discussion on area stratification. Discussion focused on two alternatives: 1) use of a single WCPO area and 2) use of three area-based fishery definitions. The authors proposed to treat the pre-1975 fishery as a single fishery in the WCPO. The working group noted that the fishery had not expanded into the entire WCPO during the 1950s, which may result in hyper-stability (i.e. CPUE declining slower than actual relative abundance) in the early part of this series. It was noted that size composition data were available for the years 1970-1974. The working group endorsed a single area fishery and CPUE definition for the 1952-1974 period. The working group agreed to the consideration of this series for use in the assessment, preferably using only the years 1962-1974 which would be consistent with the last stock assessment. The WG also recommended that the effects of using an alternative standardized CPUE series estimated for 1952-1974 and of eliminating the estimated CPUE series for 1962-1974 from the stock assessment should be explored.

One request was made to the authors during the meeting and is listed below:

Request: Produce a standardized CPUE series for 1962-1974.
Reason: Prior to the 1960s the fishery expanded across the North Pacific. As a result, a separate GLM analysis was needed to estimate the 1962-1974 trends.
Outcome: A CPUE index was produced using the new area stratification and will be used in the assessment.

4.2 Japanese Driftnet

4.2.1 Standardized CPUE of striped marlin caught by Japanese coastal large-mesh drift fishery in the northwest Pacific in the periods between 2001 and 2009.

The CPUE of striped marlin caught by the Japanese coastal large-mesh drift fishery in the north Pacific was standardized for 2001 to 2009. The CPUE data used in the analysis were obtained from the skippers of coastal drift net boats for vessels that were larger than 70 GRT tons and that targeted striped marlin. These fishery data represented about 10% to 25 % of the total annual catch. Overall, the results of the CPUE analysis suggested a moderate downward trend in relative abundance of striped marlin on this fishing ground.

Discussion

This fishery operated in a small area during a short season but caught a relatively large amount of striped marlin. The WG questioned whether the CPUE of this fishery was representative of the relative abundance of striped marlin in the northwest and central Pacific. It was noted that this fishery seasonally targets striped marlin and that the fishing grounds coincided with a major migration corridor for striped marlin. There were also large differences in fishery CPUE between the 3rd and 4th quarters. These differences in quarterly CPUE were thought to be affected by the migratory pattern of striped marlin. In particular, the fishing grounds of this fishery coincide with the northern part of a striped marlin migration area from which striped marlin migrate as water temperature seasonally decreases.

The WG noted the limited spatial extent of the data. The authors pointed out that the driftnet fishery catch was relatively large (average annual catch of approximately 1200 t during 2001-2008), although the CPUE series was derived from a subset of the fishery operations. The working group noted that effort standardization did not include soak time or net depth. The authors clarified that operations were typically one night and that fishing nets were made by a single company and therefore uniform in depth. The working group also noted that the seasonal coefficients in the CPUE standardization were very different. Authors clarified that the seasonal effect was due to migration patterns and that the proportion of zero catches was low in season 3 but was nearly 50% in season 4. It was also noted that the mesh size effect in the CPUE analysis may have been aliased with a vessel captain effect. Furthermore, the working group noted that the Year*Quarter interaction term used in the model was not significant, did not explain much deviance, and may not be appropriate. Due to the small spatial coverage and modeling issues, the working group recommended that this CPUE index be evaluated in the stock assessment model for consistency with other data.

4.2.2 Standardized CPUE of striped marlin caught by Japanese (High Seas) large-mesh drift fishery in the north Pacific for the periods between 1977 and 1993 presented by Kotaro Yokawa (ISC\05\MAR&SWOWG\18)

Estimates of standardized CPUE of striped marlin caught by Japanese high seas drift netters in the period between 1977 and 1993 were re-examined (ISC/05/MAR&SWO-WGs/18). During 1977-1993, large mesh drift net targets were used to target swordfish, albacore, skipjack as well as striped marlin. The net size of this fishery was larger than that for targeting frying squid whose data were excluded from this analysis. The CPUE of striped marlin was defined by the catch number of striped marlin per 10km of net, and it was standardized using factors of year, area, quarter and size of mesh. The main fishing ground of this fishery occurred in the subtropical and temperate area in the northwest Pacific (west of the international dateline), but similar fishery effort also occurred in the northeastern Pacific as well as in the East China Sea. Overall, estimates of standardized CPUE decreased in the part of the time series and then increased in the later part. This pattern of CPUE decline followed by increase was robust to the selection the data used in the analysis (e.g., the results using all data were similar to the results using only data from the main fishing ground).

Discussion

The additive constant used for the GLM analysis in this study was 5% of the mean CPUE. Sensitivity analyses were conducted for alternative values of the additive constant, including 10% of the minimum value of observed CPUE. These sensitivity analyses showed that the CPUE time series based on the alternative additive constants had trends that were similar to the estimates of standardized CPUE in the WP. It was also noted that most of the size composition data for this fishery were processed weight data (gilled and gutted weights) which were converted to eye-fork length data using the conversion factors calculated from port sampling data obtained in recent years.

The working group discussed the fact that area 1 (South China Sea) was far away from the other high seas driftnet areas. The authors explained that this area had little influence on the estimated CPUE series. The working group also noted that the constant added to observed CPUE was larger than the constant used in the longline analysis (see below). Based on the analyses presented, the working group recommended consideration of this index for use in the stock assessment.

One request was made to the authors during the meeting and is listed below:

Request: Show the effects of assuming alternative additive constants for CPUE standardization.
Reason: This request was made to better understand the effect of the assumed additive constant on the estimated CPUE trend.
Outcome: The choice of additive constant did not have a strong impact on the CPUE trends.

4.3 Japanese Coastal Longline

Estimates of standardized CPUE of striped marlin caught by Japanese coastal longliners were updated through 2009 using GLM analyses. The trend of standardized CPUE decreased rapidly until 2000, and then exhibited a moderate decrease. The results of CPUE standardizations using a GLM and a Delta-Lognormal model had similar trends. The distribution of CPUE residuals was skewed, which was similar to the pattern in the analysis for the previous assessment.

Discussion

The working group noted that the coastal longline fleet had a wider distribution of effort than just around the Japan coast. It was also noted that the standardized CPUE of the coastal fleet was used in previous assessment as two series. The WG agreed to the consideration of this series for use in the assessment.

The main fishing ground of Japanese coastal longliners was in the area north of 20°N and west of 160°, but there were some coastal longline operations south of 20°N and east of 160°. These southern data were mostly obtained from longliners unloading their catch in foreign ports such as Guam, but the number of trips was relatively small. It was noted that the main source of size composition data for this fishery was from port sampling. Because the landing ports of coastal longliners differ from the ones of offshore and distant-water longliners, the size composition data for the coastal longline fishery were easy to identify using reported landing port.

5.0 BIOLOGICAL AND ECOLOGICAL DATA

5.1 Age and growth of striped marlin *(Kajikia audax)* in the waters off Taiwan: A revision presented by Nan-Jay Su (ISC/11/BILLWG-2/07)

Age and growth patterns of striped marlin in waters off Taiwan were re-examined from counts of growth rings on cross sections of the fourth spine of the first dorsal fin with length measurements on lower jaw fork length (LJFL), instead of eye fork length (EFL) which was used in the previous working paper to fit the growth model of striped marlin (ISC/11/BILLWG-1/09), for comparison with results of other studies. A total of 241 and 206 spines were successfully aged for males and females respectively. The back-calculated lengths for each age were computed using Fraser-Lee's and Monastyrsky's methods, and then used to fit the standard von Bertalanffy growth function (VBGF) and the Richards growth function. Results showed that the fits to the Richards function were substantially better than those for standard VBGF based on AIC statistics. The estimated growth equations for male and female striped marlin were not statistically different based on an analysis of residual sum of squares (ARSS, P>0.05). The estimated values of growth parameters of Richards function for striped marlin in waters off Taiwan were: L_{inf} = 263.44 cm LJFL (or 228.30 cm EFL), t_0 = -0.40 year, K = 0.04 year $^{-1}$, and m = -2.05.

Discussion

The working group discussed comparisons of the new growth curve with the growth curve presented in the last meeting in January, 2011 (ISC/11/BILLWG-1/09). The presenter stated that the growth patterns were similar, but there were slight differences in the estimated growth parameters. The WG indicated that the maximum size in the Japanese drift net and harpoon fishery (> 250 EFL) was larger than the observed maximum size of this working paper. Several discussions focused on L_{inf} (or maximum age) for the striped marlin population, values of age-at-maturity and the meaning of the plus group for the stock assessment model. The WG discussed size measurements and suggested EFL as the standard measure for data analysis. The WG also discussed the variability of the estimated size-at-age and considered how to justify the variability for the quarterly length-frequency fitting in SS3. The initial size-at-age (i.e., 0.5 year^{-1}) was also discussed, and the presenter suggested that the result of spine ageing was adjusted based on reading the daily rings of otoliths. However, the WG suggested that the sample size and sampling month for the smaller sized fish may have influenced the results of otolith ageing. The authors clarified the aging method using in WP was consistent with other striped marlin age and growth studies (e.g. Kopf 2010). Finally, the WG discussed the growth models for striped marlin in comparison to historical studies (e.g., Melo-Barrera et al. (2003), L_{inf} =221 cm LJFL) and concluded that the growth parameters of this working paper were the best available scientific information to represent the mean pattern of growth for striped marlin in the North Pacific Ocean. However, the WG also recommended that further aging samples be collected to improve the available information on striped marlin growth.

5.2 Correction to Meta-analysis of striped marlin natural mortality presented by Kevin Piner (ISC/11/BILLWG-2/08)

Natural mortality (M) estimates for North Pacific Ocean striped marlin were derived from a meta-analysis of 9 different estimators and presented to the ISC Billfish Working Group in January 2011. The M estimators relied on a range of life history parameters (e.g. maximum age, maximum size, growth rate) to predict M and a broad range of levels within each factor was used to estimate within-method uncertainty. Changes were made to the previous analysis to incorporate new information on age and growth as well as maturation presented during the current meeting. In particular, a revision was made to the age and growth paper presented at the January meeting. The new paper resulted in changes to the growth form and resulting age at 50% maturity. We accounted for these developments in a new analysis conducted using the same methods described in the January meeting.

The overall M estimate was based on a random effects inverse variance weighting of each method (0.38 –yr +- 0.028 SE). The estimate of M was assumed to represent adult M and a Lorenzen size-M relationship was used to rescale adult M to represent juvenile M. Age-classes corresponding to juveniles was based on two studies by Sun et al. (ISC/11/BILLWG-1/09, ISC/11/BILLWG-1/11) and adopted by the Working Group. Natural mortality estimates for ages 0 to 3, and ages 4 and older were: 0.54, 0.47, 0.43, 0.40, and 0.38, respectively. The age-specific estimates of M are summarized below.

Age	Natural Mortality Rate
0	0.54
1	0.47
2	0.43
3	0.40
4+	0.38

Discussion

This presenter provided an updated estimate of natural mortality based on the revision of the age and growth working paper presented at this meeting. There was no further discussion of this paper.

5.3 Reproductive biology of male striped marlin, *Kajikia audax*, in the waters off Taiwan presented by Yi-Jay Chang (ISC/11/BILLWG-2/09)

The reproductive biology of male striped marlin, *Kajikia audax*, was examined using data collected from July 2004 to September 2010 in the waters off Taiwan. Testis maturity was classified into five stages (i.e., immature, developing, mature, ripe, and resting) on the basis of morphological changes in the germinal epithelium. The estimated minimum size-at-maturity was 120.8 cm eye-to-fork length (EFL) and the size-at-50% maturity was 146.96 cm EFL. It was difficult to clearly differentiate the testis maturity stage based solely on the gonadosomatic index (GSI) class because each GSI class contained mature fish. Although mature individuals dominated throughout the year, monthly changes in mean GSI values and the proportions of testicular maturity stage generally indicated a seasonal cycle. These results imply that male striped marlin in this area showed evidence of spawning activity throughout the year with a peak spawning season from April to August.

Discussion

The WG discussed the spawning season of male striped marlin. The monthly changes in mean GSI values and the proportions of testicular maturity stage generally indicated a seasonal cycle, and suggested that male striped marlin showed evidence of spawning activity throughout the year with a peak spawning season from April to August. Similar reproductive cycles were found in other billfishes in different areas, and the presenter suggested that the estimated spawning season of this working paper can be applied to the North Pacific Ocean.

5.4 Probable value of steepness for north Pacific striped marlin presented by Jon Brodziak (ISC/11/BILLWG-2/11)

The simulation method of Mangel et al. (2010) was applied to estimate probable values of stock-recruitment steepness for a Beverton-Holt stock-recruitment curve for Western and Central North Pacific striped marlin (*Kajikia audax*). In this application, new information on the mean batch fecundity per body mass, spawning frequency, and spawning season of striped marlin along with existing information on striped marlin life history parameters consistent with the proposed stock assessment model for Western and Central North Pacific striped marlin was gathered. Results of the baseline steepness model indicated that the mean steepness estimate was uh = 0.87 with a standard deviation of sigma = 0.05. This steepness estimate was roughly equal to the average of the two values of steepness that were assumed in separate assessment scenarios (uh = 0.75 and uh = 1) for the 2007 North Pacific striped marlin assessment in the absence of any empirical information on the probable value of stock-recruitment steepness. Overall, the results of our analyses suggested that the stock-recruitment dynamics of North Pacific striped marlin were probably highly resilient. Our results also indicated that the estimated mean steepness of North Pacific striped marlin was significantly lower than unity (i.e., $\mu_h = 1$) based on the best information currently available for stock assessment. Further, sensitivity analyses indicated that the new life history parameters to be used in the current stock assessment implied a higher steepness than those used in the previous assessment.

<u>Discussion</u>

This working paper presented probable values of the steepness parameter for the Beverton Holt stock-recruitment relationship. The simulation-based approach followed in the analysis was the same as that previously applied to Pacific bluefin tuna and published in Mangel et. al (2010). The approach utilized available biological data for striped marlin including: growth, maturity, length of spawning season, the length/weight relationship, relative fecundity (eggs per gram of body weight), frequency of spawning, natural mortality, and the length of the egg/larvae/juvenile stage durations (analogous to the t0 parameter from the Von Bertalanffy growth curve). The analysis used the most recently updated estimates of the biological parameters presented at this meeting (ISC/11/BILLWG-1/09, ISC/11/BILLWG-1/11).

For many of these parameters uncertainty was included in this simulation approach and a distribution of probable values for steepness. The distribution could be approximated by a distribution with mean 0.87 and standard deviation of 0.05 (beta distribution parameters of a=24.44 and b=4.68, which were based on the maximum likelihood fit to the empirical distribution of steepness estimates). Additionally the analysis considered alternative hypotheses regarding some of the processes that were not currently included in the simulation approach, in particularly, the length of the spawning season and the duration of the early life history period.

The later sensitivity analysis was considered particularly important as the value for early life history stage duration used in the analysis was based on a value for Pacific bluefin rather than from the striped marlin growth study. The t_0 value from the striped marlin growth curve was not considered appropriate as this parameter was likely to be poorly estimated in the analysis because it was outside the range of the data.

The WG agreed that the base case distribution be used as one scenario in the assessment (Figure 1.1 from the WP), but that it would be important to consider alternative scenarios for sensitivity that took into account some of the uncertainty in the length of the spawning season and the duration of the early life history period. The WG noted that additional research on the early life history and spawning dynamics of striped marlin would help refine the range of probable values of steepness.

5.5 Biological information and catch rate of striped marlin captured by Chinese observer programme in the Pacific Ocean, presented by Xiaojie Dai (ISC/11/BILLWG-2/10)

This report summarized the biological information and nominal catch rate (CPUE) data for striped marlin *Tetrapturus audax* collected in the Chinese longline observer programs in the tropical central-eastern Pacific Ocean from 2003 to 2010. The minimum size of captured striped marlin was 121 cm LJFL. The sex ratios of captured striped marlin seemed to be temporally and spatially dependent. The CPUEs of striped marlin were lower than 0.001 individuals per 1000 hooks.

Discussion

The WG discussed the availability of length frequency data as input for an SS3 model. There was also a discussion of the variation in sex ratio reported in this working paper, and it was suggested that variation in sex ratios, in particular skewed ratios, may be related to spawning activity. The presenter indicated that there may have been a bias in determining sexes due to the lack of experience of some observers in sex identification. The WG also discussed the fact that the mean size of fish in one trip (trip 4 in WP) was relatively larger than the other trips. The presenter explained that there may have also been some bias in size measurements due to in-experienced observers.

5.5 Multinational Pacific Billfish Tagging Program – Status of Electronic Tagging in Eastern Taiwan presented by Wei-Chuan Chiang (ISC/11/BILLWG-2/12)

This program utilized the local eastern Taiwan harpoon fishing fleet to deploy pop-up satellite archival tags (PSATs) on billfish to determine habitat and ecosystem characterizations, as well as data to advance the development of a multinational Pacific Ocean billfish tagging program. To date, a total of 27 PSATs have been deployed via harpoon on 2 striped marlin, 7 black marlin and 18 blue marlin in eastern Taiwan coastal waters. Continuing these deployments of PSATs on marlin using harpoon vessels or longline vessels would increase the data resources and enable us to better characterize marlin movements and habitat preferences in northwest Pacific Ocean. These results can provide useful data to parameterize a simulation model to help develop a statistical sampling protocol for a Pacific-wide billfish tagging research effort.

Discussion

The WG agreed that more tagging and simulation studies were needed to improve the design of this study. The WG noted that obtaining tagging data for the blue marlin stock assessment would be important, via acknowledgements and cooperation with data owners.

There was some concern in the WG about using electronic tagging data directly in the stock assessment. However, it was noted that there is currently a PFRP project funded to look at inclusion of electronic tagging data in assessment. It was also noted that the current tagging sample sizes may be insufficient for determining mixing and movement rates that could be assumed to represent the overall population of Pacific blue marlin.

6.0 COLLABORATIVE EFFORTS

6.1 Report of the PIFSC and IATTC collaborative sensitivity analysis of EPO striped marlin stock assessment presented by Kevin Piner (ISC/11/BILLWG-2/04)

A series of model sensitivity analyses were conducted on the 2010 IATTC stock assessment of EPO striped marlin. Model sensitivity runs were focused on examining the causes of model misfit. Results indicated a conflict between the purse seine observations and other data components owing to the unusually large size of fish in the purse seine samples. However resolving these conflicts may not change the management interpretation of the assessment.

Discussion

The working group noted that the collaboration produced a model with an overall better fit to the data than the current base model. The IATTC will be noting the results of this work, which indicated that the statement of stock status by the IATTC was robust to the issues examined The WG encouraged further collaborative efforts on the EPO striped marlin stock assessment.

6.2 Billfish Biological Sampling

The ISC BILLWG Chairman reviewed the available biological data for stock assessment. At this point, insufficient funding limits the implementation of the ISC sampling program. Biological sampling is a critical component of all stock assessment efforts.

SPC informed the WG that it has been collecting biological samples from bigeye and albacore tuna throughout the WCPO and trains observers in the collection of biological samples. It might be possible in the future to coordinate the collection of billfish samples with SPC (if training materials can be provided).

7.0 WORK PLAN

Gerard DiNardo discussed the work plan for the upcoming blue marlin stock assessment previously scheduled for completion in July 2012. This deadline has been postponed until December 2012 due to the delay in completion of the North Pacific striped marlin assessment. After the blue marlin assessment is completed in December 2012, it will be presented at the ISC Plenary 2013 for endorsement.

The Chair informed the WG of the peer review process that has already been used for the 2009 ISC BILLWG North Pacific swordfish assessment, and intends to use the same review process for the 2012 ISC BILLWG blue marlin assessment, as well as the 2012 North Pacific striped marlin assessment, at no cost to the ISC. This independent peer review process will be run by the Center for Independent Experts (CIE). The CIE is a program designed to conduct independent peer reviews of the science carried out by NOAA Fisheries.

Discussion

The WG discussed that a desktop-style peer review of the striped marlin assessment may be insufficient for providing a comprehensive review. It was noted that in some cases, having a face-to-face review process with an expert panel, was essential for identifying and resolving some key problems in stock assessments. It was also noted that desktop-style peer reviews can be appropriate in certain circumstances, for example, when the reviewers have access to the assessment scientists.

The WG noted that because blue marlin is currently considered a pan-Pacific stock, the engagement from many agencies would be advantageous in completing the stock assessment.

8.0 FUTURE MEETINGS

The ISC11 Plenary meeting will be held in San Francisco, California, USA from 20-25 July 2011.

The next intercessional BILLWG workshop is scheduled for the first two weeks of December 2011 in Honolulu, Hawaii, USA. Because many of the BILLWG members overlap with the ISC Shark WG, and to reduce the amount of travel for WG members, the next intercessional BILLWG workshop will be scheduled in conjunction with the ISC Shark WG workshop.

The following intercessional workshop is tentatively scheduled for April 2012.The decision on location and exact dates for this meeting will be decided at a later time.

9.0 OTHER BUSINESS

9.1 ISC Billfish Chairperson Elections

Jon Brodziak was unanimously elected the next ISC Billfish Chairman. The WG thanked the outgoing Chairperson Gerard DiNardo for a job well done.

9.2 Work Assignments

The BILLWG were given a number of assignments:

- Submit all outstanding catch, standardized CPUE, and size composition data for the striped marlin stock assessment by June 30, 2011 to the Billfish WG Chair.
- Finalize all working papers submitted at this meeting by June 30, 2011.
- ISC member countries need to submit maps of effort by fishery at the appropriate and temporal resolution (e.g. 5x5 maps). The ISC BILLWG Chairman will clarify the details at a later time.

The Chairman of the ISC BILLWG was assigned:

- Send request detailing the maps of effort by fishery that BILLWG members need to submit.
- Revise striped marlin catch data tables (i.e., Tables 2 and 3) to reflect new catch data provided at this meeting.
- The ISC BILLWG Chair will inquire with the STATWG about data for mapping fishing effort.

10.0 ADJOURNMENT

The ISC BILLWG intercessional workshop was adjourned at 11:30am on 1 June 2011. The Chairman expressed his appreciation to all participants for their contributions and cooperation in completing a successful meeting. Chi-Lu Sun and his staff were also especially thanked for hosting the meeting.

11.0 REFERENCES

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Figure 1. Catches of North Pacific striped marlin (t) reported to the WCPFC by Japan, Korea, Chinese Taipei, and USA (solid circle) and other countries (open circle) along with estimates of unreported striped marlin catch (t) by other countries (solid triangle).

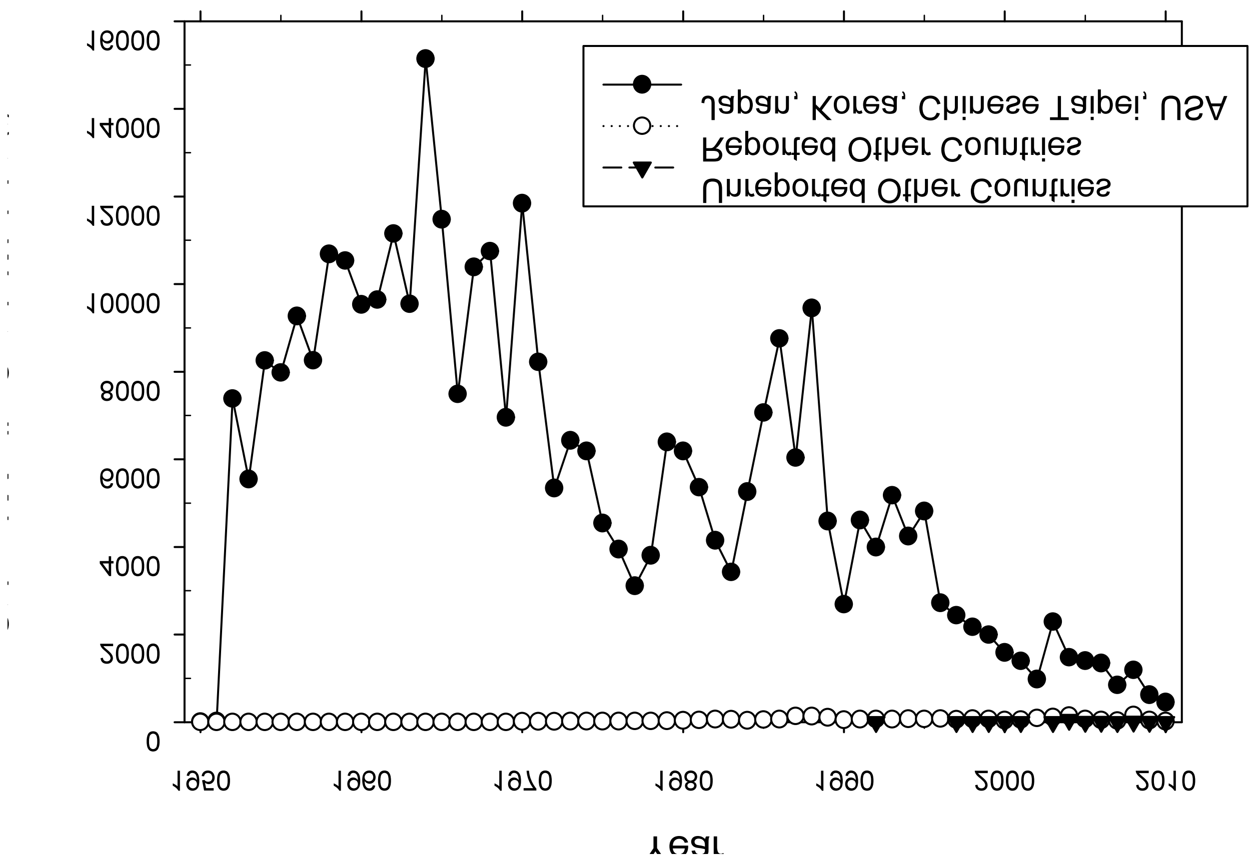

Table 1. Estimates of unreported North Pacific striped marlin catches (t) by non-ISC countries.

Year	Philippines	Indonesia	Vanuatu	Federated States of Micronesia	Belize
1992				0.04	
1993					
1994					
1995					
1996					
1997			0.06		
1998			0.05		
1999			0.05		
2000			0.04		
2001			0.03		
2002					
2003				0.26	
2004	6.29	47.88			
2005	5.88				
2006	5.56			0.63	
2007	3.51	0.25			
2008	5.38	0.39			4.15
2009	2.64	0.19			2.04
2010	1.87	0.13			

Table 2. Striped marlin catches (in metric tons) by fisheries, 1952-2010. Blank (“ “) indicates no effort. Dash (“–“) indicates data not available. Zero (“0”) indicates a catch of less than 1 metric ton.

	Japan							Mexico			United States					Costa Rica	
Year	Distant-water and Offshore Longline	Coastal Longline	Other Longline	Small Mesh Gillnet	Large Mesh Gillnet	Other[3]	Japan Total	Longline	Sport[2]	Mexico Total	Longline	Troll	Handline	Sport[2]	US Total	Sport	WCPFC non-ISC Countries[4]
1951	2,494	-	673	-	0	1,281	4,448										
1952	2,901	-	722	-	0	1,564	5,187							23	23		
1953	2,138	-	47	-	0	954	3,139							5	5		
1954	3,068	-	52	-	0	1,088	4,207							16	16		
1955	3,082	-	28	-	0	1,038	4,148							5	5		
1956	3,729	-	59	-	0	1,996	5,785							34	34		
1957	3,189	-	119	-	0	2,459	5,767							42	42		
1958	4,106	-	277	-	3	2,914	7,300							59	59		
1959	4,152	-	156	-	2	3,191	7,501							65	65		
1960	3,862	-	101	-	4	1,937	5,904							30	30		
1961	4,420	-	169	-	2	1,797	6,388							24	24		
1962	5,739	-	110	-	8	1,912	7,769							5	5		
1963	6,135	-	62	-	17	1,910	8,124							68	68		
1964	14,304	-	42	-	2	2,344	16,692							58	58		
1965	11,602	-	19	0	1	2,794	14,416							23	23		
1966	8,419	-	112	0	2	1,570	10,103							36	36		
1967	11,698	-	127	0	3	1,551	13,379							49	49		
1968	15,913	-	230	0	0	1,043	17,186							51	51		
1969	8,544	600	3	0	3	2,668	11,818							30	30		
1970	12,996	690	181	0	3	1,032	14,902							18	18		11
1971	10,965	667	259	0	10	2,042	13,943							17	17		12
1972	7,006	837	145	0	243	993	9,224							21	21		13
1973	6,357	632	118	0	3,265	702	11,074							9	9		15
1974	6,700	327	49	0	3,112	775	10,963							55	55		17
1975	5,281	286	38	0	6,534	686	12,825							27	27		18
1976	5,136	244	34	0	3,561	585	9,560							31	31		15
1977	3,019	256	15	0	4,424	547	8,261							41	41		21
1978	3,957	243	27	0	5,593	546	10,366							37	37		21
1979	5,561	366	21	0	2,532	526	9,006							36	36		26
1980	6,378	607	5	0	3,467	536	10,993							33	33		32
1981	4,106	259	12	0	3,866	542	8,785							60	60		43
1982	5,383	270	13	0	2,351	656	8,673							41	41		61
1983	3,722	320	10	22	1,845	827	6,746							39	39		59
1984	3,506	386	9	76	2,257	719	6,953							36	36		36
1985	3,897	711	24	40	2,323	733	7,728					18		42	60		51
1986	6,402	901	33	48	3,536	577	11,497	-				19		19	38		62
1987	7,538	1,187	6	32	1,856	513	11,132	-			272	30	1	28	331		137
1988	6,271	752	7	54	2,157	668	9,909	-			504	54		30	588		129
1989	4,740	1,081	13	102	1,562	537	8,035	-			612	24	0	52	688		101
1990	2,368	1,125	3	19	1,926	545	5,986	-	181	181	538	27	0	23	588		50
1991	2,845	1,197	3	27	1,302	507	5,881	-	75	75	663	41	0	12	716	106	61
1992	2,955	1,247	10	35	1,169	303	5,719	-	142	142	459	38	1	25	523	281	66
1993	3,476	1,723	1	-	828	708	6,736	-	159	159	471	68	1	11	551	438	60
1994	2,911	1,284	1	-	1,443	383	6,022	-	179	179	326	35	0	17	378	521	72
1995	3,494	1,840	3	-	970	283	6,590	-	190	190	543	52	0	14	609	153	68
1996	1,951	1,836	4	-	703	152	4,646	-	237	237	418	54	1	20	493	122	73
1997	2,120	1,400	3	-	813	163	4,499	-	193	193	352	38	1	21	412	138	55
1998	1,784	1,975	2	-	1,092	304	5,157	-	345	345	378	26	0	23	427	144	69
1999	1,608	1,551	4	-	1,126	184	4,473	-	266	266	364	28	1	12	405	166	68
2000	1,152	1,109	8	-	1,062	297	3,628	-	312	312	200	14	1	10	225	97	41
2001	985	1,326	11	-	1,077	237	3,636	-	237	237	351	42	2	-	395	151	50
2002	764	796	5	-	1,264	290	3,119	-	305	305	226	30	0	-	256	76	88
2003	1,013	842	3	-	1,064	203	3,124	-	322	322	552	29	0	-	581	79	105
2004	699	1,000	2	-	1,339	92	3,132	-	-	0	376	34	1	-	411	19 [1]	137
2005	562	668	1	0	1,214	98	2,543	-	-	0	511	20	0	-	531	- [1]	66
2006	623	539	1	0	1,190	95	2,448	-	-	-	611	21	0	-	632	-	42
2007	306	860	5	-	970	79	2,220	-	-	-	276	13	0	-	289	-	31
2008	390 [1]	609 [1]	10 [1]	- [1]	1,302[1]	97 [1]	2,408[1]	-	-	-	426	14	0	-	440	-	154
2009	166 [1]	606 [1]	21 [1]	- [1]	821 [1]	90 [1]	1,704[1]	-	-	-	256 [1]	10 [1]	0 [1]	-	266 [1]	-	41
2010	-	-	-	-	-	-	109 [5]	-	-	-	158 [1]	5 [1]	0 [1]	-	163 [1]	-	16
2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Provisional data

[2] Estimated from catch in number of fish

[3] Contrains bait fishing, net fishing, trapnet, trolling, harpoon, etc

[4] Contains catches reported to the WCPFC by the Philippines, Indonesia, China, Vanuatru, Federated States of Micronesia, and Belize, totaled with the estimated unreported catch by the Philippines, Indonesia, Vanuatu, Federated States of Micronesia, and Be

[5] From Appendix

Table 2. (Continued) Striped marlin catches (in metric tons) by fisheries, 1952-2010. Blank (" ") indicates no effort. Dash ("–") indicates data not available. Zero ("0") indicates a catch of less than 1 metric ton.

Year	Chinese Taipei[2]												Korea			Grand Total
	Distant-water Longline	High-seas Drift Gillnet	Offshore Longline	Offshore Gillnet	Offshore Others	Coastal Harpoon	Coastal Setnet	Gillnet & Other net	Coastal Longline	Coastal Others	Other	Chinese Taipei Total	Longline	High-seas Drift Gillnet	Korea Total	
1951														-		4,448
1952												-	-	-	-	5,210
1953												-	-	-	-	3,144
1954												-	-	-	-	4,223
1955												-	-	-	-	4,153
1956												-	-	-	-	5,819
1957												-	-	-	-	5,809
1958			543								387	930	-	-	-	8,289
1959			391								354	745	-	-	-	8,311
1960			398								350	748	-	-	-	6,682
1961			306								342	648	-	-	-	7,060
1962			332								211	543	-	-	-	8,317
1963			560								199	759	-	-	-	8,951
1964			392								175	567	-	-	-	17,317
1965			355								157	512	-	-	-	14,951
1966			370								180	550	-	-	-	10,689
1967	2		385								204	591	-	-	-	14,019
1968	1		332								208	541	-	-	-	17,778
1969	2		571								192	765	-	-	-	12,613
1970	0		495								189	684	-	-	-	15,615
1971	0		449								135	584	0	-	0	14,556
1972	9		380								126	515	0	-	0	9,773
1973	1		568								139	708	0	-	0	11,806
1974	24		650								118	792	0	-	0	11,827
1975	64		732								96	892	0	-	0	13,761
1976	32		347								140	519	0	-	0	10,125
1977	17		524								219	760	43	-	43	9,126
1978	0		618								78	696	28	-	28	11,149
1979	26		432								122	580	-	-	-	9,648
1980	61		223								132	416	37	-	37	11,512
1981	17		491								95	603	-	-	-	9,490
1982	7		397								138	542	39	-	39	9,356
1983	0		555								214	769	19	-	19	7,632
1984	0		965								330	1,295	23	-	23	8,342
1985	0		513								181	694	16	-	16	8,550
1986	0		179								148	327	61	-	61	11,985
1987	31		383								151	565	1	-	1	12,166
1988	7		457								169	633	11	-	11	11,270
1989	8		184								157	349	26	-	26	9,199
1990	2		137								256	395	315	-	315	7,515
1991	36		254								286	576	141	-	141	7,556
1992	1		219								197	417	318	-	318	7,466
1993	5		221								142	368	388	-	388	8,700
1994	1		137								196	334	1,045	-	1045	8,552
1995	27		83								82	192	307	-	307	8,109
1996	26		162	8	6	30	3	-	-	-	-	235	429	-	429	6,236
1997	59		290	9	-	33	3	-	2	-	-	396	1,017	-	1017	6,710
1998	90		205	15	-	19	6	1	9	-	-	345	635	-	635	7,122
1999	66		128	7	-	26	5	1	3	-	-	236	433	-	433	6,047
2000	153		161	17	1	29	6	1	1	-	-	369	537	-	537	5,209
2001	121		129	16	-	30	5	-	-	-	-	301	254	-	254	5,024
2002	251		226	14	-	6	8	1	-	-	-	506	188	-	188	4,539
2003	241		91	26	-	11	5	1	-	-	-	375	206	-	206	4,792
2004	261		95	8	1	7	5	2	-	1	-	380	75	-	75	4,154 [1]
2005	176		76	1	-	5	9	9	-	8	-	284	141	-	141	3,565 [1]
2006	-	-	-	-	-	-	-	-	-	-	-	123 [5]	56	-	56	3,301 [1]
2007	-	-	-	-	-	-	-	-	-	-	-	260 [5]	28	-	28	2,828 [1]
2008	-	-	-	-	-	-	-	-	-	-	-	196 [5]	-	-	56 [5]	3,254 [1]
2009	-	-	-	-	-	-	-	-	-	-	-	198 [5]	-	-	44 [5]	2,253 [1]
2010	-	-	-	-	-	-	-	-	-	-	-	183 [5]	-	-	30 [5]	501 [1]
2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Provisional data

[2] Estimated from catch in number of fish

[3] Contrains bait fishing, net fishing, trapnet, trolling, harpoon, etc.

[4] Contains catches reported to the WCPFC by the Philippines, Indonesia, China, Vanuatru, Federated States of Micronesia, and Belize, totaled with the estimated unreported catch by the Philippines, Indonesia, Vanuatu, Federated States of Micronesia, and Belize

[5] From Appendix

Table 3. Swordfish catches (in metric tons) by fisheries, 1952-2010. Blank (" ") indicates no effort. Dash ("–") indicates data not available. Zero ("0") indicates a catch of less than 1 metric ton.

	Japan								Mexico	United States[6]					
										Hawaii	California				
Year	Distant-water and Offshore Longline	Coastal and Other Longline	Squid Driftnet and Driftnet	Harpoon[3]	Bait Fishing	Trapnet	Other[4]	Japan Total	All Gears	Longline	Longline	Gill Net	Harpoon	Unknown[7]	US Total
1951	7,246	115	10	4,131	88	78	10	11,678	-	-	-	-	-	-	-
1952	8,890	152	0	2,569	6	68	6	11,691	-	-	-	-	-	-	-
1953	10,796	77	0	1,407	20	21	87	12,408	-	-	-	-	-	-	-
1954	12,563	96	0	813	104	18	17	13,610	-	-	-	-	-	-	-
1955	13,064	29	0	821	119	37	41	14,111	-	-	-	-	-	-	-
1956	14,596	10	0	775	66	31	7	15,486	-	-	-	-	-	-	-
1957	14,268	37	0	858	59	18	11	15,251	-	-	-	-	-	-	-
1958	18,525	42	0	1,069	46	31	21	19,734	-	-	-	-	-	-	-
1959	17,236	66	0	891	34	31	10	18,267	-	-	-	-	-	-	-
1960	20,058	51	1	1,191	23	67	7	21,400	-	-	-	-	-	-	-
1961	19,715	51	2	1,335	19	15	11	21,147	-	-	-	-	-	-	-
1962	10,607	78	0	1,371	26	15	18	12,115	-	-	-	-	-	-	-
1963	10,322	98	0	747	43	17	16	11,244	-	-	-	-	-	-	-
1964	7,669	91	4	1,006	40	16	26	8,852	-	-	-	-	-	-	-
1965	8,742	119	0	1,908	26	14	182	10,991	-	-	-	-	-	-	-
1966	9,866	113	0	1,728	41	11	4	11,763	-	-	-	-	-	-	-
1967	10,883	184	0	891	33	12	5	12,008	-	-	-	-	-	-	-
1968	9,810	236	0	1,539	41	14	9	11,649	-	-	-	-	-	-	-
1969	9,416	296	0	1,557	42	11	14	11,336	-	-	-	-	-	-	-
1970	7,324	427	0	1,748	36	9	3	9,547	-	5	-	-	612	10	627
1971	7,037	350	1	473	17	37	31	7,946	-	1	-	-	99	3	103
1972	6,796	531	55	282	20	1	2	7,687	2	0	-	-	171	4	175
1973	7,123	414	720	121	27	23	2	8,430	4	0	-	-	399	4	403
1974	5,983	654	1,304	190	27	16	2	8,176	6	0	-	-	406	22	428
1975	7,031	620	2,672	205	58	18	2	10,606	-	0	-	-	557	13	570
1976	8,054	750	3,488	313	170	14	12	12,801	-	0	-	-	42	13	55
1977	8,383	880	2,344	201	71	7	2	11,888	-	17	-	-	318	19	354
1978	8,001	1,031	2,475	130	110	22	1	11,770	-	9	-	-	1,699	13	1,721
1979	8,602	1,038	983	161	45	15	4	10,848	7	7	-	-	329	57	393
1980	6,005	849	1,746	398	29	15	1	9,043	380	5	-	160	566	62	793
1981	7,039	727	1,848	129	58	9	3	9,813	1,575	3	0	473	271	2	749
1982	6,064	874	1,257	195	58	7	1	8,456	1,365	5	0	945	156	10	1,116
1983	7,692	999	1,033	166	30	9	2	9,931	120	5	0	1,693	58	7	1,763
1984	7,177	1,177	1,053	117	98	13	0	9,635	47	3	12	2,647	104	75	2,841
1985	9,335	999	1,133	191	69	10	0	11,737	18	2	0	2,990	305	104	3,401
1986	8,721	1,037	1,264	123	47	9	0	11,201	422	2	0	2,069	291	109	2,471
1987	9,495	860	1,051	87	45	11	0	11,549	550	24	0	1,529	235	31	1,819
1988	8,574	678	1,234	173	19	8	0	10,686	613	24	0	1,376	198	64	1,662
1989	6,690	752	1,596	362	21	10	0	9,431	690	218	0	1,243	62	56	1,579
1990	5,833	690	1,074	128	13	4	0	7,742	2,650	2,436	0	1,131	64	43	3,674
1991	4,809	807	498	153	20	5	0	6,292	861	4,508	27	944	20	44	5,543
1992	7,234	1,181	887	381	16	6	0	9,705	1,160	5,700	62	1,356	75	47	7,240
1993	8,298	1,394	292	309	43	4	1	10,341	812	5,909	27	1,412	168	161	7,677
1994	7,366	1,357	421	308	37	4	0	9,493	581	3,176	631	792	157	24	4,780
1995	6,422	1,387	561	423	34	7	0	8,834	437	2,713	268	771	97	29	3,878
1996	6,916	1,067	428	597	45	4	0	9,057	439	2,502	346	761	81	15	3,705
1997	7,002	1,214	365	346	62	5	0	8,994	2,365	2,881	512	708	84	11	4,196
1998	6,233	1,190	471	476	68	2	0	8,440	3,603	3,263	418	931	48	19	4,679
1999	5,557	1,049	724	416	47	5	0	7,798	1,136	3,100	1,229	606	81	27	5,043
2000	6,180	1,121	808	497	49	5	0	8,660	2,216	2,949	1,885	646	90	9	5,579
2001	6,932	908	732	230	30	15	0	8,847	780	220	1,749	375	52	5	2,401
2002	6,230	965	1,164	201	29	11	0	8,600	465	204	1,320	302	90	3	1,919
2003	5,376	1,063	1,198	149	28	4	0	7,818	671	147	1,812	216	107	0	2,282
2004	5,395	1,509	1,062	229	30	4	0	8,229	270	213	898	169	62	37	1,379
2005	5,359	1,294	956	187	337	3	0	8,136	235	1,622		220	76	0	1,918
2006	6,181	1,507	796	244	342	5	1	9,076	347	1,211		444	71	2	1,728
2007	6,109	2,016	829	122	367	2	1	9,446	383	1,735		484	58	0	2,277
2008	4,402 [1]	1,780 [1]	648 [1]	173 [1]	349 [1]	3 [1]	0 [1]	7,355 [1]	84	1,980		280	33	1	2,294
2009	4,400 [1]	1,548 [1]	682 [1]	239 [1]	249 [1]	3 [1]	0 [1]	7,121 [1]	-	1,813 [1]		172 [1]	34 [1]	1 [1]	2,020
2010	-	-	-	-	-	-	-	-	-	1,654 [1]		33 [1]	22 [1]	4 [1]	1,713
2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

[1] Catch data are currently unavailable for Republic of Korea, Philippines, and some other countries catching swordfish in the North Pacific.
[2] Catches by gear for 1952-1970 were estimated roughly using FAO statistics and other data. Catches for 1971-2002 are more reliably estimated.
[3] Contrains trolling and harpoon but majority of catch obtained by harpoon.
[4] For 1952-1970 "Other" refers to catches by net fishing and various unspecified gears.
[5] Offshore longline category includes some catches from harpoon and other fisheries but does not include catches unloaded in foreign ports.
[6] Estimated round weight of retained catch. Does not include discards.
[7] Unknown includes pole and line, purse seine, troll and troll/handline, half ring, and unspecified gears.

(hatched) only one vessel fished so combined with Hawaii longline

Table 3. (Continued) Swordfish catches (in metric tons) by fisheries, 1952-2010. Blank (" ") indicates no effort. Dash ("–") indicates data not available. Zero ("0") indicates a catch of less than 1 metric ton.

	Chinese Taipei[5]											Korea			
Year	Distant-water Longline	Offshore Longline	Offshore Gillnet	Offshore Others	Coastal Harpoon	Coastal Setnet	Coastal Gillnet & Other Net	Coastal Longline	Coastal Others	Other	Chinese Taipei Total	Longline	High-seas Drift Gillnet	Korea Total	Grand Total
1951												-	-	-	11,678
1952	-	-									-	-	-	-	11,691
1953	-	-									-	-	-	-	12,408
1954	-	-									-	-	-	-	13,610
1955	-	-									-	-	-	-	14,111
1956	-	-									-	-	-	-	15,486
1957	-	-									-	-	-	-	15,251
1958	-	-									-	-	-	-	19,734
1959	-	427								91	518	-	-	-	18,785
1960	-	520								127	647	-	-	-	22,047
1961	-	318								73	391	-	-	-	21,538
1962	-	494								62	556	-	-	-	12,671
1963	-	343								18	361	-	-	-	11,605
1964	-	358								10	368	-	-	-	9,220
1965	-	331								27	358	-	-	-	11,349
1966	-	489								31	520	-	-	-	12,283
1967	-	646								35	681	-	-	-	12,689
1968	-	763								12	775	-	-	-	12,424
1969	0	843								7	850	-	-	-	12,186
1970	-	904								5	909	-	-	-	11,083
1971	-	992								3	995	0	-	0	9,044
1972	-	862								11	873	0	-	0	8,737
1973	-	860								119	979	0	-	0	9,816
1974	1	880								136	1,017	0	-	0	9,627
1975	29	899								153	1,081	0	-	0	12,257
1976	23	613								194	830	0	-	0	13,686
1977	36	542								141	719	219	-	219	13,180
1978	-	546								12	558	68	-	68	14,117
1979	7	661								33	701	-	-	-	11,949
1980	10	603								76	689	64	-	64	10,969
1981	2	656								25	683	-	-	-	12,820
1982	1	855								49	905	48	-	48	11,890
1983	0	783								166	949	11	-	11	12,774
1984	-	733								264	997	48	-	48	13,568
1985	-	566								259	825	24	-	24	16,005
1986	-	456								211	667	9	-	9	14,770
1987	3	1,328								190	1,521	44	-	44	15,483
1988	-	777								263	1,040	27	-	27	14,028
1989	50	1,491								38	1,579	40	-	40	13,319
1990	143	1,309								154	1,606	61	-	61	15,733
1991	40	1,390								180	1,610	5	-	5	14,311
1992	21	1,473								243	1,737	8	-	8	19,850
1993	54	1,174								310	1,538	15	-	15	20,383
1994	-	1,155								219	1,374	66	-	66	16,294
1995	50	1,135								225	1,410	10	-	10	14,569
1996	9	701	2	-	19	10	-	-	-		741	15	-	15	13,957
1997	15	1,358	1	1	27	8	-	24	-		1,434	100	-	100	17,089
1998	20	1,178	8	-	17	15	1	-	-		1,239	153	-	153	18,114
1999	70	1,385	4	-	51	5	1	-	-		1,516	132	-	132	15,625
2000	325	1,531	5	-	74	5	1	1	-		1,942	202	-	202	18,599
2001	1,039	1,691	17	-	64	8	1	1	-		2,821	438	-	438	15,287
2002	1,633	1,557	7	1	1	16	1	1	-		3,217	439	-	439	14,640
2003	1,084	2,196	3	-	-	8	-	-	-		3,291	381	-	381	14,443
2004	884	1,828	5	-	-	7	1	-	3		2,728	410	-	410	13,016
2005	437	1,813	1	-	-	5	2	-	18		2,276	434	-	434	12,999
2006	-	-	-	-	-	-	-	-	-	-	-	477	-	477	11,629
2007	-	-	-	-	-	-	-	-	-	-	-	452	-	452	12,558
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,733
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,141
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,713
2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

1 Catch data are currently unavailable for Republic of Korea, Philippines, and some other countries catching swordfish in the North Pacific.
2 Catches by gear for 1952-1970 were estimated roughly using FAO statistics and other data. Catches for 1971-2002 are more reliably estimated.
3 Contrains trolling and harpoon but majority of catch obtained by harpoon.
4 For 1952-1970 "Other" refers to catches by net fishing and various unspecified gears.
5 Offshore longline category includes some catches from harpoon and other fisheries but does not include catches unloaded in foreign ports.
6 Estimated round weight of retained catch. Does not include discards.
7 Unknown includes pole and line, purse seine, troll and troll/handline, half ring, and unspecified gears.

Appendix. Annual North Pacific striped marlin catches (t) reported to the WCPFC by country.

	Annual Striped Marlin Catch (mt) by Country									
Year	Japan	Chinese Taipei	Korea	United States of America	Philippines	Indonesia	China	Vanuatu	Federated States of Micronesia	Belize
1950	7									
1951	19									
1952	7,379									
1953	5,545									
1954	8,249									
1955	7,975									
1956	9,266									
1957	8,254									
1958	10,138	543								
1959	10,137	391								
1960	9,133	398								
1961	9,333	306								
1962	10,815	332								
1963	8,982	560								
1964	14,745	392								
1965	11,118	355								
1966	7,147	340								
1967	9,997	386								
1968	10,411	333								
1969	6,379	572								
1970	11,341	495			11					
1971	7,767	449			12					
1972	4,952	384			13					
1973	5,855	568			15					
1974	5,683	501			17					
1975	3,694	766	77		18					
1976	3,529	362	53		15					
1977	2,542	534	30		21					
1978	3,100	618	82		13	9				
1979	5,851	458	78		17	9				
1980	5,921	251	10		22	11				
1981	4,725	505	125		30	13				
1982	3,638	402	102		35	26				
1983	2,849	555	17		52	8				
1984	4,219	965	72		23	12				
1985	6,489	516	56		33	18				
1986	8,512	179	61		44	18				
1987	5,566	393	73		69	68				
1988	8,896	488	60		58	71				
1989	4,349	191	41		63	37				
1990	2,477	178	29		10	40				
1991	3,813	259	12	524	10	51			0	
1992	3,168	228	49	545	10	56				
1993	4,254	231	55	631	10	43	6		1	
1994	3,632	147	79	384	10	40	21		1	
1995	3,815	175	94	727	10	43	11		4	
1996	1,953	190	51	524	10	51	11	0	2	
1997	1,997	341	62	35	10	43	2		1	
1998	1,625	292	215	38	10	53	0		6	
1999	1,245	260	161	326	10	55	3		1	
2000	994	248	69	274	10	25	2		5	
2001	766	52	35	539	10	32	8		0	1
2002	521	47	112	297	10	50	17	6	0	6
2003	1,078	152	190	870	10	74	8	10		4
2004	481	410	102	481			3	72	3	5
2005	342	425	132	497		0	2	54	1	3
2006	420	123	192	606		0	2	33		1
2007	298	260	23	260			1	20	4	3
2008	533	196	56	403			124	18	1	
2009	140	198	44	237			23	12	0	
2010	109	183	30	127			1	5	1	8

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Attachment 2. Working Papers

WORKING PAPERS

ISC/11/BILLWG-2/01	Striped Marlin Catches in the North Pacific from WCPFC Data. Darryl Tagami. (Darryl.Tagami@noaa.gov)
ISC/11/BILLWG-2/02	Catch estimation of striped marlin by Chinese longline fishery in Pacific Ocean. Xiaojie Dai. (WITHDRAWN)
ISC/11/BILLWG-2/03	Update of USA swordfish catches in the North Pacific. Darryl Tagami. (Darryl.Tagami@noaa.gov)
ISC/11/BILLWG-2/04	Report of the PIFSC and IATTC collaborative sensitivity analysis of EPO striped marlin stock. Kevin Piner. (Kevin.Piner@noaa.gov)
ISC/11/BILLWG-2/05	Standardized CPUE of striped marlin caught by Japanese coastal large-mesh drift fishery in the northwest Pacific in the periods between 2001 and 2009. Kotaro Yokawa and Ai Kimoto. (yokawa@fra.affrc.go.jp)
ISC/11/BILLWG-2/06	CPUE standardization of striped marlin in west north Pacific Ocean. Minoru Kanaiwa,
ISC/11/BILLWG-2/07	Age and growth of striped marlin *(Kajikia audax)* in the waters off Taiwan: A revision. Chi-Lu Sun, Wen-Sheng Hsu, Nan-Jay Su, Su-Zan Yeh, Yi-Jay Chang, Wei-Chuan Chiang. (chilu@ntu.edu.tw)
ISC/11/BILLWG-2/08	Correction to Meta-analysis of striped marlin natural mortality. Kevin Piner and Hui-Hua Lee. (Kevin.Piner@noaa.gov)
ISC/11/BILLWG-2/09	Reproductive biology of male striped marlin, *Kajikia audax*, in the waters off Taiwan. Chi-Lu Sun, Hsiao-Yun Chang, Yi-Jay Chang, Su-Zan Yeh, Nan-Jay Su, Wei-Chuan Chiang, Yu-Jia Lin. (chilu@ntu.edu.tw)
ISC/11/BILLWG-2/10	Biological information and catch rate of striped marlin captured by Chinese observer programme in the Pacific Ocean. Xiaojie Dai, Jiangfeng Zhu, Liuxiong Xu, Siquan Ti. (xjdai@shou.edu.cn)

ISC/11/BILLWG-2/11	Probable values of steepness for north Pacific. Jon Brodziak. (Jon.Brodziak@noaa.gov)
ISC/11/BILLWG-2/12	International cooperative billfish tagging program in eastern Taiwan waters. Wei-Chuan Chiang, Chi-Lu Sun, Nan-Jay Su, Michael Musyl, Gerard DiNardo. (wcchiang@mail.tfrin.gov.tw)

Attachment 3. Agenda

INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC

BILLFISH WORKING GROUP (BILLWG)

INTERCESSIONAL WORKSHOP ANNOUNCEMENT

Meeting Site: National Taiwan University
Institute of Oceanography
1, Sect. 4, Roosevelt Rd., Taipei, Taiwan

Meeting Dates: May 24 – June 1, 2011

Goals: Finalize NP striped marlin data and stock assessment work plan.
Develop work plan for completing blue marlin assessment.
Elect Chair of ISC Billfish WG.

Draft Agenda:

May 24 (Tuesday), 1000-1030 – Registration

May 24 (Tuesday), 1030-1700

1. Opening of Billfish Working Group (BILLWG) Workshop
   a. Welcoming Remarks
   b. Introductions

2. Adoption of Agenda and Assignment of Rapporteurs

3. Computing Facilities
   a. Access
   b. Security Issues

4. Numbering Working Papers and Distribution Potential

5. Status of Work Assignments

6. Annual Billfish Catch/Effort (Category I, II,& III data)
   a. Review of Data
   b. Catch Projections for Recent Years (through 2011)
   c. Update and Adoption of Catch Tables

May 25 (Wednesday), 930-1700

6. Annual Billfish Catch/Effort (Category I, II,& III data) (con't)
    a. Review of Data
    b. Catch Projections for Recent Years (through 2011)
    c. Update and Adoption of Catch Tables

May 26 (Thursday), 930-1700

6. Annual Billfish Catch/Effort (Category I, II,& III data) (con't)
    a. Review of Data
    b. Catch Projections for Recent Years (through 2011)
    c. Update and Adoption of Catch Tables

7. Striped Marlin Catch & Size-at-Catch Data by Assessment Area (WCPO-EPO)
    a. Review of Data
    b. Adoption of Catch & Size-at-Catch Data

May 27(Friday), 930-1700

8. Striped Marlin CPUE Time Series
    a. Review of Available Data
    b. Adoption of CPUE Time Series
    c. ISC/IATTC Collaboration

May 28 (Saturday), 930-1600

8. Striped Marlin CPUE Time Series (con't)
    a. Review of Available Data
    b. Adoption of CPUE Time Series

May 29 (Sunday), No Meeting

May 30 (Monday), 930-1300

9. Review and Adoption of Biological/Ecological Data
    a. Growth
    b. Natural Mortality
    c. Steepness

10. Blue Marlin Work Plan
    a. Tagging
    b. Biological Sampling

11. Other Business
    a. Future Meetings
    b. ISC Billfish Chairperson Election

May 30 (Monday), 1400-1700

12. Rapporteurs and participants complete sections

May 31 (Tuesday), 930-1700

13. Complete report and circulate; WG reviews report

June 1 (Wednesday), 930-1200

14. Clearing of Report

15. Adjournment