Annex 7

REPORT OF THE BILLFISH WORKING GROUP WORKSHOP

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

19-27 January 2011
Honolulu, Hawaii, USA

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 Honolulu, Hawaii, USA from 19-27 January 2011. The goals of this workshop were to 1) review available North Pacific striped marlin fishery-dependent and fishery-independent data for possible inclusion in the upcoming stock assessment, including region specific Category I, II, and III data, CPUE time series, and life history parameters, and 2) identify and adopt data input files and 3) identify appropriate model structure.

Gerard DiNardo, Chairman of the BILLWG, welcomed participants from Chinese Taipei, Japan, Republic of Korea, the Inter-American Tropical Tuna Commission (IATTC), the Secretariat of the Pacific Community (SPC), and the United States of America (USA) (Attachment 1). Gerard DiNardo , provided the welcoming remarks and assigned rapporteuring duties to Valerie Chan, Dean Courtney, Michael Hinton, Gakushi Ishimura, Minoru Kanaiwa, Ai Kimoto, Hui-Hua Lee, Jae-Bong Lee, Kevin Piner, Chi-Lu Sun, Mioko Taguchi, William Walsh, 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 adopted (Attachment 3). All authors who submitted a working paper agreed to have their papers posted on the ISC website where they will be available to the public.

It should be noted that two North Pacific striped marlin stocks were delineated at the April 2010 BILLWG Workshop for inclusion in the assessment:.

- WCPO stock- West of 140°W and north of the equator
- EPO stock- East of 140°W and north of the equator

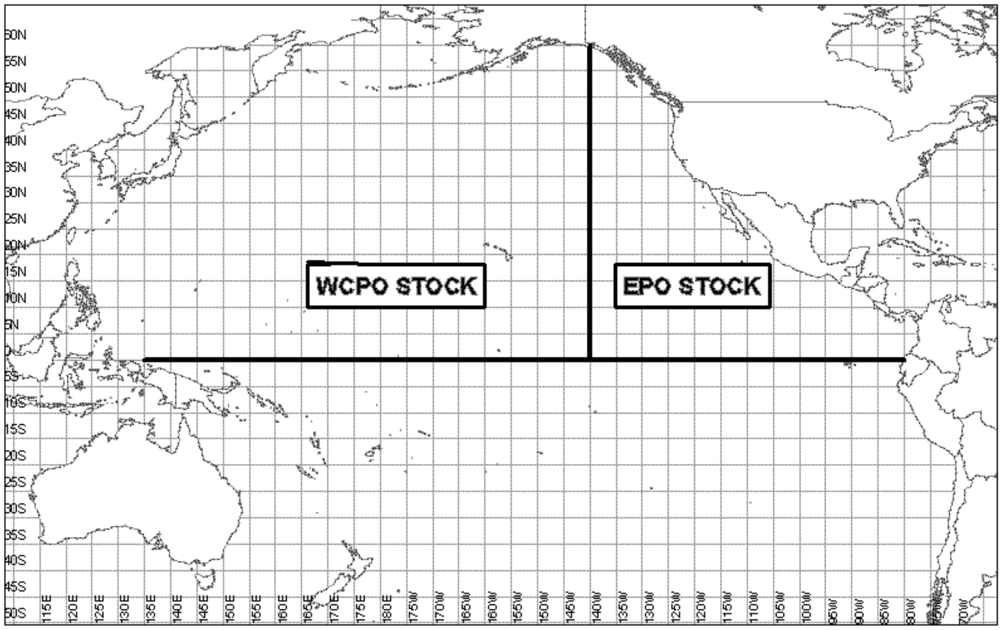

Figure 1. Stock boundary delineated for the 2011 stock assessment of North Pacific striped marlin.

2.0 STATUS OF WORK ASSIGNMENTS

In 2009, the ISC was tasked with identifying potential Biological Reference Points (BRPs) for northern stocks of highly migratory species in the Pacific Ocean at the 5th regular session of the Northern Committee (NC) in Nagasaki, Japan, and asked to report its findings at the 6th session of the NC6 in September 2010. Gerard DiNardo reported that the BRP table for billfish was presented and endorsed at both the 10th meeting of the ISC Plenary (ISC10) and NC6. The table included 17 BRPs that are commonly used for stock assessment of highly migratory species, and were characterized using attributes including: the definition and management purpose, model structure, data needs, limit or target reference point, type of overfishing, and the pros/cons..

The NC commended the ISC Working Groups on completing the assignment on short notice.

The ISC BILLWG Chairman reported that the NC has not made any recommendations regarding the BRP table and thanked the WG for their diligence in completing the assignment. The BILLWG Chairman also noted that the BILLWG should continue thinking about potential BRPs.

3.0 RFMO/RFO MEETING SUMMARIES

3.1 ISC10 Plenary

The ISC10 was held in Victoria, B.C., Canada from 21-26 July 2010 and attended by members from Canada, Chinese Taipei, Japan, Korea, Mexico, United States and, North Pacific Maine

Science Organization (PICES), and the WCPFC. The Plenary reviewed results and conclusions, which were based on new data and updated analyses of the BILLWG. In particular, the Plenary endorsed the findings that the eastern Pacific stock of swordfish is healthy and in good condition. The Plenary thanked the BILLWG for completing the swordfish assessment, with special thanks to Jon Brodziak who completed most of the workload. Conservation advice for striped marlin in the North Pacific Ocean and the western and central North Pacific stock of swordfish, adopted at ISC9, were reviewed and purposed with minor changes for clarification and adopted.

The recommendation of the billfish working group to postpone convening a World Blue Marlin Symposium was also endorsed. The albacore, Pacific bluefin, and billfish working groups provided information on candidate biological reference points for northern stocks of highly migratory species in the North Pacific Ocean which the Plenary endorsed. These were forwarded for consideration at NC6 in September 2010. The ISC workplan for 2010-2011 includes completing a new stock assessment for albacore and striped marlin by ISC11, continuing preparations for a Pacific bluefin tuna and blue marlin stock assessments in 2012, implementing improved database and website management, and updating and clarifying ISC operations procedures were also adopted. After five years serving as Chairman of ISC, Gary Sakagawa stepped down. The Plenary elected Gerard DiNardo to serve as Chairman for 2010-2013. The next Plenary will be held in the United States in July 2011.

3.2 WCPFC-SC6

The 6th Scientific Committee of the Western and Central Pacific Fisheries Commission was held in Nukualofa, Tonga from 10-19 August, 2010. At this meeting, it was requested that the ISC present full presentations, stock assessments and advice to the SC for North Pacific striped marlin and albacore. To increase transparency, the SC also recommended promoting wider participation in the ISC's assessment activities, providing sufficient funding is available.

3.3 WCPFC-NC6

The 6th Regular Session of the Northern Committee was held in Fukuoka, Japan from 7-10 September 2010. At this meeting, the ISC BRP tables were presented and accepted. The North Pacific swordfish assessment and conservation advice were also presented and adopted by the NC. The NC also agreed to abolish the NC Striped marlin Working Group but also agreed that it should continue to work on striped marlin. NC7 may prepare a draft conservation and management measure based on the outputs of the pending striped marlin stock assessment scheduled to be completed in 2011.

3.4 WCPFC7

The 7th Regular Session of the Western and Central Pacific Fisheries Commission (WCPFC7) was held in Honolulu, Hawaii, USA from 6-10 December 2010. The Commission reiterated the WCPFC-SC recommendations to increase transparency and to make full presentations of stock assessments. Funding permitting, the ISC will send representatives to WCPFC-SC7 to be held in Pohnpei, FSM in August 2011. The Commission adopted a measure that calls for Commission members and cooperating non-members with vessels fishing in the Convention area north of the equator to reduce their harvests of North Pacific striped marlin by 10% in 2011 below the highest catch they made between 2000 and 2003. The measure also calls for further reductions in 2012 and 2013 and beyond; however, the measure may be amended pending the completion of a new North Pacific striped marlin stock assessment in 2011 by the ISC.

3.5 IATTC-SAC

The 1st meeting of the Inter-American Tropical Tuna Commission Scientific Advisory Committee (SAC) met in La Jolla, California, USA from 31 August – 3 September 2010. The SAC, established by the Antigua Convention, replaces the IATTC Stock Assessment Working Group and is composed of one representative designated by each member of the Commission. At the meeting the 2010 stock assessment of striped marlin [*Kajikia audax*] (Philippi, 1887) in the northeast Pacific Ocean (NEPO) was presented. A review of the results of previous (2003-2009) stock assessments was presented to provide a perspective for the 2010 assessment. The results of this (2010) assessment are consistent with the previous results. Key results of the assessment and the sensitivity analyses conducted by varying the values of fixed model parameters were:

1. The stock is not overfished;
2. Overfishing is not occurring;
3. Stock biomass has increased from a low of about 750 t in 2003 to an estimated 3,600 t in 2009.

As with any assessment review, a number of questions were raised and additional model runs requested. No additional model runs were performed during the SAC and the status of these requests is unknown.

4.0 STRUCTURE OF THE 2011 STRIPED MARLIN STOCK ASSESSMENT AND BACKGROUND INFORMATION

4.1 IATTC stock assessment of striped marlin in the eastern Pacific Ocean presented by Michael Hinton (http://www.iattc.org/Meetings2010/PDF/Aug/SAC-01-Meeting-report.pdf)

A summary of the status and trends of the stock of striped marlin [*Kajikia audax* (Philippi, 1887)] in the northeast Pacific Ocean as reported in the 2010 assessment conducted by the IATTC was presented. The assessment was made over an area expected to cover the principal distribution of this stock, a region of the eastern Pacific Ocean lying east of 145°W and north of 5°S. The assessment was conducted with Stock Synthesis (Version 3.10b) and the principal conclusion was that the striped marlin stock in the northeast Pacific Ocean was not overfished or being overfished. The complete report of the assessment was made available to the working group as a background paper, so that details not orally presented were available to participants.

The model included data for the period 1954-2009. The spatial distribution for the longline fisheries was determined using regression-tree analysis of distributions of size frequency from the longline fisheries of Japan. Three standardized indices of relative abundance (CPUE: retained catch per 1000 hooks fished) for the 1954-2009 period, corresponding to subareas of the assessment region, were derived for longline fisheries of Japan using delta-lognormal generalized linear models. These indices were used in fitting the assessment model. In addition to these three fisheries, other fisheries in the model were the pole-and-line recreational fishery of Mexico, the purse seine fishery operating in the eastern Pacific Ocean, and the longline fisheries of flag-States other than Japan. In addition to the size frequency data of Japan, data from catches made by the purse seine fishery was also included in the model. A von Bertalanffy growth model and a Beverton-Holt recruitment model were used. Natural mortality (M) was assumed equal to 0.5 and steepness (h) equal to 1.0.

Though the time period in the model was 1954-2009, the dynamics were fully implemented in 1975. Early recruitment deviates were used to provide information on population conditions from years prior to 1975. A wide range of sensitivity analyses were conducted to investigate assumed values of fixed parameters and model structure, including exclusion of the northwestern-most subarea of the stock region.

Discussion

The WG thanked Dr. Hinton for presenting the IATTC striped marlin stock assessment. The working group made several suggestions for potential sensitivity analyses to be included in future investigations of the striped marlin stock assessment model in the EPO. First, evaluate model sensitivity to the selectivity estimated for Fishery 3 (the selectivity of Fishery 3 equal to that of Fishery 1). The rationale for this assumption was that the length frequency distribution of Fishery 3 and Fishery 1 appeared to be similar but the estimated fishery selectivities for Fishery 3 and Fishery 1 differed. In addition, many years of length frequency data were available from Fishery 1 while only two years of length frequency data were available for Fishery 3. Second, evaluate model sensitivity to the length frequency data from the recreational fishery (Fishery 5). The selectivity estimated for Fishery 3 is currently applied to the recreational fishery (Fishery 5) which occurs in the same subregion (A3). However, the catch in the recreational fishery has increased in recent years and now represents a large fraction of the total catch, while the catch in the longline fishery (Fishery 3) has decreased in recent years and now represents a small fraction of the total catch. Third, evaluate model sensitivity to the assumption of equilibrium fishing mortality prior to the start of population dynamics in 1975 for Fishery 1 and Fishery 2.

The working group discussed the values assumed for natural mortality and steepness in the current IATTC model. Natural mortality and steepness of the stock recruit relationship are related. The base case model fixed natural mortality of 0.5 and evaluated model sensitivity to natural mortality of 0.3 and 0.7. This natural mortality rate in the base case is higher than that used in the previous ISC striped marlin assessment (0.3). Results from the sensitivities did not fit as well as the base case. The base case model also fixed steepness of the stock recruit relationship at 1.0 which assumes an environmentally driven stock-assessment relationship. However, there was evidence that the model sensitivity run with steepness set to 0.75 had better model fits (lower model likelihood).

The working group discussed the residual pattern to the fits to CPUE indices in the IATTC model. The CVs of CPUE for Fishery 1 were fixed at 0.2, while the CVs of Fishery 2 and

Fishery 3 were estimated within the model. The predicted CPUE for Fishery 1 appeared to drive the estimated population dynamics. The working group also clarified that past IATTC striped marlin stock assessments included CPUE data before 1975 and estimated two catchability coefficients, one for the years before, and the other for the years after 1975. The current IATTC striped marlin assessment only includes CPUE after 1975. The rationale for this change is that after 1975, the fishery is fully expanded in all areas and the influence of this expansion is removed. The influence of CPUE prior to 1975 was captured by allowing recruitment deviations prior to that.

The working group discussed the methods used to standardize CPUE for input in the IATTC model. The working group requested more detailed documentation of standardization methods to clarify how large each factors affect was in the standardization. The working group also discussed the use of distance from shore and distance from land instead of Latitude and Longitude. It was clarified that distance from land was used to evaluate the effect of proximity to islands in the EPO.

The IATTC striped marlin assessment included data from east of 145°W and north of 5°S. The working group concluded that the striped marlin catch and effort data were limited between 0°and 5°S and between 140°W and 145°W, so the slightly different stock assessment regions (ISC 140ºW, 0º; IATTC 145ºW, 5ºS) would have limited effects on model results.

The working group discussed that IATTC stock assessment of striped marlin includes data for striped marlin with maximum lengths larger than those normally found in the western north Pacific Ocean. Striped marlin in the southwestern Pacific reach similar maximum lengths as those in the EPO. A question was raised if it is possible that two separate growth morphs are being captured in the EPO. It was stated that this is likely not occurring and that differences in maximum length observed in the EPO between fisheries results from the different catchabilities of the fisheries and or location of large fish. The working group also noted that appeared to be a continuous length frequency data set is available from the purse seine fishery (Fishery 6), but that this was down-weighted in the model. The working group also noted that model sensitivity to the removal of data from year 1978 might be related to the selectivity estimated for Fishery 3. The year 1978 appeared to be one of two years with length data from Fishery 3.

4.2 A review of Taiwan's billfish fisheries in the North Pacific, 1997-2009 presented by Chi-Lu Sun (ISC/11/BILLWG-1/01)

Catches of billfish, including swordfish, striped marlin, blue marlin, black marlin, and sailfish, in the Taiwanese longline, gillnet, harpoon, and set net fisheries in the North Pacific Ocean from 1997-2009 were presented. Most of the billfish catches was caught in the Taiwanese offshore longline fishery. The largest proportion of catches in the distant-water fishery is swordfish, while most of catches in the offshore longline fishery is blue marlin. Sailfish and black marlin are caught mainly in gillnet, harpoon, and set net fisheries in offshore and coastal waters off Taiwan, of which black marlin has the largest proportion in catches of the Taiwanese coastal harpoon fishery.

<u>Discussion</u>

At the start of discussion it was confirmed that the data presented would be available in tabular form. It was further elucidated that the catch data was obtained from the fishermen associations in each landing port, and that the data was the landed catch. During the general discussion, it was noted that the logbook coverage in the offshore longline fishery has been about 15 percent. Logbooks are sent by fishermen to the Overseas Fisheries Development Council (OFDC), and it is from these that data are obtained. It was noted that within the longline fisheries striped marlin have been a very small fraction of the landed catch of billfish. The recent increase in the landed catch from harpoon fisheries were noted, and it was pointed out that this may possibly be due to the high value of black marlin relative to other marlins, causing change in target. Taiwan will provide catch data in metric tons. The shift of target catch for black marlin would have influenced the catch proportions in landings of the harpoon fisheries, which increased in 2004.

4.3 U.S. Commercial Fisheries for Marlins in the North Pacific Ocean presented by Russell Ito and William Walsh (ISC/11/BILLWG-1/02)

This working paper presents summaries for U.S. commercial fisheries that catch marlins (Istiophoridae) in the North Pacific Ocean. The two largest fisheries for marlins were the Hawaii longline fishery and the small boat troll fishery; primarily in Hawaii also. Blue marlin *Makaira nigricans* and striped marlin *Kajikia audax* were the dominant components of the nominal marlin catch. Nominal CPUEs for both blue and striped marlins were on a declining trend. Though the longline fishery covered a larger area of fishing compared to the troll and handline fisheries, the latter fisheries landed larger marlins than the longline fishery in 2009.

Discussion

During discussion of the nature of the data, it was noted that data recently (the number of years was not noted) has units of both weight and length, but that presently the data obtained from the auction has been weight and condition (e.g. gilled and gutted). Also, rarely would a sale record be for more than one fish, but if so, the size and quality of fish in the sale would be similar. It is also the case that the logbook/fishing area information is not generally available, but it may be possible to estimate a general region of capture. Conversion factors were used to raise size data obtained from processed fish (whole fish are not available for measure), and there was an interest to confirm that those being applied are correct for current delivery products. The size frequency sample fraction in recent years is at, or nearly, 100 percent due to presence of observers on board the vessels. It was noted that the observer program was put in place to monitor protected-species interactions, and sampling of fish has been an added, though possibly transient, benefit. Prior to the initiation of the observer program in 2000, size frequency sample rates were about 33 percent. It was also suggested that historical data on size frequency of catches be abstracted from documents of the Hawaii Department of Aquatic Resources. It was confirmed that the category "other marlin" does not include swordfish and that it is principally black marlin and sailfish.

Most vessels are currently making deep sets, which along with troll fisheries, account for most of the landed catch of marlins.

It was also noted that the catch rates for deep setting gear were about 0.5 (marlin/1000 hooks) , and about 0. 7 (marlin/1000 hooks) for shallow set gear. Both length and weight frequency distributions were bimodal, though it was more clearly evident in the weight frequency data. The explanation for this was that the data were from markets, and the lower-valued mode was likely biased low due to the lesser value of small fish in the market.

4.4 Review of Korea’s billfish fisheries in the North Pacific Ocean presented by Jae-Bong Lee

The distant-water Korean tuna longline has been engaged in fishing billfish as incidental catch in the North Pacific since 1980. The total catch of swordfish and billfishes (striped marlin, blue marlin, black marlin and sailfish) was over 2,000 ton in 1982 and then decreased to below 100 ton in the early of 1990s. Since the mid of 1990s, the total catch increased and reached 2,633 tons in 1997, which was the maximum catch of billfish by Korean longliners in the North Pacific. During the period of 2000s, the total catch of billfish including swordfish was 1,500 tons in the North Pacific. The species composition of catch changed; sailfish comprised 70-80% of billfish catch in 1980s, and during the period of 1990s striped marlin comprised 40-50% of billfish catch in the North Pacific. The catch compositions of black marlin and swordfish have increased since the late of 1990s and comprised about 50% and 30%, respectively in the recent years. The CPUE (catch per 1,000 hooks) of striped marlin have shown two peaks since 1980 in the North Pacific; one was 65kg in 1982 and the other was 41kg in 1997. Since 1997, the CPUE of striped marlin decreased and has sustained at low level in the recent years.

Discussion

It was clarified that the targeted species of the Korean longline fisheries were tunas and that billfish were a bycatch. It was also noted that there were no Korean fisheries targeting swordfish, though there were bycatches on the order of 750-1,000 t in the mid-2000's. The category "other marlin" were noted to be principally unidentified billfish. It was noted that the longline data included information from distant-water fisheries. The WG requested that Korea split the striped marlin catch data into WCPO and EPO assessment areas.

4.5 SPC data holdings presented by Nick Davies (Oral Presentation only)

SPC responded to a request from the ISC chairman for a summary of the available catch, effort and size composition data for striped marlin held by SPC on behalf of the Western and Central Pacific Fisheries Commission (WCPFC), and presented an overview of these data. Total annual catch weights (mt) for the Western North Pacific Ocean (WNPO: 120°E - 140°W; 0° - 50°N) based on raised aggregate data for vessel nationalities not represented at the BILLWG increased from less than 20 mt pre-1980 to an average of 70 mt after 1990, with peaks of around 120 mt in some years. Annual sample sizes of lower jaw-fork length (LJFL) measurements for striped marlin in WNPO collected under the WCPFC regional observer program from longline vessels (1990 to 2009) ranged between 9 to 450 fish, and smaller sample sizes (maximum of 43 fish) were available from Purse seine catches. These data were made available to the BILLWG for potential inclusion in the assessment model.

Following the presentation, SPC were subsequently requested to:

- Prepare these data in the format required for input to the model
- Follow up on enquiries regarding reporting of discards from Purse seine catches by observers

Discussion

The possibility for duplication of data in those reported by members of the ISC and by RFMOs was discussed. It was noted that the potential for duplication does exist, but that the general policy followed by the IATTC in this regard was to not provide data of ISC members to working groups. It was noted that there were some size frequency data held by SPC which could be useful in upcoming assessments.

It was noted that the data on catches was landed catches and did not include discarded catch. The observer coverage of the longline fishery in territorial waters has been about five percent, and data on discarded catch would be available from these records.

4.6 Available data of striped marlin and swordfish by the Japanese fishery in the North Pacific presented by Kotaro Yokawa (ISC/10/BILLWG-2/06)

This report was presented at a previous ISC BILLWG Workshop and was presented again due to its relevance. The report provides available data for striped marlin by Japanese fishery, including catch amount, total hooks and size data within two-stock structure zone (BILLWG, 2010). The catch amount was separately estimated by gear from Japanese year books and log books, and the available period was between 1951 and 2008. Total number of hooks by Japanese offshore longline was estimated in each zone during the same period. The number of available size data was also estimated. Additionally, this study provided the updated catch amount of swordfish in the North Pacific. The estimated catch and the total number of hooks of striped marlin in the recent years were significantly decreased in the two zones, compared to those before 1990. These results showed that the recent decreasing trend of the coverage of Japanese offshore and distant-water longline data should be treated with care in the work of stock assessment, especially in the northeastern Pacific.

Discussion

The discussion that occurred following the original presentation of this working paper at the July 2010 ISC BILLWG Workshop held in Victoria, BC, Canada is as follows:

"It was pointed out that the only Japanese fishery in the EPO area, as defined by the BILLWG for the upcoming striped marlin stock assessment, is the distant-water longline fishery. Swordfish catches were also presented by gear from 1951-2008 for both the one stock and two stock scenarios. It was also noted that the number of available size data in the north Pacific decreased substantially since 2004. This may be due to new sampling methods implemented at that time and problems with the choice of fork length measured. Efforts are being made to correct some of these errors which will increase the number of available size data from 2004-

2008. The number of sets conducted in the EPO area substantially decreased in recent years. Most of the observed reduction occurred off Mexico, which is the main fishing ground for striped marlin in the EPO. This could have an effect on the representativeness of CPUE obtained from Japanese longline data.

5.0 STRIPED MARLIN CATCH AND SIZE-AT-CATCH DATA

5.1 Review of size data for striped marlin *(Kajikia audax)* caught by Japanese Commercial Fisheries in the North Pacific from 1970-2009 presented by Mioko Taguchi (ISC/11/BILLWG-1/04)

A total of 700,000 size data, in eye fork length (EFL, cm) and/or product weight (kg), of striped marlin caught by Japanese commercial fisheries in the North Pacific between 1970 and 2009 were reviewed in the present document for their utility in stock assessment analyses. The size data were mainly collected from trawling, drift net, harpoon and longline, and size measurements were collected either at-sea or in fishing ports in Katsuura, Yaizu, Shimizu, Tokyo and Kesennuma. The frequency distributions in EFL were different between fisheries, e.g., fishes caught by trawling and harpoon were larger than by drift net and longline, and fishes smaller than 120cm were caught only by longline. Moreover, the length frequencies of striped marlin caught by longline were also different among areas and periods.

Discussion

The working group requested that all size data should be separated by assessment area. The attention was made to the comparison of size of fish caught by the deep-set and shallow-set of longliners. The working group pointed out that to address representative sample size concerns, a sampling intensity measure over time could be presented (e.g. total fish measured in weight / total catch in weight by port).

It was indicated that amount of size data in the EPO area seems to be larger than that used in the stock assessment by IATTC. This was verified by the IATTC. The IATTC did not use weight frequency data, instead relying solely on length data.

5.2 Length Frequency of Striped Marlin from the Hawaii-based Longline Fishery, 1994-2010 presented by Dean Courtney (ISC/11/BILLWG-1/05)

This working paper summarizes quarterly length frequency data for striped marlin from the observed Hawaii-based pelagic longline fishery during the years 1994 – 2010. Length frequency data were combined for shallow-sets (i.e., < 15 hooks per float) and deep-sets (i.e., ≥ 15 hooks per float), because data from shallow sets were limited. Length frequency data were combined for males, females, and unknown sex, because sexually specific length frequency data were limited. Modal progression was evident in striped marlin quarterly length frequency in recent years. This might indicate the presence of strong recruitment events.

Discussion

The working group suggested that a sampling intensity measure over time should be presented for the Hawaii-based longline fisheries. It was noted that the sex was not identified for all the fish measured. It was indicated that only one vessel from the California-based longliners fleet operated and that these data were excluded.

5.3 A long-term corrected catch history for striped marlin *Kajikia audax* in Hawaiian waters presented by William Walsh (ISC/111/BILLWG-1/03)

This working paper presents a 62-year (1948–2009) catch history for striped marlin *Kajikia audax* in Hawaiian waters. These catch estimates were obtained by compiling data from several sources, including federal, state, commercial, and recreational. Known biases in the data (e.g., under-reporting; species misidentifications) were corrected using published methodologies whenever possible and on the basis of experience in this fishery in other instances. Results from recent years (1995–2009) were used to correct for discarding throughout the time series. We conclude that this corrected 62-year catch history is more accurate than an uncorrected time series with known biases. Use of this corrected catch history in the stock assessment for striped marlin in lieu of nominal catch data from Hawaiian waters is strongly recommended.

Discussion

The WG recognized that this work estimates discards and this is encouraged in future work. The working group asked for clarification of the expansion of catch between the late 1970's and 1987. It was clarified that the interpolation is a linear prediction based on an early year before the expansion of the fishery and a later year where catch was monitored by NOAA personnel. It was further clarified that the method of linear interpolation was peer-reviewed and published in Marine Fisheries Review. Copies of that paper would be made available to the working group. The working group suggested that prediction of catch using measures of effort in that period should be researched as it may provide a more realistic estimate of catch. It was noted that the relatively large increase in catch beginning in the late 1980's is due to the expansion of the fishery for swordfish and tuna. The working group also noted that regulation to protect sea turtles has impacted the location of some Hawaiian fisheries but that the areas of high striped marlin catch have not been affected.

In regards to the cause of mis-reporting of striped marlin, the working thought that relative price differences between blue and striped marlin may result in some of the bias. The working group wondered if the corrections for mis-identification in logbook could be corroborated with dealer data (which is thought to be more accurate). The authors noted that there was good agreement between dealer based catch estimates and the corrected catch estimates in the years where they have been compared.

6.0 STRIPED MARLIN CPUE TIME SERIES

6.1 Review of Available Data

6.1.1 Overview of Japanese longline fishery for striped marlin in EPO and preliminary results

of the standardized CPUE presented by Ai Kimoto

The presentation outlined potential problems with striped marlin catch and effort data of the Japanese distant-water longline fishery in the EPO area and provided preliminary results of standardized CPUE. The current Japanese longline fishery in the EPO mainly targets big-eye tuna. However, from the mid-1960's to the mid-1970's the fleet actively targeted striped marlin. Fishing effort in the EPO has been decreasing largely since 1990, with higher levels observed between the 1960s to 1980s. In the 1960's to 1980's, large numbers of striped marlin were caught in the off-shore areas of the US and Mexico using shallow setting longline gear (the number of hooks per basket (HPB): 3-7). However, these shallow operations almost disappeared and even longline boats with deep tuna sets seldom went into these area after 1991.

The HPB values of the sets conducted in the WCPO started to change around 1995, and have gradually but steadily shifted to 15-18 HPB from 8-14 HPB. The operational pattern has changed in the most recent years especially after 2007. The amount of effort and the operational area have been greatly reduced, and is concentrated into a small area near the western boundary of the EPO. Taking into account these complicated and skewed fishery data, the standardized CPUE of Japanese longline fishery was preliminarily estimated. However it should be noted that some unrealistically large variability still remained. Further refinement of the method or data selection should be necessary to estimate reliable indices.

Discussion

The working group discussed the estimates of CPUE presented here compared to what was used in the IATTC assessment. The working group thought a direct comparison of the areas A3 (IATTC) and area 5 (this paper) would be helpful as those areas were nearly identical in location. It was noted that area 5 is a good fishing area with high CPUE, but in some years adjacent areas also had very high catch rates. The working group discussed if this result may have been due to movement associated with environmental influences. It was also noted that hooks-per-basket (HPB) changed over time and this effect will be important on estimated catch rates. Suggested approaches included estimating 3 distinct CPUE series associated with periods of relative HPB stability. The working group noted that effort declined in the EPO with relatively little effort after 1991. Subsequent to the working group discussion, the authors presented a comparison of their CPUE series to that used by IATTC. Although some differences were noted it is not clear if they are important to the understanding of stock dynamics. The working group drew no conclusion on which series was more appropriate for stock assessment.

6.1.2 Analysis of area separation to standardize CPUE of striped marlin in the North Pacific Ocean presented by Minoru Kanaiwa (ISC/11/BILLWG-1/06)

Area separation is one of the important issues to standardize CPUE. Several data selections and methods were tried to separate areas. The trends of area separations are similar among all scenarios. Importantly, there are two features in common among all scenarios. First is that the line between 10° and 15°N divide the area north from south. Second is that the line between 150° and 170°E divide the northern area east from west. So area separation using Ichinokawa and Brodziak (2010) with all possible data is adopted to analyze CPUE.

Discussion

The working group discussed how the areas defined in the paper related to the location of striped marlin catch. It was noted that the two largest areas defined in the analysis were the location of the majority of the catch. Furthermore, the authors clarified that their area separation was based on areas of homogeneous CPUE. The working group noted that areas could also be based on similarity of the size distributions, in addition to CPUE. The working group also discussed the limited latitudinal stratification in the EPO resulting from the analysis, noting there is little catch above 40N.

6.1.3 CPUE standardization of the Japanese offshore and distant-water longliners presented by Kotaro Yokawa

Recent findings about the characteristics of catch and effort data of Japanese offshore and distant-water longliners, which create a challenge in the CPUE standardization of the striped marlin were summarized. Japanese offshore and distant-water longliners have continuously increased the number of hooks per basket (HPB) to catch larger and higher quality bigeye tuna since the mid 1970s. At the same time, new gear materials which enable them to set gear to deeper depths have also been developed several times. Analysis of striped marlin CPUE revealed apparent positive relationship between the number of sets deployed into a 5x5 degree block and CPUE of striped marlin. Results showed that at least 15 – 20 sets are needed to obtain a stable relationship between them. The analysis of the data aggregated by 5x5 degree block, month and HPB revealed that the aggregated data with more than 15 sets was only available with limited popular HPB categories in the period. It was also shown that the popular HPB categories changed considerably through time. Because good fishing grounds of bigeye tuna and striped marlin are roughly consistent in the scale of 5x5 degree block and month, GLM analysis produced the result of higher striped marlin CPUE with deeper sets. This result conflicts with the existing biological knowledge. In the area west of the date line, a variety of additional problems were also found. For example, the mixing of different fishing strategies (deep-set and shallow set) for the same fishery (i.e. offshore longline fishery) A method to overcome these problems should be developed for the estimation of the abundance index of striped marlin in the north Pacific.

Discussion

The WG noted that some of the issues highlighted in the analysis for Japanese longline fleet are likely issues for all fisheries. The working group noted that successful fishermen are likely to be the first to try new gear or grounds, but if they are successful the rest of the fleet soon follows. The authors clarified that the offshore fleet is more adaptable to market changes (e.g. switch from bigeye to albacore if fishing good or market demands) than the distant water fleet. Possible solutions were discussed and provided to the author.

6.1.4 Relationship between hydrographic structure and longline catch presented by Akiko Takano

Japanese offshore surface longliners have targeted both swordfish and blue shark. Historically, however, their primary target was swordfish until they changed their strategy in the beginning of the 2000s. With this change the ratio of blue shark targeted sets increased. Many skippers of Japanese offshore surface longliners report that the catch of striped marlin changed significantly between blue shark directed sets and swordfish directed sets, although the number of hooks per basket is same. Thus the development of a new method to separate these two types of sets will be necessary for the CPUE standardization of striped marlin. In this report, the method to separate blue shark sets from swordfish sets using oceanographic information is presented. In addition, the result of longline research which provides the basic idea for the development of the new method is also introduced.

A ship observation was conducted from 6th October to 7th November in 2010 by Shunyo-maru in the western North Pacific. This area is called Kuroshio-Oyashio transition region located between the subtropical circulation characterized as high temperature and high salinity and the subarctic circulation characterized as low temperature and low salinity. Many eddies are formed by pinching off from the Kuroshio extension meander which is a part of subtropical circulation. Hydrographic observation and longline fishing was conducted around the eddy which retains properties of subtropical water from mixed layer to about 300 meter depth, and commercial longliners conducted in the northern side of that eddy. As a result, we observed that catch composition was changed by the properties of water mass (Temperature and salinity distribution). Many small or medium size of blue shark was caught in the subarctic water (Low temp. and sal.) and most of blue shark directed sets of commercial longliners were occurred in the similar hydrographic condition, while small number of big blue shark was caught in the subtropical water (High temp. & salinity). Relatively big swordfish was found in subtropical water mass or at the front of the eddy. These results indicated that combination of temperature and salinity in mixed layer are useful index to separate blue shark sets from swordfish sets. Based on the idea that properties of water mass is useful for the segregation of blue shark directed set from the swordfish directed one, Optimum temperature and salinity of 25 m depth layer for striped marlin was estimated using historical and extensive area data of hydrographic structure from FRA-JCOPE (Japanese Coastal Ocean Predictability Experiment) and fisheries logbook data from Japanese offshore surface longliners based on Kessnnuma fishing port. Temperature and salinity range with high catch and high CPUE was 18-26 degree and 33.8-34.9 psu, respectively. With the index of temperature and salinity, optimum area for striped marlin was subtracted. As a result of comparison between annual distributions of the optimum area and locations of longline sets, locations of longline sets has been shifted to the north where is good fishing area for blue shark, and more than 50 % of longline sets have been out of the optimum area after 2000 in 2nd and 3rd quarters. Furthermore, the optimum area is getting smaller because of high salinity in the center of subtropical circulation after 2004.

Combination of the surface temperature and salinity of 25 m depth layer at the position of the each longline set supposed to be a good indicator for the segregation of blue shark directed set from the swordfish directed one. Because high CPUE tend to be occurred in the marginal part of the optimal area designated the surface temperature and salinity in the 25m depth, further refinement of the method presented in the report should be a necessary for the standardization of CPUE of striped marlin caught by Japanese offshore surface longliners.

Discussion

The working group discussed the idea that in southern areas where oceanographic structure (e.g. eddies) may be less pronounced, identifying productive fishing areas may be more difficult. It was clarified that Japanese vessels use not only satellite information (oceanography) but they also work as teams to explore fishing grounds sharing information. The working group also noted that in recent years a shift in targeting swordfish and blue shark is from only one part of the fleet. The working group recognized that for some fleets an understanding of the environment is important to standardization of CPUE and encourage future work in this area.

6.1.5 WCPO longline fisheries operations pattern and use in developing CPUE presented by Minoru Kanaiwa

There are some conclusions that apply to the analysis of CPUE: There is a big historical change of HPB composition. Area 4 and 5 have many operations and striped marlin catch. The shallow set's effective effort may change but is hard to standardize effective effort. The operation pattern of shallower setting in area 5 has changed because the target species of fishery was changed. It is big change from past stock assessment so new method of standardization is required. Optimal time and area separation and data selection are required and the work is ongoing.

Discussion

The working group noted difficulties in standardizing this data set and the concerns of fishermen. However it was also pointed out that these issues were also problematic in previous CPUE analyses. The working group recommends that any new series be compared with the previous series although it is acknowledged that the boundaries may be different . The working group discussed disaggregating the data into different fisheries with associated CPUE and selectivity patterns to reduce the effects of the changes in fisheries operations.

6.1.6 Standardized catch-rates of striped marlin (Kajikia audax) for Taiwanese distant-water longline fishery in the North Pacific Ocean for 1967-2009 presented by Chi-Lu Sun (ISC/BILLWG-1/07)

Catch-rates of the striped marlin caught by the Taiwanese tuna longline fishery in the North Pacific Ocean were standardized using generalized linear models based on the proposed two-stock scenario (WCPO and EPO stocks, in the North Pacific Ocean). Category II data from 1967-1994 without HPB information and logbook data from1995-2009 with HPB information available were used in two separate analyses. Results suggest the standardized catch-rates of striped marlin are generally stable over the 1967-2009, with a slightly decreasing trend after 2005 in both stocks in the North Pacific Ocean. The standardized catch-rates of striped marlin with or without HPB information included in the standardization are quite similar, especially for the WCPO stock, although a little difference was noticed for the EPO stock before 2001 due to the very limited sample size of HPB information available.

Discussion

The working group discussed the importance of HPB to the estimation of standardized catch rates in the Taiwanese fishery. The authors subsequently presented the deviance table from their analysis showing that HPB was an important factor. The working group suggested that two series be produced which are marked by an early (without HPB) and late (with HPB). It was noted the early part of the time series is much less precise than the later period and that relative uncertainty should be maintained in the assessment model.

6.1.7 Standardization of striped marlin CPUE with Generalized Linear Models fitted to Pelagic Longline Observer Data from the Hawaii-based Fishery: 1995-2009 presented by William Walsh (ISC/11/BILLWG-1/08)

This working paper presents catch-per-unit-effort standardizations for striped marlin *Kajikia audax* in the Hawaii-based pelagic longline fishery from 1995–2009. Catch and operational data were gathered by NOAA Fisheries Pacific Islands Regional Observer Program (PIROP) personnel. The standardizations were conducted by fitting generalized linear models (Poisson GLM; delta-lognormal GLM). Explanatory variables used as factors were the fishing year, quarter of the year, and fishing region. Sea surface temperature, hooks per float, hooks per longline set; the number of shortbill spearfish *Tetrapturus angustirostris* caught per set were used as continuous explanatory variables. Results include descriptive catch statistics, an analysis of deviance for each model with residuals plots and a table summarizing the residuals, and graphical presentations of the nominal and GLM-standardized rates.

<u>Discussion</u>

The working group asked for clarification on why the authors chose to use the observer data instead of the logbook information which contains more observations. The authors pointed out that the observer dataset is measurements by scientific staff and should therefore be less biased than self reported data. It was further clarified that observer coverage of trips was approximately 5% -20% until the most recent period which has nearly full observer coverage. It was also noted that the Poisson error assumption was a slightly better fitting model relative to the delta lognormal. The working group discussed the use of spearfish catch as an independent factor, noting that this may violate the assumption of independence. The authors clarified that the explanatory power of the spearfish factor was low, but it was similar to other factors in the model. The working group requested CPUE be estimated excluding spearfish for comparison. The authors subsequently presented results showing that exclusion of spearfish as a factor had negligible effects on estimated CPUE. The authors also demonstrated that inclusion of SST*region interactions also did not affect model results. The working group also discussed the high variability of the data that may not be fully explained by the model. However it was acknowledged that methods used to standardize this data were appropriate.

6.2 Adoption of CPUE Time Series

The working group adopted the reduced (without spearfish) Poisson model of Hawaiian long-line CPUE for use in the stock assessment.

The working group adopted the Taiwanese long-line CPUE as two series: 1995-2009 that includes HPB and 1967-1994 without HPB for use in the stock assessment.

The working group agreed to receive new CPUE series until February 15th, 2011. Submissions will be circulated to the WG for review and adoption.

The working group agreed to use the WCPO CPUE series (areas 1-4) that were used in the prior stock assessment model if a new Japanese longline CPUE cannot be developed for this assessment area.

7.0 LIFE HISTORY PARAMETERS

7.1 Summary of ISC Striped marlin Life History presented by Robert Humphreys

Striped marlin research on the determination of sex-specific length-at-age relations and size and age at 50% reproductive maturity were reviewed from the recently completed Ph.D. dissertation of R. Keller Kopf, Charles Sturt University, Australia. The region of the study focused on the southwest Pacific, primarily offshore of eastern Australia, but also included portions of the south central Pacific. Gonads, heads (for otoliths), and 1st dorsal fins (for dorsal fin spines) were collected at sea from commercial longline vessels. The 4th dorsal fin element was cross-sectioned just above the base to evaluate and enumerate annual growth bands. Concurrently, otoliths were sectioned and presumed daily increments enumerated to identify the first annulus mark from other growth mark checks in the dorsal spine sections of 1+ age fish. This was then used for other dorsal spine sections of larger fish to identify the first true annulus correctly. A generalized von Bertalanffy growth curve was fitted to the back-calculated ages derived from spine section readings:

$$LJFL_t = L_{inf}\,(1 - e^{-k(1-m)\ t-t0)})^{\ (1/1-m)}$$

where $L_{inf} = 2722$, $K = 0.11$, $t_0 = -0.07$, and $m = -1.56$ for females and $L_{inf} = 2581$, $K = 0.16$, $t_0 = -0.14$, and $m = -1.29$ for males.

The oldest aged fish in this study were 8 years for females and 7 years for males; the growth curves were not significantly different between sexes. Size and age at 50% reproductive maturity was determined based on an evaluation of histological preparations of gonad samples. Eye-fork lengths at 50% reproductive maturity were 171.5cm EFL for females and 160.0 cm EFL. The corresponding ages at 50% reproductive maturity were 1.9 years and 1.4 years for females and males, respectively.

<u>Discussion</u>

Discussion of this presentation within the working group concentrated on five major points. Two were related to ageing, two were related to maturation, and one was related to striped marlin sizes in the Western Pacific Ocean.

The ageing discussion focused on the comparability of recent results and the technical difficulties involved in obtaining accurate age measurements. The major point in the first context was that the ageing methods employed by Keller Kopf and in Taiwan (Sun et al.) were identical. As such, their results are fully comparable. This has not previously been the case, when growth curves were developed by other methods (e.g., length frequencies). The major technical point regarding ageing of old fish was that vascularization of the fin spine and obscured increments increase the inherent difficulty of this work.

The maturation discussion focused on one technical matter and a second issue regarding interpretation of the relevant literature. The technical aspect was related to determination of maturation. Histological studies have been conducted to improve understanding of the reproductive cycle of striped marlin, but it can be difficult to distinguish virgin females from those that have completed spawning. The issue regarding interpretation of the literature is that it is not clear whether certain accounts refer to observed first maturity or 50% maturity.

The striped marlin size discussion focused on the relation between size and distribution in the Western Pacific Ocean. Striped marlin from the Coral Sea were relatively small, whereas large fish were caught in the Tasman Sea, in New Zealand waters, and south of French Polynesia.

Finally, the working group specifically recognized the importance of biological sampling. It is strongly recommended that biological studies (including bio-sampling) continue in the future.

7.2 Age and growth of striped marlin (*Kajikia audax*) in waters off Taiwan presented by Chi-Lu Sun (ISC/11/BILLWG-1/09)

Age and growth of striped marlin in waters off Taiwan were examined based on counts of annual growth rings on cross sections of the fourth spine of the first dorsal fin. In total, 1,416 length samples (EFL) of striped marlin were collected from November 2004 to April 2010. Sex combined length-weight relationship was $W=5\times10^{-6}EFL^{3.15}$. A total of 517 spines were collected; 291 male and 226 female. For males, 241 (83%) were successfully aged compared to 206 (91%) female striped marlin. The time of the formation of the first ring was validated by reading the daily rings on the cross section of the otolith of striped marlin. The analysis of marginal increment ratio suggested that the growth bands of striped marlin formed once a year (during October to next January). The back-calculated lengths for each age were computed using the simple linear and power functions, and then used to fit the standard von Bertalanffy growth function (VBGF) and Generalized von Bertalanffy growth function (Richards function). Results showed a superior fit of Richards function to standardized VBGF based on AIC statistics. The estimated growth equations for male and female striped marlin were not statistically different through the analysis of residual sum of squares (ARSS, $P > 0.05$). The sex-combined generalized VBGF of striped marlin was estimated as

$$L_t = 277.4\left(1 - e^{-0.17(1-0.73)(t-0.22)}\right)^{1/(1-0.73)}.$$

Discussion

Discussion of this working paper within the Working Group considered the comparability of these results to those from other studies. Because the fourth dorsal spine was used for ageing, this study can be regarded as fully comparable to the aging research conducted by Keller Kopf (see above).

Discussion also focused on the method by which the growth curve was fitted. The growth curve for Taiwanese waters was fitted by the Richards function rather than the standard Von Bertalanffy equation because the Akaike Information Criterion (AIC) value for the Richards function was less than that with the standard Von Bertalanffy function.

Discussion continued regarding whether the growth curve provided by Melo-Barrera is suitable for the Western Pacific Ocean, Eastern Pacific Ocean, both or neither. There is concern as to the validity of the first annulus in the Melo-Barrera curve. One suggestion was that rather than simply 'shift' the Melo-Barrera growth curve in an attempt to account for a missing annulus, an iterative approach could be preferable. A second suggestion was that any change in methodology (e.g., a switch from the Melo-Barrera to the Taiwanese growth curve) should be accompanied by a model run using the previously employed growth curve to assess sensitivity to the change.

The working group arrived at three decisions following this discussion. The first was that the Taiwanese growth curve will be used for the Western Central Pacific Ocean. The second was that the Melo-Barrera growth curve will also be tried in a model run as a sensitivity analysis. The third was that sex-specific growth curves should be considered in future studies.

The WG pointed out that the sample size of large fish is relatively small and that future work should focus on collecting more samples.

7.3 Meta-analysis of striped marlin natural mortality presented by Kevin Piner (ISC/11/BILLWG-1/10)

Natural (M) mortality estimates for North Pacific Ocean striped marlin were derived from a meta-analysis of 9 different estimators. The M estimators relied on a range of factors (e.g. maximum age, maximum size, growth rate) and a broad range of levels within each factor was used to estimate within-method uncertainty. The overall M estimate was based on a random effects inverse variance weighting of each method (0.38 –yr ± 0.028 SE). An un-weighted mean (0.42 –yr ± 0.021 SE) was also calculated for comparison. These estimates of M were assumed to represent adult M and a Lorenzen size-M relationship was used to rescale adult M t represent juvenile M. A literature review of the magnitude of M used world-wide in the population modeling of billfish indicated that most billfish are assumed to be somewhat less productive (0.3 –yr ± 0.040 SE) than these new estimates.

Discussion

The discussion focused on whether or not newly computed age-specific mortality estimates should be used. The alternative was to use a juvenile value (Ages 0–1) and adults (Age 2 and older). It was emphasized that change in mortality rates is important to the model.

The working group agreed that the Richards function with sexes combined from Taiwanese waters will be used for the growth curve in the Western Pacific Ocean.

7.4 Reproductive biology of female striped marlin (*Kajikia audax*) in the waters off Taiwan presented by Chi-Lu Sun (ISC/11/BILLWG-1/11)

Length-weight data and gonad samples from 1219 striped marlin were collected at fish markets in Tungkang, Shinkang, and Nanfangao during November 2004 to September 2010. Reproductive activity assessed using histology and the gonadosomatic index, indicated that the spawning season occurs from April to August. The estimated size-at-50%-maturity for females was 178.98 cm EFL (age 2.3). Based on the proportion of mature females with postovulatory follicles, the spawning fraction (0.29) implies that the striped marlin spawned once every 3.4 days on average. The averaged batch fecundity was 4.38 million oocytes and the average relative fecundity was 53.61 oocytes per gram of body weight.

<u>Discussion</u>

Discussion of this working paper within the Working Group focused on sex ratios in relation to body size. While the sample size for small striped marlin is limited, they are mostly males, whereas most striped marlin 180-200 cm eye fork length are females. Two major questions were raised in this context. The first was whether striped marlin undergo sex-specific migrations in Taiwanese waters. The presenter stated that there is no clear evidence to support whether or not there were sex-specific migrations. The second question was related to striped marlin size and the growth curves. Specifically, is it a contradiction to assume that the growth curve is identical for the two sexes when the large striped marlin are almost all females. One suggestion for a possible explanation was that the small but not statistically significant difference in growth curves between sexes could be a contributory factor. Two additional suggestions regarding changes in sex ratios were that there may be some difference(s) in age-specific mortality or bias in determining sexes from market samples. The latter could be possible because visual identification of testes of immature males is more difficult than recognizing ovaries of immature females.

A second area of discussion was maturation and spawning. The gonadosomatic index and histological study were used to identify the spawning season (April–August). It also appears that spawning occurs in opposite months in the northern and southern hemispheres.

The working group arrived at three decisions from this discussion. The first was that the results of this study will be used for sex ratios, while use of sex-specific growth rates may prove appropriate for future work. The second was that the maturity ogive from this working paper (Figure 6) would be used. The third decision was that sensitivity analyses should be run to assess the effects of the revisions in the perceived biological characteristics of this stock. The reason is that the new results suggest that this stock is more productive than had been believed, maturing in about half the time than had previously been believed.

8.0 ECONOMIC ANALYSES

8.1 Searching for optimal fishing effort for swordfish (*Xiphias gladius*) by Japanese distant water longline fishing vessels presented by Gakushi Ishimura (ISC/11/BILLWG-1/13)

An empirically-estimated landing function for Japanese off-shore longline fishing vessels is integrated with a demand model for swordfish and operating costs. This integrated model is used to explore optimal fishing efforts to both maximize yields and profits. The simulation explores sensitivities of profits to fuel price and subsidies. The results demonstrate explicit differences between optimizing effort for the maximum landing per trip (45 days per trip) and maximum profits per trip (25 days per trip). As the average days per trip is 41, this result suggests that this group of vessels operates close to the open access equilibrium which is not optimal for the economic maximization. The simulation results suggest, 1) a fuel subsidy increases maximum profit but also the risk of overfishing and 2) an increase in fuel price would lead to lesser maximum profit and a constricted range of efforts for positive profit. The results also demonstrate the possibilities to induce economic reference points for the management of swordfish resources in the North Pacific. While the specific results from this analysis reflect the characteristics of a swordfish fishery by a Japanese off-shore longline fishing vessel, the general conclusions and the modeling approach are applicable for other fishery species under ISC management.

<u>Discussion</u>

The WG discussed the role of skippers as decision makers, whether results from this study would have any effects on behavior and trip length, and information sharing across the fleet. There was also discussion as to whether replacing larger vessels with smaller vessels or reducing the hold capacity of current vessels would result in vessel trips closer to economic maximization. It was acknowledged, however, that under the current economic climate most vessels (most vessels in this fleet are >20 years) will be retrofitted instead of replaced. The WG clarified that the curve of swordfish harvest per trip declined with larger effort, because their maximum trip length is limited to about 50 days by the ability of these vessels.

8.2 Preliminary development of economic capacity and reference points for Western and Central swordfish fisheries (*Xiphias gladius*) in North Pacific presented by Gakushi Ishimura (ISC/11/BILLWG-1/14)

Economic capacity and reference points of the Western and Central swordfish stock in the North Pacific are estimated by extrapolating the optimal economic yield of a swordfish fishery by a Japanese off-shore fishing vessel which accounts for 19% of landings of the North pacific. The Bayesian production model conducted in 2010, Maximum Sustainable Yield (*MSY*) and the profitability analysis on a Japanese off-shore longline fishing vessel suggests a point estimate of Maximum Economic Yield (*MEY*) as 3,130 *MT* per year and biomass at MEY ranging from 31,040 *MT* to 100,640 *MT*. While the specific results from this analysis reflect the limitations of available data and characteristics of a swordfish fishery by a Japanese off-shore longline fishing vessel, additional data from other swordfish fisheries in Japan, US and Taiwan could contribute to a more complete picture of economic capacity and reference points of Western and Central swordfish fisheries in North Pacific.

Discussion

The WG noted that economic reference points are gaining more interest in the RFMO community. There was discussion on how the addition of historical data could help identify which level of MEY should be preferred.

8.3 Determining the ex-vessel price of landings in the Japanese distant-water longline fishery presented by Gakushi Ishimura (ISC/11/BILLWG-1/12)

This paper conducts an empirical estimation of the price elasticity of landings of seven fish species by a Japanese off-shore fishing vessel. This estimation is used to quantify the effects of price determinants, freshness of landings (total days per trip), and landing quantities per trip. Results demonstrate that the ex-vessel price of swordfish is statistically affected by both price determinants. The results also demonstrate that freshness dominantly affects the ex-vessel price of swordfish, more than the landing quantity per trip. This study suggests that the fishing strategies of a Japanese off-shore longline fishing vessel, which targets swordfish, should put an emphasis on maintaining freshness of already- harvested fish rather than searching for additional catches.

Discussion

The WG noted that vessels from the off-shore longline fishery are delivering products fresh on ice and not frozen so shorter trips would result in fresher product. Catches from the harpoon and coastal longline fisheries command higher prices because they are much fresher and sold to a different market. Buyers are only given information on the location of the fishing ground, not trip length and must infer freshness from observing samples cut from the tail of the fish. The study used trip length as a proxy for freshness. The WG commented that it would be more efficient to operate smaller vessels. Price for blue sharks are not entirely governed by the buyer as there is some cost sharing in this industry. It was noted that the species composition of landings is similar to that observed in Hawaii. However, in Hawaii, blue sharks are considered bycatch, and discarded whereas in Japan there are unique operations in Kesennuma especially for processing blue shark into various products.

8.4 Preliminary study on socio-economic reference points for internationally shared fishery resources presented by Gakushi Ishimura (ISC/11/BILLWG-1/15)

While biological reference points, such as biomass at the maximum sustainable yield, have often been applied to measure performance of fish stocks for fishery management, social and economic data are rarely adapted analogously, to help guide management. Indeed, one of the most constraining challenges in internationally shared fishery resource management is to establish common socio-economic reference points among participating countries. This situation is a result of the diverse interests of different groups of fishermen within each country, as well national domestic policies. This study reviewed, 1) social and economic assessments of U.S.

fishery policy and 2) *the Basic Plan for Fisheries* of Japan. The first and urgently needed step to establish common socio-economic reference points for the management of internationally shared fish stock is to determine the baseline condition of fishery. A key component of the analyses on socio-economic reference points will be the comparison of different projected social and economic impacts, under the implementation of different fishery management scenarios. For international management of shared fish stocks, such procedures need to be guided by the scientific committees of RFMOs.

Discussion

The WG noted that as it is taking considerable time to develop and adopt biological reference points in RFMOs and that it would likely take substantially more time to develop socioeconomic reference points. It was also noted that some domestic fisheries management systems may be more amenable than others to consider socioeconomic reference points. For example, in the U.S. the Magnuson Act specifies MSY-based reference points. However, other countries such as Canada and Japan have management systems that give greater consideration to stakeholders. It is thus important to develop guidelines to be able to compare differences in different fisheries management systems. There was discussion on whether it would be easier to come to agreement on reference points for incidental species such as striped marlin, and whether that would serve to generate momentum for reference point development. It was noted that it might not be easier to reach agreement if a species such as blue shark are targeted in some countries, but considered as a non-target species in others. There was also discussion about the difficulties in getting cost information and the importance of having that information.

9.0 STRIPED MARLIN STOCK ASSESSMENT PROCESS

9.1 Work Plan

A workplan for 2011 was outlined for the completion of the striped marlin stock assessment in the WCPO for presentation at the ISC11 Plenary Meeting.

	January	February	March	April	May	June	July
	BILLWG-1				BILLWG-2		ISC Plenary
	Honolulu, HI				Taipei, Taiwan		Location TBD
Data approval	Final						
Tardy data submission		Final					
Finalize data tables for distribution		Final					
Update most recent year data					Final		
Stock assessment completion					Final		
Reference points calculation					Final		
Projections					Final		
Report						Final	

9.2 Stock Assessment Data and Input Parameters

The working group reviewed data availability from each of the member countries fisheries. Each country delegation was requested to submit their quarterly catch data, quarterly size data, and annual time series of standardized CPUE. The working group noted that catch is assumed to be without error but if there is known error, estimate of catch error could be submitted. These data were requested to be separated into the eastern Pacific Ocean (EPO) and western central Pacific Ocean (WCPO) consistent with the assumed stock structure.

Member countries have raised concern about the difficulty to estimate quarterly catch for their small-scaled fisheries (e.g. harpoon fisheries, trap, net and bait fishing). The working group suggested that an educated guess based on the available information of effort or equal proportion assigned to each season, or catch proportion from the last assessment could be used as an alternative of estimating quarterly catch may be appropriate, however, judgement was entrusted to scientists from each member countries. It was pointed out that quarterly catch was provided in the last stock assessment. The working group also noted that examination of the reported catch with that recently provided is needed to avoid duplication. The working group was concerned about the lack of catch data for China in the ISC but noted that the catch may be contained in that reported to the SPC. The working group indicated that no data for Mexican recreational fisheries was provided, but it was noted that it is available in the IATTC stock assessment. The Chairman will make a request to address the above issues.

Size composition data were combined for the Japan longline fisheries. It was pointed out that the size data can be further separated into Japanese surface and tuna longline fisheries, although a shorter time series will be obtained. The Taiwan delegation indicated that a small number of samples of size composition is available for some fisheries. The working group noted that for those fisheries without size composition data, an alternative fishery selectivity pattern will need to be assumed. It is recommended that each country provide guidance for this assumption if necessary.

The working group reviewed the life history parameters in WCPO. Age-specific natural mortality for juvenile (age 0 and age 1) and adult (age 2 above) was agreed to be used as the schedule of natural mortality for striped marlin in WCPO (WP10). The maturity ogive presented in the Figure 6 of the WP12 was adopted for the next assessment. Richards growth curve provided in the WP09 was agreed to be used. Length-weight relationship from the last assessment will be used. The working group noted that various sensitivity runs across different life history parameters are needed. The sensitivity runs assuming the same model structure or same parameter used in the last assessment was also suggested. Table of candidate sensitivity analysis will be provided and circulated to the BILLWG for review.

The assessment will be conducted using the Stock Syntheses 3 (SS3) as a base case. The working group also discussed use of alternative assessment models. Trials using alternative assessment models is encouraged however, there may not be sufficient time to conduct such analyses. Having said that, Chinese Taipei agreed to use and age-structured model to assess stock status given sufficient time to complete the work. If other alternative models are used, the SS3 assessment will be the preferred model for estimating harvest rate and biomass for striped marlin

9.3 Collaboration

It was noted that the IATTC's striped marlin stock assessment in the EPO was completed prior to this meeting. The working group discussed whether this assessment is satisfactory to use in conjunction with the NP striped marlin stock assessment in the WCPO to characterize the striped marlin status in the North Pacific. The WG agreed, pending discussions with the IATTC, to send a representative to work with the IATTC on their assessment. Regarding the sensitivity analyses that were requested, they are already in progress. If the BILLWG concludes that a NP EPO SM Assessment in the EPO is needed, the assessment completion date will need to be postponed until 2012. The WG requested that there will be sensitivity analyses that use the boundaries delineated by the BILLWG.

10.0 BILLFISH RESEARCH

10.1 Striped marlin satellite tagging research to assess the distribution and behavioral ecology of southwest Pacific striped marlin presented by Tim Sippel (PFRP) – Presentation only

The presentation reviewed existing knowledge about striped marlin movement, summarized outcomes of satellite tagging research on striped marlin in the southwest Pacific Ocean, summarized hypothesized oceanographic influences on behavior and distribution of striped marlin in the southwest Pacific Ocean and made some recommendations for uses of electronic tagging data in stock assessment of striped marlin population dynamics.

Existing conventional and electronic tagging data for striped marlin are limited in spatio-temporal scale, duration, and sample size. As a result, a striped marlin satellite tagging program was conducted from 2003 – 2010 for a New Zealand recreational fishery. Double tagging methods were developed utilizing pop-up satellite tags (PSAT) and smart position or temperature transmitting (SPOT) tags to collect the best possible geo-location data. A behavioral model was developed to investigate movement and behavior patterns in tagging data. The model was used to identify area restricted behavior (possibly foraging), transitory movements (possibly migration), and behavioral shifts associated with arrival in austral tropics (20 °S). Striped marlin were observed in SST ranging from 20-28 °C. The East Australian Current and Southern Equatorial Current appeared to have a strong effect on the distribution of the striped marlin population from the southwest Pacific Ocean. Mixed layer depth also appeared influential on the behavior and distribution of striped marlin. Inferred behaviors correspond generally with diving patterns concurrently observed. A potential behavioral bias was also identified in the tagging data, suggesting the capture and/or tagging process may have an effect on the behavior of tagged animals. Electronic tagging data can be very informative to stock assessment. In particular, depth distributions of striped marlin in the southwest Pacific observed in this study were substantially deeper than those in the eastern Pacific Ocean observed in previous studies, and this should be considered when trying to standardize CPUE data by depth. Mortality rates were identifiable from tagging data in this study (both natural mortality and mortality associated with capture/tagging events), and these rates may be useful for stock assessment. Electronic tagging studies of behavioral ecology also inform our understanding of basic biology, population distribution and density, and spatial stratification. Caveats are the limited battery life and problems with tag retention (1 yr sat tags not yet achieved), as well as the possibility of capture and/or tagging induced biases in behavior.

Discussion

The BILLWG discussed that there is value in collecting stomach contents as well as electronic tagging data when attempting to infer foraging behavior. The BILLWG also discussed the accuracy of geolocation estimates and whether or not the electronic tagging data supported the WCPFC striped marlin stock assessment boundary and/or evidence of stock structure from genetics.

10.2 Biological Sampling

A biological research plan for collecting and analyzing billfish samples from ISC member countries was previously developed. The plan was presented and endorsed by the WCPFC-NC, but funding has yet to materialize. The BILLWG stands behind the biological research plan that was forwarded by the ISC and encourages member countries to "contribute".

11.0 OTHER BUSINESS

11.1 ISC Billfish Chairperson Elections

The election for ISC BILLFISH Chairperson was postponed until the next workshop.

11.2 Striped Marlin Stock Assessment Review

The BILLWG Chair discussed the need for independent experts to review the stock assessments that come out of the WG. The Chair informed the WG of the review process that has already been used for the 2009 ISC BILLWG North Pacific swordfish assessment, and that the same process will be implemented for the 2011 North Pacific striped marlin assessment at no cost to the ISC. This review process is run by the Center for Independent Experts (CIE). The CIE is a program designed to promote independent participation in peer reviews of the science carried out by NOAA Fisheries.

Discussion

The WG recommended that the assessment reviews should not only be distributed directly to WG members, but should also be posted on the ISC website. The ISC Chair agreed and will look into it.

11.3 Historic Working Papers for Website Posting

In the future, the ISC Billfish Working Group plans on having all working papers ever submitted to the ISC Marlin, Swordfish, or Billfish Working Group posted on the ISC website, with the author's permission. In order for this to be completed, we need to get author's permission on all archived working papers.

In September 2010, a request was sent out to get all authors' permissions for public posting on all archived working papers. The BILLWG Chair urges WG members who were contacted to complete this request as soon as possible, if they haven't done so already.

11.4 Work Assignments

The BILLWG were given a number of assignments:

- Finalize all working papers submitted at this meeting by February 28, 2011
- Submit late striped marlin Category I, II, and III data to Dr. Kevin Piner by February 15, 2011
- Finalize data tables for distribution by February 28, 2011
- Update most recent year data for striped marlin by May 15, 2011

12.0 FUTURE MEETINGS

The next intercessional BILLWG workshop is scheduled for 24 May – 1 June 2011 in Chinese Taipei. The goal of this meeting will be to finalize the North Pacific striped marlin stock assessment for presentation at the 11th ISC Plenary meeting. A formal announcement for this meeting will be sent out shortly after the conclusion of this meeting, with a list of hotels that will be available for meeting participants. The local host of the meeting will need to know by 1 March 2011 if you will be attending the meeting in order to have adequate time to make hotel arrangements.

13.0 ADJOURNMENT

The ISC BILLWG intercessional workshop was adjourned at 12:48pm on 27 January 2011. The Chairman expressed his appreciation to all participants for their contributions and cooperation in completing the meeting. The Chairman also expressed his concern with the lack of apparent commitment on the part of some participants. If we are to make progress, participants need to come to with workshop with data in hand.

Table 1. Striped marlin catches (in metric tons) by fisheries, 1952-2005. Blank indicates no effort. - indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ).

	Japan							Chinese Taipei[1]												Costa Rica[1]	Korea			Mexico			United States					Grand Total
Year	Distant-water and Offshore Longline	Coastal Longline	Other Longline	Small Mesh Gillnet	Large Mesh Gillnet	Other[2]	Total	Distant-water Longline	High-seas Drift Gillnet	Offshore Longline	Offshore Gillnet	Offshore Others	Coastal Harpoon	Coastal Setnet	Coasta Gillnet & Other net	Coastal Longline	Coastal others	Other	Total	Sport	Longline	High-seas Drift Gillnet	Total	Longline	Sport[1]	Total	Longline	Troll	Handline	Sport[1]	Total	
1951	2,494	-	673	-	0	1,281	4,447																									4,447
1952	2,901	-	722	-	0	1,564	5,187												-		-		0			0				23	23	5,210
1953	2,138	-	47	-	0	954	3,139												-		-		0			0				5	5	3,144
1954	3,068	-	52	-	0	1,088	4,207												-		-		0			0				16	16	4,223
1955	3,082	-	28	-	0	1,038	4,148												-		-		0			0				5	5	4,153
1956	3,729	-	59	-	0	1,996	5,785												-		-		0			0				34	34	5,819
1957	3,189	-	119	-	0	2,459	5,767												-		-		0			0				42	42	5,809
1958	4,106	-	277	-	3	2,914	7,300			543								387	930		-		0			0				59	59	8,289
1959	4,152	-	156	-	2	3,191	7,501			391								354	745		-		0			0				65	65	8,311
1960	3,862	-	101	-	4	1,937	5,904			398								350	748		-		0			0				30	30	6,682
1961	4,420	-	169	-	2	1,797	6,388			306								342	648		-		0			0				24	24	7,060
1962	5,739	-	110	-	8	1,912	7,769			332								211	543		-		0			0				5	5	8,317
1963	6,135	-	62	-	17	1,910	8,124			560								199	759		-		0			0				68	68	8,951
1964	14,304	-	42	-	2	2,344	16,692			392								175	567		-		0			0				58	58	17,317
1965	11,602	-	19	0	1	2,794	14,416			355								157	512		-		0			0				23	23	14,951
1966	8,419	-	112	0	2	1,570	10,103			370								180	550		-		0			0				36	36	10,689
1967	11,698	-	127	0	3	1,551	13,379	2		385								204	591		-		0			0				49	49	14,019
1968	15,913	-	230	0	0	1,043	17,186	1		332								208	541		-		0			0				51	51	17,778
1969	8,544	600	3	0	3	2,668	11,818	2		571								192	765		-		0			0				30	30	12,613
1970	12,996	690	181	0	3	1,032	14,902	0		495								189	684		-		0			0				18	18	15,604
1971	10,965	667	259	0	10	2,042	13,943	0		449								135	584		0		0			0				17	17	14,544
1972	7,006	837	145	0	243	993	9,224	9		380								126	515		0		0			0				21	21	9,760
1973	6,357	632	118	0	3,265	702	11,074	1		568								139	708		0		0			0				9	9	11,791
1974	6,700	327	49	0	3,112	775	10,963	24		650								118	792		0		0			0				55	55	11,810
1975	5,281	286	38	0	6,534	686	12,825	64		732								96	892		0		0			0				27	27	13,744
1976	5,136	244	34	0	3,561	585	9,560	32		347								140	519		0		0			0				31	31	10,110
1977	3,019	256	15	0	4,424	547	8,261	17		524								219	760		43		43			0				41	41	9,105
1978	3,957	243	27	0	5,593	546	10,366	0		618								78	696		28		28			0				37	37	11,127
1979	5,561	366	21	0	2,532	526	9,006	26		432								122	580		-		0			0				36	36	9,622
1980	6,378	607	5	0	3,467	536	10,993	61		223								132	416		37		37			0				33	33	11,479
1981	4,106	259	12	0	3,866	542	8,785	17		491								95	603		-		0			0				60	60	9,448
1982	5,383	270	13	0	2,351	656	8,673	7		397								138	542		39		39			0				41	41	9,295
1983	3,722	320	10	22	1,845	827	6,746	0		555								214	769		19		19			0				39	39	7,573
1984	3,506	386	9	76	2,257	719	6,953	0		965								330	1,295		23		23			0				36	36	8,307
1985	3,897	711	24	40	2,323	733	7,728	0		513								181	694		16		16			0		18		42	60	8,498
1986	6,402	901	33	48	3,536	577	11,497	0		179								148	327		61		61	-		0		19		19	38	11,923
1987	7,538	1,187	6	32	1,856	513	11,132	31		383								151	565		1		1	-		0	272	30	1	28	331	12,029
1988	6,271	752	7	54	2,157	668	9,909	7		457								169	633		11		11	-		0	504	54		30	588	11,141
1989	4,740	1,081	13	102	1,562	537	8,035	8		184								157	349		26		26	-		0	612	24	0	52	688	9,098
1990	2,368	1,125	3	19	1,926	545	5,986	2		137								256	395		315		315	-	181	181	538	27	0	23	588	7,465
1991	2,845	1,197	3	27	1,302	507	5,881	36		254								286	576	106	141		141	-	75	75	663	41	0	12	716	7,495
1992	2,955	1,247	10	35	1,169	303	5,719	1		219								197	417	281	318		318	-	142	142	459	38	1	25	523	7,400
1993	3,476	1,723	1	-	828	708	6,736	5		221								142	368	438	388		388	-	159	159	471	68	1	11	551	8,640
1994	2,911	1,284	1	-	1,443	383	6,022	1		137								196	334	521	1,045		1,045	-	179	179	326	35	0	17	378	8,479
1995	3,494	1,840	3	-	970	283	6,590	27		83								82	192	153	307		307	-	190	190	543	52	0	14	609	8,041
1996	1,951	1,836	4	-	703	152	4,646	26		162	8	6	30	3	-	-	-		235	122	429		429	-	237	237	418	54	1	20	493	6,162
1997	2,120	1,400	3	-	813	163	4,499	59		290	9	-	33	3	-	2	-		396	138	1,017		1,017	-	193	193	352	38	1	21	412	6,655
1998	1,784	1,975	2	-	1,092	304	5,157	90		205	15	-	19	6	1	9	-		345	144	635		635	-	345	345	378	26	0	23	427	7,053
1999	1,608	1,551	4	-	1,126	184	4,473	66		128	7	-	26	5	1	3	-		236	166	433		433	-	266	266	364	28	1	12	405	5,979
2000	1,152	1,109	8	-	1,062	297	3,628	153		161	17	1	29	6	1	1	-		369	97	537		537	-	312	312	200	14	1	10	225	5,168
2001	985	1,326	11	-	1,077	237	3,636	121		129	16	-	30	5	-	-	-		301	151	254		254	-	237	237	351	42	2		395	4,974
2002	764	796	5	-	1,264	290	3,119	251		226	14	-	6	8	1	-	-		506	76	188		188	-	305	305	226	30	0		256	4,450
2003	1,013	842	3	-	1,064	203	3,124	241		91	26	-	11	5	1	-	-		375	79	206		206	-	322	322	552	29	0		581	4,687
2004	699	1,000	2	-	1,339	92	3,132	261		95	8	1	7	5	2	-	1		380	(19)	75		75	-	-	0	376	34	1		411	3,998
2005	562	668	1	-	1,214	98	2,543	176		76	1	-	5	9	9	-	8		284	-	141		141	-	-	0	493	20	0		513	3,481
2006	623	539	1	-	1,190	95	2,448														56		56				609	21	0		630	3,134
2007	(306)	(860)	(5)	(-)	(970)	(79)	(2,220)														28		28				265	13	0		278	(2,526)
2008	(394)	(606)	(10)	(-)	(1,302)	(97)	(2,408)																									-2,408

[1] Estimated from catch in number of fish

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

updated 7/13/10

ISC/10/BILLWG-2/06, Table 1

Table 2. Swordfish catches (in metric tons) by fisheries, 1952-2005. Blank indicates no effort. - indicates data not available. 0 indicates less than 1 metric ton. Provisional estimates in ( ).

Year	Japan: Distant-water and Offshore Longline[2]	Japan: Coastal Longline	Japan: Driftnet	Japan: Harpoon[3]	Japan: Other Bait Fishing	Japan: Trapnet	Japan: Other[4]	Japan: Total	Chinese Taipei[5]: Distant-water Longline	Chinese Taipei: Offshore Longline	Chinese Taipei: Offshore Gillnet	Chinese Taipei: Offshore Others	Chinese Taipei: Coastal Harpoon	Chinese Taipei: Coastal Setnet	Chinese Taipei: Coastal Gillnet & other net	Chinese Taipei: Coastal Longline	Chinese Taipei: Coastal Others	Chinese Taipei: Other	Chinese Taipei: Total	Korea: Longline	Korea: High-seas Drift Gillnet	Korea: Total	Mexico: All Gears	United States[6]: Hawaii Longline	United States: California Longline	United States: California Gill Net	United States: California Harpoon	United States: California Unknown[7]	United States: Total	Grand Total
1951	7,246	115	10	4,131	88	78	10	11,678																						11,678
1952	8,890	152	0	2,569	6	68	6	11,691	-	-									-	-			-	-	-	-	-	-	-	11,691
1953	10,796	77	0	1,407	20	21	87	12,408	-	-									-	-			-	-	-	-	-	-	-	12,408
1954	12,563	96	0	813	104	18	17	13,610	-	-									-	-			-	-	-	-	-	-	-	13,610
1955	13,064	29	0	821	119	37	41	14,111	-	-									-	-			-	-	-	-	-	-	-	14,111
1956	14,596	10	0	775	66	31	7	15,486	-	-									-	-			-	-	-	-	-	-	-	15,486
1957	14,268	37	0	858	59	18	11	15,251	-	-									-	-			-	-	-	-	-	-	-	15,251
1958	18,525	42	0	1,069	46	31	21	19,734	-	-									-	-			-	-	-	-	-	-	-	19,734
1959	17,236	66	0	891	34	31	10	18,267	-	427								91	518	-			-	-	-	-	-	-	-	18,785
1960	20,058	51	1	1,191	23	67	7	21,400	-	520								127	647	-			-	-	-	-	-	-	-	22,047
1961	19,715	51	2	1,335	19	15	11	21,147	-	318								73	391	-			-	-	-	-	-	-	-	21,538
1962	10,607	78	0	1,371	26	15	18	12,115	-	494								62	556	-			-	-	-	-	-	-	-	12,671
1963	10,322	98	0	747	43	17	16	11,244	-	343								18	361	-			-	-	-	-	-	-	-	11,605
1964	7,669	91	4	1,006	40	16	26	8,852	-	358								10	368	-			-	-	-	-	-	-	-	9,220
1965	8,742	119	0	1,908	26	14	182	10,991	-	331								27	358	-			-	-	-	-	-	-	-	11,349
1966	9,866	113	0	1,728	41	11	4	11,763	-	489								31	520	-			-	-	-	-	-	-	-	12,283
1967	10,883	184	0	891	33	12	5	12,008	-	646								35	681	-			-	-	-	-	-	-	-	12,689
1968	9,810	236	0	1,539	41	14	9	11,649	-	763								12	775	-			-	-	-	-	-	-	-	12,424
1969	9,416	296	0	1,557	42	11	14	11,336	0	843								7	850	-			-	-	-	-	-	-	-	12,186
1970	7,324	427	0	1,748	36	9	3	9,547	-	904								5	909	-			-	5	-	-	612	10	627	11,083
1971	7,037	350	1	473	17	37	31	7,946	-	992								3	995	0			-	1	-	-	99	3	103	9,044
1972	6,796	531	55	282	20	1	2	7,687	-	862								11	873	0			2	0	-	-	171	4	175	8,737
1973	7,123	414	720	121	27	23	2	8,430	-	860								119	979	0			4	0	-	-	399	4	403	9,816
1974	5,983	654	1,304	190	27	16	2	8,176	1	880								136	1,017	0			6	0	-	-	406	22	428	9,627
1975	7,031	620	2,672	205	58	18	2	10,606	29	899								153	1,081	0			-	0	-	-	557	13	570	12,257
1976	8,054	750	3,488	313	170	14	12	12,801	23	613								194	830	0			-	0	-	-	42	13	55	13,686
1977	8,383	880	2,344	201	71	7	2	11,888	36	542								141	719	219			-	17	-	-	318	19	354	12,961
1978	8,001	1,031	2,475	130	110	22	1	11,770	-	546								12	558	68			-	9	-	-	1,699	13	1,721	14,049
1979	8,602	1,038	983	161	45	15	4	10,848	7	661								33	701	-			7	7	-	-	329	57	393	11,949
1980	6,005	849	1,746	398	29	15	1	9,043	10	603								76	689	64			380	5	-	160	566	62	793	10,905
1981	7,039	727	1,848	129	58	9	3	9,813	2	656								25	683	-			1,575	3	0	473	271	2	749	12,820
1982	6,064	874	1,257	195	58	7	1	8,456	1	855								49	905	48			1,365	5	0	945	156	10	1,116	11,842
1983	7,692	999	1,033	166	30	9	2	9,931	0	783								166	949	11			120	5	0	1,693	58	7	1,763	12,763
1984	7,177	1,177	1,053	117	98	13	0	9,635	-	733								264	997	48			47	3	12	2,647	104	75	2,841	13,520
1985	9,335	999	1,133	191	69	10	0	11,737	-	566								259	825	24			18	2	0	2,990	305	104	3,401	15,981
1986	8,721	1,037	1,264	123	47	9	0	11,201	-	456								211	667	9			422	2	0	2,069	291	109	2,471	14,761
1987	9,495	860	1,051	87	45	11	0	11,549	3	1,328								190	1,521	44			550	24	0	1,529	235	31	1,819	15,439
1988	8,574	678	1,234	173	19	8	0	10,686	-	777								263	1,040	27			613	24	0	1,376	198	64	1,662	14,001
1989	6,690	752	1,596	362	21	10	0	9,431	50	1,491								38	1,579	40			690	218	0	1,243	62	56	1,579	13,279
1990	5,833	690	1,074	128	13	4	0	7,742	143	1,309								154	1,606	61			2,650	2,436	0	1,131	64	43	3,674	15,672
1991	4,809	807	498	153	20	5	0	6,292	40	1,390								180	1,610	5			861	4,508	27	944	20	44	5,543	14,306
1992	7,234	1,181	887	381	16	6	0	9,705	21	1,473								243	1,737	8			1,160	5,700	62	1,356	75	47	7,240	19,842
1993	8,298	1,394	292	309	43	4	1	10,341	54	1,174								310	1,538	15			812	5,909	27	1,412	168	161	7,677	20,368
1994	7,366	1,357	421	308	37	4	0	9,493	-	1,155								219	1,374	66			581	3,176	631	792	157	24	4,780	16,228
1995	6,422	1,387	561	423	34	7	0	8,834	50	1,135								225	1,410	10			437	2,713	268	771	97	29	3,878	14,559
1996	6,916	1,067	428	597	45	4	0	9,057	9	701	2	-	19	10	-	-	-		741	15		15	439	2,502	346	761	81	15	3,705	13,957
1997	7,002	1,214	365	346	62	5	0	8,994	15	1,358	1	1	27	8	-	24	-		1,434	100		100	2,365	2,881	512	708	84	11	4,196	17,089
1998	6,233	1,190	471	476	68	2	0	8,440	20	1,178	8	-	17	15	1	-	-		1,239	153		153	3,603	3,263	418	931	48	19	4,679	18,114
1999	5,557	1,049	724	416	47	5	0	7,798	70	1,385	4	-	51	5	1	-	-		1,516	132		132	1,136	3,100	1,229	606	81	27	5,043	15,625
2000	6,180	1,121	808	497	49	5	0	8,660	325	1,531	5	-	74	5	1	1	-		1,942	202		202	2,216	2,949	1,885	646	90	9	5,579	18,599
2001	6,932	908	732	230	30	15	0	8,847	1,039	1,691	17	-	64	8	1	1	-		2,821	438		438	780	220	1,749	375	52	5	2,401	15,287
2002	6,230	965	1,164	201	29	11	0	8,600	1,633	1,557	7	1	1	16	1	1	-		3,217	439		439	465	204	1,320	302	90	3	1,919	14,640
2003	5,376	1,063	1,198	149	28	4	0	7,818	1,084	2,196	3	-	-	8	-	-	-		3,291	381		381	671	147	1,812	216	107	0	2,282	14,443
2004	5,395	1,509	1,062	229	30	4	0	8,229	884	1,828	5	-	-	7	1	-	3		2,728	410		410	270	213	898	169	62	37	1,379	13,016
2005	5,359	1,295	956	187	337	3	0	8,137	437	1,813	1	-	-	5	2	-	18		2,276	434		434	235	1,475		220	76	0	1,771	12,853
2006	6,181	1,508	796	244	342	5	1	9,077												477		477	347	1,175		444	71	2	1,692	11,593
2007	(6,109)	(2,017)	(829)	(122)	(367)	(2)	(1)	(9,446)												452		452	383	1,444		484	58	0	1,986	(12,267)
2008	(4,426)	(1,758)	(648)	(173)	(349)	(3)	(0)	(7,357)															(84)							(7,441)

[1] Catch data are currently unavailable for Republic of Korea, Philippines, and some other countries catching swordfish in the North Pacific.

(shaded cell) only one vessel fished so combined with Hawaii longline

[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.

updated 7/13/2010

ISC/10/BILLWG-2/06, Table 2

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Attachment 2. Working Papers and Background Papers

WORKING PAPERS

ISC/11/BILLWG-1/01	A review of Taiwan's billfish fisheries in the North Pacific, 1997-2009. Chi-Lu Sun, Nan-Jay Su, Su-Zan Yeh, Yi-Jay Chang. (chilu@ntu.edu.tw)
ISC/11/BILLWG-1/02	U.S. Commercial Fisheries for Marlins in the North Pacific Ocean. Russell Ito and William Walsh. (Russell.Ito@noaa.gov)
ISC/11/BILLWG-1/03	A Long-term Corrected Catch History for Striped Marlin, *Kajikia audax*, in Hawaiian Waters. William Walsh and Russell It. (William.Walsh@noaa.gov)
ISC/11/BILLWG-1/04	Review of size data for striped marlin *(Kajikia audax)* caught by Japanese Commercial Fisheries in the North Pacific from 1970 to 2009. Mioko Taguchi and Kotaro Yokawa. (tagu305@affrc.go.jp)
ISC/11/BILLWG-1/05	Length Frequency of Striped Marlin from the Hawaii-based Longline Fishery, 1994-2010. Dean Courtney. (Dean.Courtney@noaa.gov)
ISC/11/BILLWG-1/06	Analysis of area separation to standardize CPUE of striped marlin in the North Pacific Ocean. Minoru Kanaiwa and Kotaro Yokawa. (m3kanaiw@bioindustry.nodai.ac.jp)
ISC/11/BILLWG-1/07	Standardized catch-rates for striped marlin *(Kajikia audax)* for Taiwanese distant-water longline fishery in the North Pacific Ocean for 1967-2009. Chi-Lu Sun, Nan-Jay Su, Su-Zan Yeh, Yi-Jay Chang. (chilu@ntu.edu.tw)
ISC/11/BILLWG-1/08	Standardization of Striped Marlin, *Kajikia audax*, CPUE with Generalized Linear Models fitted to Pelagic Longline Observer Data from the Hawaii-based Fishery: 1995-2009. William Walsh and Hui-Hua Lee. (William.Walsh@noaa.gov)
ISC/11/BILLWG-1/09	Age and growth of striped marlin (Kajikia audax) in waters off Taiwan. Chi-Lu Sun, Wen-Sheng Hsu, Yi-Jay Chang, Su-Zan Yeh, Nan-Jay Su, Wei-Chuan Chiang. (chilu@ntu.edu.tw)

ISC/11/BILLWG-1/10	Meta-analysis of striped marlin natural mortality. Kevin Piner and Hui-hua Lee. (Kevin.Piner@noaa.gov)
ISC/11/BILLWG-1/11	Reproductive biology of female striped marlin *(Kajikia audax)* in the waters off Taiwan (preliminary). Chi-Lu Sun, Siao-Yun Chang, Yi-Jay Chang, Su-Zan Yeh. (chilu@ntu.edu.tw)
ISC/11/BILLWG-1/12	Determining the ex-vessel price of landings in the Japanese distant-water longline fishery. Koichiro Ito, Gakushi Ishimura, Kotaro Yokawa, Koshiro Ishida. (gakugaku@sgp.hokudai.ac.jp)
ISC/11/BILLWG-1/13	Searching for optimal economic fishing effort for swordfish (*Xiphias gladius*) by Japanese distant longline fishing vessels. Gakushi Ishimura, Keita Abe, Jon Brodziak, Minoru Kadota. (gakugaku@sgp.hokudai.ac.jp)
ISC/11/BILLWG-1/14	Preliminary development of Economic capacity and reference points for Western and Central swordfish fisheries (*Xiphias gladius*) in the North Pacific. Gakushi Ishimura, Keita Abe, Jon Brodziak, Minoru Kadota. (gakugaku@sgp.hokudai.ac.jp)
ISC/11/BILLWG-1/15	Preliminary study on socio-economic reference points for internationally shared fishery resources. Keita Abe, Gakushi Ishimura, Kim Engie. (gakugaku@sgp.hokudai.ac.jp)

BACKGROUND PAPERS

ISC/10/BILLWG-2/REPORT	Report from the July 2010 ISC Billfish Working Group Workshop. 12-13 July 2010. BILLWG. (Gerard.DiNardo@noaa.gov)
	Status and Trends of the Striped Marlin*, Kajakia audax* (Philippi, 1887), in the Northeast Pacific Ocean in 2009. Michael Hinton and Mark Maunder.
	Ishimura. G. and Bailey, M. Defining the sustainable use of fishery resources. Sustainability Science, UNU Press, 2011.

Attachment 3. Agenda

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

BILLFISH WORKING GROUP (BILLWG)

INTERCESSIONAL WORKSHOP AGENDA

Meeting Site: Hawaii Imin International Conference Center @ Jefferson Hall
Kamehameha Room
1777 East-West Road
Honolulu, HI 96848

Meeting Dates: January 19-27, 2011

Goals: Review available NP striped marlin fishery-dependent and fishery-independent data for possible inclusion in the upcoming stock assessment, including region specific Category I, II, & III data, CPUE time series, and life history parameters. Identify necessary data input files and appropriate model structure.

As data input files will be frozen at the conclusion of this workshop, it is imperative that we have full participation.

Draft Agenda:

January 19 (Wednesday), 0930-1000 – Registration

January 19 (Wednesday), 1000-1700

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. RFMO/RFO Meeting Summaries

a. ISC Plenary
b. WCPFC-SC
c. WCPFC-NC
d. WCPFC
e. IATTC-SAC

7. Annual Billfish Catch/Effort (Category I, II,& III data)
    a. Country Reports
        1. Japan
        2. Korea
        3. Taiwan
        4. Mexico
        5. China
        6. U.S.A.
        7. Other
    b. Update and Adoption of Catch Tables

January 20 (Thursday), 900-1600

8. Striped Marlin Catch & Size-at-Catch Data by Assessment Area (WCPO-EPO)
    a. Country Reports (Catch data should be quarterly)
        1. Japan
        2. Korea
        3. Taiwan
        4. Mexico
        5. China
        6. U.S.A.
        7. Other
    b. Adoption of Catch & Size-at-Catch Data

9. Economic Analyses
    a. Capacity Research
    b. Socio-economic Reference Point Research

January 21 (Friday), 900-1700

10. Life History Parameters
    a. Review of Available Data
    b. Adoption of Life History Parameters for Assessment
        1. Growth
        2. Natural mortality
        3. Steepness
        4. Size at maturity

January 22 (Saturday), 900-1400

11. Striped Marlin CPUE Time Series
    a. Review of Available Data
        1. Japan
        2. Taiwan
        3. U.S.A
        4. Other
    b. Adoption of CPUE Time Series

January 23 (Sunday), No Meeting

January 24 (Monday), 900-1700

12. Striped Marlin Stock Assessment Process
    a. Collaboration (ISC-IATTC-WCPFC)
    b. Work Plan (January-May, 2011)

January 25 (Tuesday), 900-1300

13. Billfish Research
    a. Tagging
    b. Biological Sampling

` 14. ISC Billfish Chairperson Elections

15. Other Business
    a. Striped Marlin Stock Assessment Review
    b. Historic WP for Website Posting

16. Future Meetings

January 25 (Tuesday), 1400-1700

17. Rapporteurs and participants complete sections

January 26 (Wednesday), 900-1700

18. Complete report and circulate; WG reviews report

January 27 (Thursday), 900-1200

19. Clearing of Report

20. Adjournment