Annex 5

REPORT OF THE BILLFISH WORKING GROUP WORKSHOP

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

15-22 April 2010
Hakodate, Hokkaido, Japan

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 Hakodate, Hokkaido, Japan from 15-22 April 2010. The goals of this workshop were to 1) review the status of the North Pacific swordfish assessment using SS3 and Bayesian production models, 2) discuss progress of the blue marlin symposium, 3) delineate striped marlin stock boundaries, and 4) identify potential billfish biological reference points (BRP).

Gerard DiNardo, Chairman of the BILLWG, welcomed participants from Chinese Taipei, Japan, United States of America (USA), and Inter-American Tropical Tuna Commission (IATTC) (Attachment 1). Kotaro Yokawa and Ai Kimoto provided the welcoming remarks. Rapporteuring duties were assigned to Jon Brodziak, Gerard DiNardo, Michael Hinton, Minoru Kanaiwa, Ai Kimoto, Kevin Piner, Gary Sakagawa, Chi-Lu Sun, 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, with the exceptions of Jon Brodziak (ISC/10/BILLWG-1/06), Ayumi Shibano (ISC/10/BILLWG-1/09), and Gakushi Ishimura (ISC/10/BILLWG-1/11) agreed to have their papers posted on the ISC website where they will be available to the public.

2.0 NOVEMBER 2009 ISC BILLWG WORKSHOP SUMMARY

Gerard DiNardo provided a summary of the intercessional workshop of the ISC BILLWG that was convened in Honolulu, Hawaii, USA 30 November-4 December 2009. The main goal of this workshop was to develop plausible stock structure scenarios for striped marlin in the North Pacific for use in stock assessments. Other goals included reviewing (1) the status of the North Pacific swordfish assessment using Stock Synthesis 3 (SS3), (2) the blue marlin symposium, and (3) billfish economic research.

Conclusions from this meeting included:

- The North Pacific striped marlin stock assessment, scheduled to be completed in 2011, will proceed assuming two stocks:
    - Western-Central Pacific Ocean (WCPO)
    - Eastern Pacific Ocean (EPO)

- Catch data used in North Pacific swordfish Bayesian Surplus Production (BSP) model and SS3 model were incomplete for Sub-Area 2; data from southern portion of EPO was missing.

- Following a request from the Northern Committee, identify and characterize potential biological reference points (target and limit) for billfish; initial focus will be swordfish and possibly striped marlin.

2.1 Status of Work Assignments

At the November 2009 workshop, the BILLWG was tasked a number of assignments that included:

- Analyze available data to delineate North Pacific striped marlin stock boundaries

- Assemble catch data in Sub-Area 2, and update North Pacific swordfish BSP model and SS3 model with catch data from southern portion of EPO.

- Present potential biological reference points for billfish, especially swordfish

The WG Chairman, Gerard DiNardo, reported that these assignments have been completed.

3.0 NORTH PACIFIC SWORDFISH

3.1 Age structured stock assessment of North Pacific swordfish (*Xiphias gladius*) with stock synthesis under a two stock scenario presented by Dean Courtney (ISC/10/BILLWG-1/01)

This report summarizes Stock Synthesis model runs for a North Pacific Swordfish (*Xiphias gladius*) stock assessment under a two stock scenario. The stock structure assumed for this assessment was two stocks (Sub-Area 1 and Sub-Area 2) with a diagonal boundary from Baja, California (25ºN x 110ºW) to approximately 170ºW at the equator and no substantive mixing between Sub-Areas. Model structure was based on preliminary age structured stock assessments of North Pacific swordfish under a single stock scenario and a two stock scenario presented separately. Model results were compared to those from BSP models fit to the same data. The Stock Synthesis model for Sub-Area 1 adequately estimated selectivity for the major fisheries with some caveats, fit catch-per-unit effort (CPUE) time-series reasonably well, and adequately fit length compositions from the major fisheries with some caveats. In contrast, the Stock Synthesis model for Sub-Area 2 had a relatively poor fit to the limited length frequency data, and estimates of female spawning biomass and age-0 recruitment were highly uncertain. The Stock Synthesis model for Sub-Area 2 was also sensitive to minor changes made to the model since the preliminary assessment, as well as to the addition of updated catch data. Together, these results suggest that Stock Synthesis model results may be more reliable for Sub-Area 1 than for Sub-Area 2. Both models were consistent with model results from the BSP in that ending year 2006 female spawning biomass was estimated above spawning biomass at maximum sustainable yield (MSY) and 2006 fishing mortality (F) was estimated below F at MSY.

Discussion

Topics of discussion centered around changes in the modeling which had been made since May, 2009 (ISC/09/BILLWG-2/REPORT).

The spawning period was changed from January-March to April-June based on a review of information by, and the recommendation of, Robert Humphreys, Jr. In the brief discussion on this change, it was noted that the spawning periods north and south of the equator did not coincide.

For Sub-Area 2 only, the effective sample size for catch rates was originally estimated using iterative re-weighting. Under this scenario, estimated variance in the last five years of the catch rate series for longline fisheries of Chinese Taipei diminished to unrealistically low levels approaching zero. This estimation in the model was replaced by direct input of the error structure estimated from the GLM used to fit model catch rates in SS3. A few moments were spent making clear how this change was implemented.

For Sub-Area 2 only, Japan longline fisheries catch of swordfish from the equator to 20 degrees south were assembled and catch data series were updated for the Korean- and Spanish-flag longline fisheries. These updates increased the estimated total catch in Sub-Area 2 by about 80% during the years 1951-2006. There was no discussion on this change, other than to note that it provided an improved data set.

Discussion focused primarily on modeling of selectivity for the longline fishery of Japan. A second break (1993) in selectivity was added to the original model, which had a break only at 1983. This second break captures changes in fishing gear and operations of the longline fleet of Japan. Similar break points for selectivity had been reported (Kanaiwa and Yokawa 2009). Implementation of the break was accomplished by estimating selectivity-at-length for each of the three time periods defined by the break points in the time series. It was noted that there appears to be a correlation between recruitment and spawning stock biomass, but while interesting, no explanation for why was available. It was noted that the size of vessels participating in the fishery increased around 1982, making it possible for the vessels to travel into regions where larger fish were available. There was general discussion about the variability of selectivity across years and areas. Courtney explained that the variability is averaged out in the current model. A concern was raised that the catch rates may not reflect abundance well, since it was estimated from complex fisheries data. In the final model, a better fit in Sub-Area 2 resulted primarily from moving to fixed estimates of variance from iterative re-weighting estimates. It was suggested that there should be further analysis of this sensitivity.

During the discussion it was noted that the analysis is fitting available data under a set of assumptions, thus, observation error can influence results. There was particular concern that the sensitivity to the length data may be a reflection of observation errors. This raised the question, what might be changed in the data collection process in order to reduce the sensitivity of the model to changes in estimates of selectivity. It was suggested that observations errors could be minimized by (1) the collection of data from more trips, (2) a focus placed on the more recent data, and (3) improved precision in estimates of size at age.

3.2 Update of the production model assessment of the Eastern Pacific swordfish (*Xiphias gladius*) in 2010 presented by Jon Brodziak (ISC/10/BILLWG-1/02)

This document updates results of the stock assessment of the Eastern Pacific swordfish stock (a.k.a., Sub-Area 2) conducted in 2009 by the ISC BILLWG. The update consisted of running the BSP model for the Eastern Pacific swordfish stock with new catch data that included revised estimates of swordfish catches of Japan, Chinese Taipei, Korea, and Spain in Sub-Area 2.

As in the 2009 assessment, biomass production was modeled using a 3-parameter production model that allowed production to vary from a symmetric Schaefer curve. Input fishery data included nominal catches of Eastern Pacific swordfish during 1951-2006. Relative abundance indices for swordfish consisted of standardized CPUE for Japanese and Chinese Taipei longline fisheries in Sub-Area 2. Lognormal prior distributions for intrinsic growth rate and carrying capacity were assumed to be moderately informative with coefficients of variation set at 50%. Goodness-of-fit diagnostics included the root-mean squared error of CPUE fits and the standardized CPUE residuals. Production model results indicated that it was highly likely that current estimates of exploitable biomass of Eastern Pacific swordfish were above the biomass to maximize surplus production, B_{MSY}. Results also indicated that it was highly likely that current estimates of swordfish exploitation rates were below the harvest rate to maximize surplus production, H_{MSY}. These updated results are consistent with the results of the previous stock assessment of Eastern Pacific swordfish conducted in 2009. Stochastic projections of swordfish biomass and catch assuming recent levels of variability about swordfish fishing effort and mortality indicated that exploitable biomass was likely sufficient to support current catches through 2010.

Discussion

There was a request for clarification on how the updating of catch series impacted analyses in Sub-Area 1. It was made clear that the updating of catch data had no impact on the analysis for Sub-Area 1, because all the additional catch was from south of the equator in Sub-Area 2. It was also noted that the updating of catch series resulted from data associated with existing fleets as well as “new” fleets.

There was discussion concerning the sensitivity of the model to selection of priors. Brodziak explained that this did not seem to be a problem, that results of the most current fits fell in line with those of the previous work, and that this was a more stable result.

In response to discussion of the implication for future assessments, it was suggested that biomass projections be made to evaluate model behavior and prediction capability. Projections, however, would not be the best approach for addressing the issue of credibility of models or model choice. The point was made during the discussion that there was no contrast in the catch rate data that would allow evaluation of the scale of the results to improve model fit. Nevertheless, the results are complementary to those from other models.

There was some concern that results will not be clearly understood by non-scientists, particularly if subsequent analyses result in a change in TAC. It was pointed out that there is a concern among fishermen that based on their observations, the resource is decreasing. It was suggested that we need to understand why this observation is being made and to develop responses to them based on the results from the modeling and that these could perhaps be placed in terms of fishing effort as it relates to TAC.

The Kobe-plots based on the two models for Sub-Area 2 were different, and the WG recommended that the update to the BSP model be presented to the ISC Plenary and that work on the SS3 model for Sub-Area 2 continue. It was further recommended that conservation advice for North Pacific swordfish stemming from this assessment follow the advice proffered from the previous assessment.

3.3 An update of stock assessment for North Pacific swordfish based on two-stock scenario using age-structured models presented by Chi-Lu Sun (ISC/10/BILLWG-1/03)

Based on the two scenarios of spatial structure for swordfish stock in the North Pacific Ocean, an age-structured population dynamics model was fitted to catch, catch-rate, and length-frequency data for the main swordfish fisheries to examine the current status of the swordfish population in the North Pacific Ocean. Results indicate that the current spawning stock biomass (2006) was at a high fraction of its unfished level (above B_{MSY}) and that current fishing intensity (2006) was less than F_{MSY} for different scenarios of stock structure of swordfish. The swordfish stock in the North Pacific Ocean appears to be relatively stable at the current level of exploitation. However, the two stocks of swordfish population need to be monitored carefully as the estimated current exploitation rate across all fleets is close to F_{MSY}.

Discussion

The WG welcomed this contribution and recommends further work. It was noted that using a natural mortality rate of M=0.35 would be a useful run to conduct for the alternative age-structured model for comparison with SS3 and BSP models. It was pointed out that biomass and F trends from all 3 models are similar.

4.0 STRIPED MARLIN STOCK BOUNDARY DELINEATIONS

4.1 Additional works of the preliminary analysis on possible stock boundary of striped marlin in the North Pacific using fishery data of Japanese longliners presented by Kotaro Yokawa (ISC/10/BILLWG-1/05)

Further analyses based on a previously reported approach methodology (ISC/09/BILLWG-3/03; Ichinokawa and Yokawa 2009) using Pacific-wide striped marlin catch and effort data from Japanese offshore and distant-water longliners was presented. The scope of the analysis was based on previous recommendations from the WG. To ensure use of Pacific-wide data in the study, the analyses had to be limited to two time periods, 1970-1975 and 1986-1989. The results of this study seem to characterize the uniqueness of the eastern part of the Pacific, especially the northern part of the northeastern Pacific. But as indicated in the previous study, the general trend of standardized CPUE are similar among area within the period analyzed. This may suggest that the cluster analysis results more accurately reflects the operational pattern of Japanese longliners and the general characteristics of oceanographic conditions, rather than the stock structure of striped marlin. Thus, the results of this analysis are not strong enough to change the stock structure scenario used in the initial North Pacific striped marlin assessment (single North Pacific stock). Further study would be required before moving away from the single stock assessment scenario.

Discussion

It was noted that results from this cluster analysis indicated that the southern boundary of the EPO area was slightly different from the boundary presented in an earlier study. The authors reaffirmed that results from the cluster analysis were uncertain and should not be interpreted as strong evidence of a separate EPO stock. In addition, it was clarified that from the analysis the 15°N line was the first order separation, and thus the strongest evidence of population structure. However, the authors noted that this could be an artifact of fishing operations. It was also noted that some WG members see consistency of the implied EPO stock and the available genetic information. It was suggested that a new analysis with a restricted data set could be done because the Western Pacific Ocean has higher catches than the Eastern and that may mask the EPO result.

4.2 Striped marlin stock structure considerations presented by Michael Hinton

A summary review of previously presented BILLWG working (ISC/08/BILLWG-SS/01; ISC/09/BILLWG-01/18) and background (SARM-10-08-MLS-ASSESSMENT-2008. IATTC Stock Assessment Review Meeting. La Jolla, CA. http://iattc.org/PDFFiles2/SARM-10-08-MLS-Assessment-2008.pdf; BILLWG, May, 2009, Busan, Korea) papers was made. Included in the data and analyses used and presented in these reports were those from (1) tagging (conventional and PSAT), (2) genetic analyses (McDowell & Graves 2008, and C. Purcell, University of Southern California, personal communication, May 2009), (3) size frequency distributions in recreational and commercial fisheries, (4) spatial distributions of fishing effort by Japanese-flag longline fisheries during the periods 1965-1974 and 1998-2007, and (5) trends in standardized catch rates for striped marlin taken by the Japanese-flag longline fisheries in the Pacific. The presentation made to this meeting of the WG also included information on trends in standardized catch rates by subarea of the north and the eastern Pacific (Hinton & Bayliff 2002, and Hinton 2002), comparisons of trends in standardized catch rates in the eastern and western Pacific (Unpublished analyses.), as well as more resent results from analyses of genetic information (Purcell 2009). Considering these *in toto*, it was suggested that there were three stocks of striped marlin in the North Pacific Ocean with distinct spawning areas and that all were bounded on the south by the equator. The first was a northeastern stock centered in the region east of about 140ºW; the second, a central Pacific stock centered between about 140ºW and 170ºE; and the third, a northwestern stock centered west of about 170ºE.

Discussion

There was discussion regarding the validity of the Southern California samples that were genetically identified as belonging to the western Japanese stock. It was argued that the lack of a Japanese stock genetic signal in Hawaii could be interpreted as Southern California fish not returning to the US, and thus essentially lost to the population. However it was also argued that it was possible that they could return to the Western Pacific in some other way that bypasses the Hawaii region. It was also noted that the patterns suggested in the genetics data may result from distinct spawning grounds, though stocks may be mixed in the fisheries. It was pointed out that the identification of a spawning area off Hawaii by Purcell (2009) was the result of finding only 7 eggs/larvae. It was also noted that this was similar to the original findings off Mexico which, when investigated, led to confirmation of spawning and juveniles in the area. It was noted that there was no known spawning in the area of California. It was also noted that a spawning ground may be located in coastal areas of Japan. Further work to confirm the presence of active spawning off Hawaii is needed to confirm the suggestion of a separate Hawaiian spawning location.

4.3 An investigation of patterns in Japanese longline CPUE of striped marlin (*Tetrapturus audax*) in relation to a stock boundary of swordfish (*Xiphias gladius*) in the North Pacific presented by Jon Brodziak (ISC/10/BILLWG-1/06)

Patterns in aggregated Japanese longline CPUE of striped marlin during 1975-2006 were analyzed in relation to a stock boundary of swordfish in the North Pacific. Three spatial domains were considered in the analyses to account for spatial heterogeneity in fishing effort and fish distribution; these rectangular regions were defined by the corners: North Pacific [120˚E, 0˚N] to [260˚E, 55˚N]; Central and Eastern North Pacific [180˚E, 0˚N] to [260˚E, 55˚N]; and Eastern North Pacific [210˚E, 0˚N] to [260˚E, 55˚N]. Generalized additive model analyses showed how year, month, latitude, longitude (East), and hooks per basket influenced striped marlin catch rates within each spatial domain. Three model analyses were used to show where natural breaks in the CPUE predictors occurred within each spatial domain. Empirical cumulative distribution functions of striped marlin CPUE broken out by catch rate density and spatial domain showed that there were few catch data that exceeded a cutoff of 5 fish per 1000 hooks. This cutoff was used to separate the striped marlin CPUE data into high catch rate (> 5 fish/1000 hooks) and low catch rate (< 5 fish/1000 hooks) for further spatial analysis. The high catch rate data indicated that there were no observations of high striped marlin CPUE in the vicinity of the swordfish stock boundary for each spatial domain. The low catch rate data indicated that there were very few observations of low striped marlin CPUE in the vicinity of the swordfish stock boundary.

Overall, the striped marlin CPUE analyses indicated that there were few observations of striped marlin catches in the vicinity of the swordfish stock boundary. The low catch rates of striped marlin were consistent with the hypothesis that striped marlin densities were typically very low in the vicinity of the swordfish stock boundary.

Discussion

The WG noted that the analysis was not done using early Japanese longline data. It was suggested that similar analysis including pre-1970 data to capture the directed fisheries in the EPO be undertaken. It is unclear if this change would affect the conclusions of this study. It was also noted that the importance of the 15°N line was apparent in this analysis as well as in other analyses. The authors clarified that this line probably indicates the limits of striped marlin distribution and its preferred habitat.

4.4 Oceanographic features in the vicinity of a North Pacific swordfish stock boundary presented by Dean Courtney (ISC/10/BILLWG-1/04)

Oceanographic features are depicted in the vicinity of a swordfish stock assessment boundary previously identified by analysis of swordfish CPUE. The approximate location of the swordfish stock assessment boundary is characterized by gradients at depth in temperature, salinity, dissolved oxygen (DO), and nitrate. Strong gradients in DO and nitrate were evident in the vicinity of the swordfish stock assessment boundary at a depth of 100 m. Within the eastern tropical Pacific (ETP), there was seasonal variation in temperature, salinity, DO, and nitrate at depths of 50 to 75 m. However, the seasonal variation did not appear to extend across the gradients separating the northwest Pacific and southeast Pacific areas. Gradients in oceanographic features at depth in the vicinity of the swordfish stock boundary may provide an additional line of evidence for the location of a stock boundary for billfishes separating the northwest Pacific and the southeast Pacific areas.

Discussion

The WG noted that the swordfish stock boundary was determined using standardized CPUE and that it appears to match the oceanographic pattern presented in this study well. However in the case of striped marlin, results of stock boundaries using CPUE data were not well determined. Some members of the WG offered reasons why swordfish and striped marlin might not share similar distribution patterns with respect to oceanographic patterns in the North Pacific Ocean. Reasons included the fact that swordfish are much deeper divers than striped marlin and thus may respond differently to environmental barriers.

4.5 Stock Boundary Conclusions

The WG considered all the information presented and agreed that the next stock assessment would be based on a two stock scenario hypothesis in the North Pacific Ocean. The two stocks are defined by the following boundaries:

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

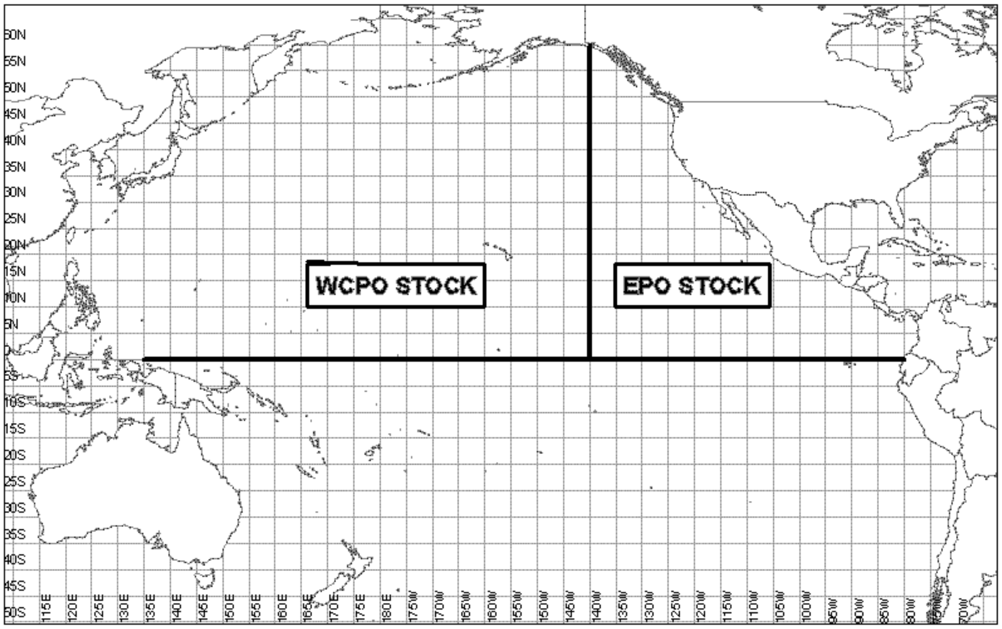

Figure 1. Stock boundary delineated for the 2011 stock assessment of North Pacific striped marlin.

The WG noted that the stock boundaries attempt to isolate stock regions suggested by genetic information and identified or suggested spawning areas, as well as analyses of fisheries data. The group also recognized that catches from any of the areas may include fish from more than one stock. The working group acknowledges that the agreed upon stock boundaries did not completely conform to results of genetic studies. Specifically, fish taken in the California fishery will be included in the EPO stock even though genetic studies placed them in the WCPO stock. Also, some of the genetic studies placed mature fish caught by the Hawaiian fishery into a separate Hawaiian stock that was independent of the WCPO and EPO stocks. It was noted that the catch from the California fishery is small and thus an incorrect assignment to a stock of fish caught by this fishery should have negligible effects on stock assessments results. Furthermore, regional structure inside each stock assessment may be examined to assess the implications of incorrect assignments of fish to a stock, including failure to account for the possibility of a separate Hawaiian stock.

5.0 BILLFISH BIOLOGICAL REFERENCE POINTS

At the 5th regular session of the Northern Committee in Nagasaki, Japan, the ISC was tasked to identify potential biological reference points (BRPs) for Pacific bluefin tuna, albacore tuna, and swordfish. Instructions for this task were received by the ISC BILLWG from the ISC Chairman which included the need to complete this assignment for swordfish by July 2010 in time for review by the 10th ISC Plenary. The assignment is to include both target and limit biological reference points.

At the November 2009 ISC BILLWG Workshop, the WG decided that the assignment would be separated into two phases: 1) identify reference points (target and limit) that are potentially useful for swordfish (if time permits other billfish), as well as the pros and cons and data requirements for each, and 2) identify the values of these biological reference points based on the recent swordfish assessment. The WG agreed that the first phase of this assignment would be completed during the next intercessional ISC BILLWG workshop held in April 2010. If necessary, it was expected that there would be time preceding the 10th ISC Plenary meeting for the BILLWG to finalize the first and second phase of the assignment in July 2010.

5.1 The role of BRP in the fish stock assessment: Lessons from the history of ICES, presented by Kotaro Yokawa (ISC/10/BILLWG-1/07)

The role of the biological reference point (BRP) was reconfirmed though review of the history of the ICES Advisory Committee of Fishery Management (ACFM), which has the longest experience in international stock assessments and a major architect of BRPs. As a result of the review, the following items should be recognized as the ISC moves forward with discussions on BRPs;

- Scientists are not in a position to make the final decisions on choice of BRP; this is generally completed by managers (with input from scientists).
- BRPs are only information, not a management objective. Thus, do not use single BRP.
- Division of roles between scientist and manager should be clarified in the discussions of BRPs. It is important to secure the neutrality and unrestrictive conventions of scientists.
- BRPs should focus on recruitment overfishing, not growth overfishing.
- Use both recommendation and advice for different purpose in preparing management advice to the managers.

One of the most important lessons ISC can learn from the ICES experience is to ensure that scientists focus on science and provide the best available science. This was emphasized over and over again.

In the documents, some BRP such as B_{lim} and B_{pa} were also introduced, as an outcome of long years of trial and error of the ACFM.

<u>Discussion</u>

It was clarified that this working paper presented a historical summary of the role of BRPs in the ICES stock assessment and management process. It was noted that the working paper focused on ICES reports from roughly 1970 to present and the WG Chair requested the final working paper include references for all cited ICES reports. Overall, it was hoped that this review would provide some insight into the concept and application of reference points.

The WG discussed the meaning of minimum biologically acceptable levels (MBAL) as a stock level below which the probability of low or poor recruitment increases. It was noted that this was not necessarily the same as a depensatory threshold. The WG discussed the relative importance of growth overfishing. In the ICES context, growth overfishing is considered to be a suboptimal use of fishery resources but it was also noted that growth overfishing was primarily an economic consideration and was not strictly a biological conservation issue. In recent years, the authors noted that the ACFM had emphasized the BRPs B_{lim}, which was a limit indicating a risk of stock collapse, and B_{pa}, which adds a buffer zone to B_{lim}. The emphasis on these new BRPs was associated with the expectation that ICES stock management advice should primarily be risk averse. The authors also noted that ICES does not currently have reference points that represent targets and that the acceptable level of risk is not a scientific consideration.

It was also questioned whether the overall approach to providing advice used by ICES was successful or not. It was suggested that the ICES scientists and managers probably believe that their strategy for stock management is very useful, although some of the fish stocks in ICES area are currently in moratorium. For example, even after the moratorium set for the North Sea cod stock, ICES did not change their strategy. It was suggested that the fault for long-term stock depletion was due to the managers and not the scientific advice (see, for example Carlberg 2005).

5.2 Review of biological reference points with specific recommendations for North Pacific billfishes presented by Kevin Piner (ISC/10/BILLWG-1/08)

This paper presents a review of commonly used biological reference points. Each reference point is categorized based upon their appropriateness as targets or limits. Based upon these criteria it is recommended that F_{MSY} and ½ B_{MSY} act as Limit reference points. Considerations for target reference points are also discussed, but it is our recommendation that final targets may need to be set in further discussion with policy makers.

<u>Discussion</u>

The authors noted that their intent was to provide a framework for discussing BRPs. It was suggested that the overall goal of having BRPs is to help maximize fishery yields and minimize risk. In this context, reference points can lead to clarity versus ambiguity. The existence of BRPs can also provide for clearer communication with stakeholders. It was also indicated that simulation approaches, such as management strategy evaluation, would be a direct means to evaluate the possible consequences of adopting a reference point or using a harvest control rule with BRPs.

There was a discussion of the BRPs that might be used by ISC. BRPs were categorized as rate-based (exploitation level) or status-based (biomass level). These two types of BRPs are part of the foundation of the so-called Kobe plot. Another categorization of reference points included the notions of recruitment or growth overfishing while another categorization involved the notion of target BRPs, which identified a desirable state, and that of limit BRPs, which provide an indication of being in an undesirable state. An example of characterizing BRPs was provided in Table 2 in the working paper.

It was noted that the authors made several clear recommendations for setting BRPs. First, they recommended that the WG should focus on setting limit reference points. In particular, it was recommended that F_{MSY} be used as a limit rate-based BRP and that ½ B_{MSY} be used as a status-based limit BRP, in the absence of further information. It was also recommended that harvest control rules be considered and developed. The WG noted that ½ B_{MSY} was an ad hoc limit because the scalar value of ½ was an arbitrary choice in the interval [0,1]. There was also discussion over the specific definition of limit versus target reference points. In this case, the WG noted that the notion of risk needs to be explicitly defined to be clear. The precise definition of the biological basis of limit reference points was also discussed. In this case, there were different points of view about the relative importance of biological risk versus risk to the fishery and stakeholders.

5.3 Biological Reference Point Conclusions

There was a general discussion of the question "Should we set biologically-based limit BRPs?". One suggestion for completing the WG assignment was to provide a list of limit reference points and their specific characteristics. It was also suggested that multiple reference points may be better able to characterize various fishery management situations because several factors may affect the choice of a limit BRP. For example, risk to the fish stock was one obvious consideration. Another consideration could be the management reaction time if a certain level of risk was exceeded. Overall, the WG agreed that the both presentations shared the same idea that the WG should focus on the issue of limit BRPs because this directly related to the recruitment overfishing.

There was some disagreement over the meaning of "risk". From one point of view, it was suggested that $F_{\text{"extinction"}}$ is the only limit reference point that is not determined by management or socioeconomic decisions or considerations. Any other limit BRP was suggested to be associated with a socioeconomic consideration. From another point of view, it was noted that there is a finite maximum amount of yield that can be taken from a resource under existing environmental conditions. The WG discussed the subjective choice of probability of risk and this choice was thought to be problematic for setting a limit BRP. Providing a decision table with various options of BRPs to the Northern Committee and allowing them to decide which BRP to use was considered to be the best option. It was suggested that the stakeholders for the ISC scientific advice were generally well-informed and would be receptive to a clear discussion of the benefits and costs of adopting various BRPs.

After further discussion, the WG agreed to characterize commonly used reference points to help complete its assignment. Providing clear unambiguous advice was mentioned as a key for making this a successful working group product. The WG considered the development of a list of BRP attributes along with a glossary of terms for assisting in the description of reference point attributes to the Northern Committee. The WG discussed the specific columns that would be needed in the BRP description table. The definition of each BRP was considered to be an important column. Another column describing data needs was also considered to be very important. Other columns were also identified and are listed in the draft below (Table 1). For explanatory purposes only, the table is populated with two rate-based BRPs, F_{MSY} and F_{MAX}.

Table 1. Draft description of biological reference points including definition, attributes, and special comments for two example BRPs for exploitation rates.

Biological Reference Point	Definition and Management Purpose	Model Structure	Data Needs	Limit or Target Reference Point	Model Includes Population Dynamics for Recruitment Overfishing	Pros/Cons and Special Comments
FMSY	Fishing mortality that maximizes yield under existing environmental conditions and fishery selectivity pattern	Age-structured or size-structured model for one or two sexes	Fishery catch, fishery catch per unit effort or other relative abundance indices, life history parameters (including natural mortality at age, size at age, weight-length relationships, fishery selectivity pattern, sex ratio in catch if two-sex model)	Has been used as limit and target reference point in various RFMOs	Yes	FMSY is difficult to estimate if stock-recruitment relationship is not known. This BRP may be easy to implement but also entails high risk of recruitment overfishing
FMAX	Fishing mortality that maximizes yield per recruit	Age-structured yield per recruit model	Life history parameters	Has been used as a limit and a target BRP	No	FMAX may be appropriate if recruitment is relatively constant over a range of fishing effort. This BRP may be very risky for some rapidly-growing species because it may cause recruitment overfishing

Table 2. Potential biological reference points for billfish.

Biological Reference Point
FMSY
FMAX
$F_{0.1}$
F_{MED}
F_{τ}
F_{SPR}
$F_{SSB\text{-}ATHL}$
F_{lim}
F_{pa}
F_{loss}
B_{MSY}
B_{MAX}
$B_{0.1}$
$B_{X\%}$ (depletion)
B_{lim}
B_{pa}
B_{loss}

The WG discussed the attributes of the reference point table. It was suggested that the column describing model structure could incorporate production model for F_{MSY} as a separate row. It was also suggested that it would be useful to identify whether a reference point was easy to implement by both managers and stakeholders and what kind of risks were associated with each reference point. The WG noted that fishery selectivity may change through time, especially for multiple fleets, and that this needed to be pointed out for BRPs that depend on fishery selectivity estimates. This information could be included for the model structure column or in the comment column. It was suggested that one could also include the rate- or status-based reference point characterization in the definition and management purpose column. It was also suggested that the column, "Model Includes Population Dynamics for Recruitment Overfishing be renamed to "type of overfishing".

Candidate reference points were listed and discussed by the WG. The issue of target and limit reference points was mentioned as being an integral part of the work task. The issue of which reference points to consider in the table was discussed at length; some wanted to include as many as possible while others wanted to present what was perceived to be the most relevant set of reference points. One key to categorizing was suggested to be the frequency of use of the BRP by RFMOs and more specifically by tuna RFMOs, i.e. IOTC, WCPFC, ICCAT, CCSBT, IATTC. This categorization was agreed upon. It was suggested that replacement yield be mentioned in a footnote to the table but this was not considered useful by some. It was also agreed that the information in each row of the table would be provided by the individual who introduced the BRP including the list excerpted from the ICES reports. Table headings were agreed upon by consensus and the list of reference points was agreed upon by consensus. The WG agreed that the BRP table entries would be completed.

In summary, the WG identified 17 BRPs as potential BRPs for inclusion in the Biological Reference Point Attributes table; these BRPs are commonly used for stock assessment of highly migratory species as discussed during the meeting (Table 2). It was agreed that the each potential BRP should be characterized using the following attributes so that the Northern Committee can understand the implications of each BRP easily: the definition and management purpose, model structure, data needs, limit or target reference point, type of overfishing, pros/cons and special comments. In particular, technical problems in the estimation of a BRP, the WG's view of the pros/cons in the management side, as well as other important issues were to be clearly described in "special comments". Last, it was agreed that the table will be filled out, reviewed and finalized at the next BILLWG meeting in July.

6.0 COOPERATIVE RESEARCH

6.1 Effective sample size of swordfish (*Xiphias gladius*) length measurements in the Hawaii-based longline fishery, 2005, for use in stock assessment presented by Dean Courtney (ISC/10/BILLWG-1/109)

This report summarizes preliminary work completed by Ayumi Shibano (Tokyo University of Agriculture) to estimate the effective sample size of swordfish (*Xiphias gladius*) length measurements for the Hawaii-based pelagic longline fishery in 2005. The study was limited to swordfish targeted shallow-sets from the year 2005 because the Hawaii-based pelagic longline fishery had nearly 100% observer coverage for shallow set trips in 2005 and most swordfish captured on observed trips in 2005 were measured for length.

Discussion

WG participants were encouraged by the results and look forward to completion of future analyses (Master's Thesis) by Shibano. It was pointed out that the developed approach may be used to estimate effective sample size for other species caught in the Hawaii longline fishery, including striped marlin and albacore.

6.2 Evaluating the removal hooks adjacent to floats on catch amount presented by Minoru Kanaiwa (ISC/10/BILLWG-1/10)

The evaluation of the effects of removing hooks adjacent to floats on the catch of major tunas and billfishes (striped marlin, big-eye tuna and yellow-fin tuna) caught by the longline fishery as was conducted. The Japanese training vessel data was used for this analysis. Information on the branch line location relative to the float and the associated catch of tunas and billfishes, was used to construct statistical models to estimate the effect on catch when the 1st hook adjacent to float is removed. In this analysis no interaction between branch number and environmental factors to explain catch was selected. For striped marlin this method can reduce about 50% of catch. For big-eye tuna there is relatively little impact. For yellow-fin tuna, the catch is reduced by 13 %. It was also determined that greatest reductions in striped marlin occur in tropical areas of the northwestern Pacific during October and November.

Discussion

Concern was raised regarding the applicability of the results given that the analysis was based solely on Japanese training vessel data. It was pointed out that the goal of this research was the development of a robust statistical framework for estimating "benefits" when simple modifications to the gear are made and because detailed operational data are collected during routine Japanese training vessel operations it seems appropriate to use this data set. A request was made for access to the Hawaii longline observer data set, particularly if catch from individual branch line data is available. It was pointed out that assessing benefits from the ratio estimator is difficult without some measure of associated variability, and future presentations should include these values. There was concern that assuming a Poisson error term may not be appropriate. The samples are not necessary independent IID estimates as required with a Poisson distribution. It was suggested that future work include simple diagnostics that can be used to assess adequacy of model fit. It was noted that environmental data are not incorporated into the model and it was suggested that future work may want to consider incorporating these data into the analyses.

7.0 BILLFISH ECONOMIC RESEARCH

7.1 Does the market value freshness? Updated and expanded estimation of preliminary evidence from a pelagic longline fishery presented by Gakushi Ishimura (ISC/10/BILLWG-1/11)

One of the dominant keys in the market value of seafood is its freshness, which is determined by a time period and the way it is preserved and treated from the fishing grounds to the market. This study approximated the freshness of seafood as the duration (days) between the occurrence of fishing and landing at the market (port), and estimated the freshness premium for landings from coastal longline fisheries in Kesen-numa, Japan that target swordfish (*Xiphias gladius*) for the raw fish market and blue shark (*Prionace glauca*) which generally processes the product into surimi. The unique nature of freshness premium for two types of fish was presented.

Discussion

It was pointed out that the author may want to use individual vessel effects as a fixed or random variable in future modeling. It was also noted that social-economic factors have a large impact on price, but the model assumes that external factors are constant over time.

8.0 OTHER BUSINESS

8.1 Work Assignments

The BILLWG were assigned a number of assignments:

- Working papers submitted to the April 2010 BILLWG workshop will be finalized by 25 May 2010.

- At the July 2010 BILLWG workshop, Japan (Yokawa) Chinese Taipei (Sun), Korea (Yoo),China (Dai), Mexico (Fleischer), USA (Ito), and IATTC (Hinton) will present area stratifications for North Pacific striped marlin within the stock boundaries delineated at April 2010 BILLWG workshop.

- BRP table (Table 1) will be filled out, reviewed and finalized at the next BILLWG meeting in July (Piner and Yokawa).

- By the scheduled January 2011 BILLWG workshop, submit stock specific Category I, II, and III North Pacific striped marlin data for review.

ISC BILLWG Chairman Assignment

- Present results from the updated North Pacific swordfish assessment at the 10^{th} ISC Plenary.

- Construct draft outline of proposed objectives and scope for World Blue Marlin Symposium by July 2010 ISC BILLWG workshop.

8.2 Future Meetings

The next intercessional BILLWG workshop is scheduled for 12-13 July 2010 in Victoria, British Columbia, Canada. This two-day workshop will precede the ISC10 Plenary meeting and overlaps with the ISC Albacore Working Group Workshop. The goals of this workshop will be to 1) finalize the biological reference point discussion that stemmed from the April 2010 BILLWG workshop for presentation at the ISC10 Plenary meeting and 2) finalize the spatial structure of North Pacific striped marlin within the areas delineated by the boundaries established at the April 2010 BILLWG workshop. Each member organization is assigned to provide information on North Pacific striped marlin spatial structure within the boundaries delineated by the BILLWG. Members were instructed to sort data by fisheries.

The following intercessional BILLWG workshop is scheduled for 19-27 January 2011 in Hawaii, USA. The goals of this workshop will be to review and adopt stock specific Category I, II, and III North Pacific striped marlin data for use in the stock assessment. All data should be separated into fisheries within the stock boundaries delineated by the BILLWG.

The subsequent intercessional BILLWG workshop is scheduled for 19-27 May 2011. The location is not yet determined. The goal of this meeting will be to finalize the North Pacific striped marlin stock assessment for presentation at the 11th ISC Plenary meeting. The World Blue Marlin Symposium will likely be linked up with this BILLWG workshop.

9.0 ADJOURNMENT

The ISC BILLWG intercessional workshop was adjourned at 1:10pmon 22 April 2010. The Chairman expressed his appreciation to all participants for their contributions and cooperation in completing a successful meeting. Appreciation was also extended to the University of Hokkaido for hosting the workshop and their tireless support. The meeting was closed with a vigorous round of applause.

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Attachment 1. List of Participants

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Table 3. 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
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	Coastal 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	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	3,130	261		95	8	1	7	5	2	-	1		380	(19)	75		75	-	-	0	376	34	1		411	(4,015)
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	(642)	(538)	(1)	-	(1,190)	(95)	(2,466)														56		56				609	21	0		630	(3,152)
2007	313						(313)														28		28				265	13	0		278	(619)
2008																																

[1] Estimated from catch in number of fish

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

Table 4. 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 ( ).

	Japan								Chinese Taipei[5]											Korea			Mexico	United States[6]						
																								Hawaii	California					
Year	Distant-water and Offshore Longline[2]	Coastal Longline	Driftnet	Harpoon[3]	Other Bait Fishing	Trapnet	Other[4]	Total	Distant-water Longline	Offshore Longline	Offshore Gillnet	Offshore Others	Coastal Harpoon	Coastal Setnet	Coastal Gillnet & other net	Coastal Longline	Coastal Others	Other	Total	Longline	High-seas Drift Gillnet	Total	All Gears	Longline	Longline	Gill Net	Harpoon	Unknown[7]	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)	(1,294)	(956)	(187)	(337)	(3)	(0)	(8,136)	437	1,813	1	-	-	5	2	-	18		2,276	434		434	235	1,475		220	76	0	1,771	(12,852)
2006	(6,261)	(1,505)	(796)	(244)	(342)	(5)	(1)	(9,154)												477		477	347	1,175		444	71	2	1,692	(11,670)
2007	6,499							(6,499)												452		452	383	1,444		484	58	0	1,986	(9,320)
2008																							(84)							(84)

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

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.

Attachment 2. Working Papers and Background Papers

WORKING PAPERS

ISC/10/BILLWG-1/01	Age Structured Stock Assessment of North Pacific Swordfish (*Xiphias gladius*) with Stock Synthesis under a Two Stock Scenario. Dean Courtney and Kevin Piner. (Dean.Courtney@noaa.gov)
ISC/10/BILLWG-1/02	Update of the Production Model Assessment of the Eastern Pacific Swordfish Stock (*Xiphias gladius*) in 2010. Jon Brodziak. (Jon.Brodziak@noaa.gov)
ISC/10/BILLWG-1/03	An update of stock assessment or North Pacific Swordfish based on two-stock scenario using age-structured models. Chi-Lu Sun, Nan-Jay Su, and Su-Zan Yeh. (chilu@ntu.edu.tw)
ISC/10/BILLWG-1/04	Oceanographic Features in the Vicinity of a North Pacific Swordfish Stock Boundary. Dean Courtney and Jon Brodziak. (Dean.Courtney@noaa.gov)
ISC/10/BILLWG-1/05	Additional works of the preliminary analysis on possible stock boundary of striped marlin in the North Pacific using fishery data of Japanese longliners. Takashi Hosono, Momoko Ichinokawa, and Kotaro Yokawa. (yokawa@fra.affrc.go.jp)
ISC/10/BILLWG-1/06	An Investigation of Patterns in Japanese Longline CPUE of Striped Marlin (*Tetrapturus audax*) in Relation to a Stock Boundary of Swordfish (*Xiphias gladius*) in the North Pacific. Jon Brodziak. (Jon.Brodziak@noaa.gov)
ISC/10/BILLWG-1/07	The role of BRP in the fish stock assessment – lessons from the history of ICES. Kotaro Yokawa and Ai Kimoto. (yokawa@fra.affrc.go.jp)
ISC/10/BILLWG-1/08	Review of biological reference points with specific recommendations for North Pacific billfishes. Kevin Piner and Hui-hua Lee. (Kevin.Piner@noaa.gov)
ISC/10/BILLWG-1/09	Effective Samples Size of Swordfish (Xiphias gladius) Length Measurements in the Hawaii-based Longline Fishery, 2005, for use in Stock Assessment. Ayumi Shibano, Minoru Kanaiwa, Kotaro Yokawa, Yukio Takeuchi, and Dean Courtney. (m3kanaiw@bioindustry.nodai.ac.jp)

ISC/10/BILLWG-1/10	The evaluation of removing hook adjacent floats for catch amount. Minoru Kanaiwa, Keith Bigelow, and Kotaro Yokawa. (m3kanaiw@bioindustry.nodai.ac.jp)
ISC/10/BILLWG-1/11	Does the market value freshness? Updated and expanded estimation of preliminary evidence from a pelagic longline fishery. Koichiro Ito, Gakushi Ishimura, Kotaro Yokawa, and Koshiro Ishida. (gakugaku@aol.com)

BACKGROUND PAPERS

ISC/08/BILLWG-SS/01	Ranges of stocks of striped marlin in the Pacific Ocean: How well can they be known? Michael Hinton. (mhinton@iattc.org)
ISC/09/BILLWG-1/18	Considerations on Regions for Use in Stock Assessments of Striped Marlin. Michael Hinton. (mhinton@iattc.org)
ISC/09/BILLWG-3/Report	Report from the November 2009 ISC Billfish Working Group Workshop. 30 November-4 December 2009. BILLWG. (Gerard.DiNardo@noaa.gov)
	Hinton, Michael. Assessment of Striped Marlin in the Eastern Pacific Ocean in 2008 and Outlook for the Future. (http://www.iattc.org/PDFFiles2/SARM-10-08-MLS-Assessment-2008.pdf)

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: Hakodate Industry-Academic-Government Cooperation Center at Hokkaido University
Hakodate, Hokkaido, Japan

Meeting Dates: April 15-23, 2010

Goals: Review status of North Pacific swordfish assessment using SS3 and Bayesian production models; discuss progress of blue marlin symposium; delineate striped marlin stock boundaries; develop billfish biological reference points.

Drat Agenda:

April 15 (Thursday), 0930-1000 – Registration

April 15 (Thursday), 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 and Meeting Summaries

6. North Pacific Swordfish
    a. Status of SS3 North Pacific swordfish assessment
    b. Reanalysis using Bayesian Production Model
    c. Other issues

April 16 (Friday), 930-1700

7. Striped Marlin
    a. Stock boundary delineations - Presentations

April 17 (Saturday), 930-1500

7. Striped Marlin (cont.)
    a. Stock boundary delineations – Discussion

April 18 (Sunday), no meeting

April 19 (Monday), 930-1700

8. Billfish Biological Reference Points

April 20 (Tuesday), 930-1300

8. Billfish Biological Reference Points

9. Blue Marlin
    a. World Blue Marlin Symposium

10. Cooperative Research
    a. Effective sample size research (Tokyo Univ. of Agriculture)

11. Work Assignments and Future Meetings

April 20 (Tuesday), 1400-1700

12. Rapporteurs and participants complete sections

April 21 (Wednesday), 930-1700

13. Complete report and circulate; WG reviews report

NC Striped Marlin Ad Hoc Working Group Meeting – Location TBD
    a. WCPFC Commission discussions
    b. Next steps

April 22 (Thursday), 930-1200

14. Clearing of Report

15. Adjournment

April 23 (Friday) – ISC Billfish Seminar, Hokkaido University