Annex 4

REPORT OF THE BILLFISH WORKING GROUP WORKSHOP

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

30 November – 4 December 2009
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 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 include reviewing (1) the status of the North Pacific swordfish assessment using Stock Synthesis 3 (SS3), (2) blue marlin symposium, and (3) billfish economic research.

Gerard DiNardo, Chairman of the BILLWG, welcomed participants from the Inter-American Tropical Tuna Commission (IATTC), Japan, and the United States of America (USA) (Attachment 1). Rapporteuring duties were assigned to Jon Brodziak, Dean Courtney, Robert Humphreys, Gakushi Ishimura, Minoru Kanaiwa, Ai Kimoto, Hui-Hua Lee, Kevin Piner, Catherine Purcell, Akiko Takano, Lyn Wagatsuma, and Kotaro Yokawa. 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, except for Catherine Purcell agreed to have their papers posted on the ISC website where they will be available to the public.

2.0 MEETING SUMMARIES

2.1 9th ISC Plenary

The ISC9 Plenary, held in Kaohsiung, Taiwan from 15-20 July 2009, was attended by members from Canada, Chinese Taipei, Japan, Korea, the United States, and the Secretariat for the WCPFC. Regarding billfish stocks, the Plenary maintained the conservation advice from ISC7 for striped marlin, endorsed a new stock assessment for swordfish which found the stocks to be healthy and above the level required to sustain recent catches, and recognized that striped marlin and blue marlin stock assessments are scheduled to be completed by July 2012, and 2011, respectively. The progress of the BILLWG since the 8th ISC Plenary meeting was also reviewed. Progress included the completion of 36 working papers, two workshop reports, and a North Pacific swordfish stock assessment. A special seminar on reference points for fisheries management was convened at the 9th ISC Plenary, and a proposal for multi-national, multi-species biological research was completed and endorsed. Several requests from the Western and Central Pacific Fisheries Commission were considered, and a Memorandum of Understanding with the IATTC was progressed. It was agreed to pursue organizing a World Blue Marlin Symposium to convene experts on this species and gather information for the upcoming stock assessment. For the coming year, work priorities will focus on achieving better functionality for the ISC website and database through engaging a Database Administrator and webpage designer. The ISC workplan for 2009- 2010 includes revisiting the 2009 swordfish assessment and preparing for albacore tuna, Pacific bluefin tuna, striped marlin, and blue marlin stock assessments. The next Plenary will be held from 20-26 July 2010 in Victoria, Canada.

2.2 WCPFC-SC5

The 5th regular session of the Western and Central Pacific Fisheries Commission Science Committee was held in Port Vila, Vanuatu from 10-21 August 2009. Results of the ISC North Pacific swordfish stock assessment and associated stock status and conservation advice was presented and accepted. The proposal for a multi-national, multi-species biological research sampling program endorsed at the ISC9 Plenary was also accepted by the Science Committee, along with the proposal to hold a World Blue Marlin Symposium in March 2011. The improvement of the ISC website was also discussed.

2.3 5th Northern Committee

The 5th regular session of the Northern Committee was held in Nagasaki, Japan from 7-10 September 2009. Information on billfish stock status and conservation advice was presented and accepted. The ISC biological sampling program and plan for the improvement of the ISC webpage and database was presented, endorsed, and a funding proposal developed for the WCPFC's consideration. The ISC BILLWG's assessment schedule was also endorsed.

The ISC was tasked by the Northern Committee to identify potential biological reference points for Pacific bluefin tuna, albacore tuna, and swordfish to help make management decisions. The ISC BILLWG would need to complete this assignment for swordfish by July 2010 in order for it to be presented and endorsed by the ISC Plenary before presentation to the Northern Committee. The assignment should include both target and limit biological reference points.

Discussion

The WG clarified that the assignment given by the Northern Committee requires more guidance and that economic reference points are currently not required, but would be an option to include at a later date. It was also clarified that the Northern Committee is only requiring biological reference points on North Pacific swordfish, but it would be beneficial for the BILLWG to submit information on other species of billfish. The WG concluded that this assignment will 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 will be completed during the next intercessional ISC BILLWG workshop held in April 2010. If necessary, there will be time preceding the 10^{th} ISC Plenary meeting for the BILLWG to finalize the first phase of the assignment in July 2010.

3.0 STATUS OF WORK ASSIGNMENTS

Progress made on assignments from the May 2009 BILLWG workshop was reviewed. The group was assigned to complete and submit data catalogues as soon as possible. The working group was also assigned to submit data for the upcoming blue marlin assessment.

At the May WG meeting, the Chairman was also given a number of assignments. These tasks include:

- Contact south Pacific scientists regarding upcoming billfish meetings, and whether members of the BILLWG are invited to participate.
- To explore with appropriate ISC members the availability of support to conduct similar spatial structure and analysis for striped marlin as was provided for swordfish.

The WG Chairman, Gerard DiNardo, reported that these assignments have been completed by both the WG and the Chairman.

4.0 SURVEY AND MONITORING – FALL 2009 SHOYO-MARU CRUISE

4.1 Relationships between the hydrographic structure of the warm core ring and the longline catch of tuna and marlins, inferred from the Fall 2009 Shoyo-maru cruise presented by Akiko Takano (ISC/09/BILLWG-3/01)

This is a report of *in-situ* observation to investigate relationships between hydrographic structures and longline catch of tuna and marlins in the western North Pacific Ocean. We focused on a warm-core ring (WCR) in the vicinity where the Japanese longliners tend to gather. A WCR which was detected from satellite altimeter and had pinched off from the large amplitude of the Kuroshio meander to the north was the target for this research. To characterize the structure of the WCR, hydrographic observations were conducted across the ring. Four longline sets were also conducted, covering the radius of WCR from the center to the western edge. Hydrographic results indicated that the WCR was characterized as a water mass with high temperature and high salinity, with a deep-thermocline. Larger bigeye tuna (59 kg) were caught in the vicinity of the center where the deep-thermocline was deepest and current speed slower. Marlins were caught at the edge of the WCR where the thermocline shallows and strong currents occurred. In areas between the center and the edge of the WCR, albacore, smaller bigeye tuna and spearfish were caught.

<u>Discussion</u>

The WG discussed why bigeye tuna was not caught at the edge of the warm-core ring. It was not because the longline had shallowed due to the strong currents, as the set depths of hooks monitored by time-depth recorders were similar between the edge and the core of the WCR. In this research, the setting course of gear and shortening ratio were chosen carefully so that the strong current did not affect the set depth of the hooks. It was also clarified that the observation location was a fishing "hot spot", but the period of the research was one month earlier than the main fishing season which commenced in October. It was also recognized that fish aggregations in WCRs are mostly related to water temperature and prey, and the relationship is not well understood. It was pointed out that characterizing catch by species from the core to the edge of the ring would be beneficial. Additional discussions related to fishermen's behavior in the vicinity of WCRs and the availability of satellite information to advance future analyses and research.

5.0 STRIPED MARLIN

5.1 The analysis of stock structure for striped marlin in the North Pacific Ocean presented by Minoru Kanaiwa (ISC/09/BILLWG-3/02)

A two step process was used to determine provisional stock boundary delineations for North Pacific striped marlin using Japanese longline CPUE data from 1975 to 2006 under the assumption that there are two stocks. In step one, a GLM analysis with multinomial error was used to test for stability in fishing patterns within 6 established year clusters (1975-1981, 1982-1986, 1987-1989, 1990-1994, 1995-2006). The year cluster 1975-1981 showed the least change in fishing pattern e.g., hooks per basket) and data from this period was used to determine stock boundary delineations in the second step using the Delta-type method of Lo et al. (1992). Results suggest a latitudinal boundary at 20° N and two longitudinal boundaries (40° N, 150° E to 20° N, 150° E and 20° N, 170° W to 170° W at the equator). Retrospective analysis was done and the boundaries were found to be robust. While it would be interesting to assume more than 2 stocks, the current modeling approach is not recommended (computationally challenging).

<u>Discussion</u>

Included in 5.2 discussion.

5.2 Preliminary analysis on possible stock boundary of striped marlin in the north Pacific using fisheries data of Japanese longliners presented by Kotaro Yokawa (ISC/09/BILLWG-3/03)

The position of the potential stock boundary of striped marlin in the North Pacific was estimated, using the method that was applied in determining the North Pacific swordfish stock boundary (Ichinokawa and Brodziak 2008), as well as cluster analysis (Cope and Punt 2009). The results of the former method varied based on the extent of the spatial footprint used in the analysis. The analysis of data from a wider (larger than the main distribution area) area separated the area into two regions with a higher CPUE region in the northeastern and a lower CPUE region in the southwestern. Results using data from the main distribution area of striped marlin in the central and eastern Pacific suggest two stocks, one in the EPO and the other in the WCPO. In either case, standardized CPUEs for the two areas showed similar trends, which indicates no stock separation occurred in the NPO. The results of cluster analysis generally support the results of former methods.

Discussion

The WG noted that catch and effort data for Japanese coastal longliners were not included in Kanaiwa's paper (ISC/09/BILLWG-3/02) or Ichinokawa's paper (ISC/09/BILLWG-3/03). The WG also noted that striped marlin catch and associated effort from the Japanese offshore longliners fishery in the north Pacific is scarce after 1990. Therefore, the data used in Ichinokawa's paper was from 1970 to 1990. It was noted that the same rationale was applied in Kanaiwa's paper and data for the analysis was limited to the period 1975 to 1982. It was pointed out that similar stock boundary results were found in both Kanaiwa's paper and Ichinokawa's paper (spatial domain A of Fig.2) when the entire North Pacific Ocean was taken into consideration. In the previous assessment, one stock for entire North Pacific Ocean was assumed, recognizing that there might be additional stocks in the North Pacific. Results of this study and the study by Kanaiwa generally support this conclusion. In fact, when analyses were limited to the main distribution area two stock were apparent.

5.3 Genetic analysis of population structure in striped marlin, *Tetrapturus audax*, in the Pacific Ocean presented by Catherine Purcell (ISC/09/BILLWG-3/04)

The stock structure of striped marlin, *Tetrapturus audax*, is still in question, and thus has limited the ability to effectively manage this fishery. This research dissertation constitutes Purcell's research and was aimed at resolving patterns of spatial and temporal variation, and thus the stock structure, of striped marlin populations in the Pacific using molecular markers. In Chapter 1, the development of 10 microsatellite markers was described. These first striped marlin-specific microsatellites were developed to increase resolution of genetic variation in subsequent analyses. Using 12 microsatellites and mitochondrial control region sequences, Chapter 2 examined geographic genetic heterogeneity of striped marlin samples collected from 7 locations around the Pacific. Microsatellite and sequence results revealed small, but significant overall spatial subdivision among locations (FST =0.0145 and KST =0.06995, respectively). Pair-wise microsatellite analysis revealed 4 stocks (1-Japan-Southern California-Immature Hawaii, 2-Mature Hawaii 3-Mexico-Central America, and 4-New Zealand-Australia); sequence results were similar but did not detect significant structure between Mature Hawaii and the Japan-Southern California-Immature Hawaii group. Temporal variability among year-classes of striped marlin was determined in Chapter 3. Overall genetic drift did not increase at points separated by longer periods of time, and temporal variation, Fs', shifted widely between/among year-classes. Significant variation was found in several year-class comparisons, however factorial correspondence analyses of location/year-classes showed temporal stability in spatial patterns detected in Chapter 2. Effective population sizes, corrected for overlapping generations, were remarkably small (e.g. 16-76); and this, in addition to the observed shifting Fs' estimates, strongly suggests highly variable reproductive success among cohorts. Finally, in Chapter 4, the heterogeneity detected in striped marlin was compared to other pelagic species in the Pacific in order to determine if any common patterns could help explain population subdivision patterns in these fish. Although no single parameter was identified, certainly the number, size and specificity of spawning locations and the duration of spawning events play a role in the heterogeneity pattern of a species throughout its distribution.

Discussion

The author concluded that factorial correspondence analyses of location/year-classes showed temporal stability in spatial patterns detected in analysis of pair-wise microsatellites and mitochondrial control region sequences, supporting the spatial subdivisions identified above. The author suggested that small effective population sizes, together with shifts in temporal variability among year classes, indicate highly variable reproductive success among cohorts. The author also noted that genetic results showed some differences with the tagging data, and suggested that available tag data (Domeier 2006) should be used in conjunction with genetic data to resolve spatial stock structure effectively.

Overall, the results of Purcell's study and the study by McDowell and Graves (2008) showed similar genetic population structure pattern for striped marlin. In particular, both studies found that groups of striped marlin in California and Mexico had significant genetic differences. The studies did differ on the existence of a separation between samples from Ecuador and Mexico. The McDowell and Graves (2008) study suggested significant genetic differences existed between samples from Ecuador and Mexico while Purcell's study found no differences between Central America and Mexico. Nonetheless, the genetic population structure of striped marlin suggested by these two studies was very consistent. As a result, the WG concluded that there was a sound scientific basis for the existence of two striped marlin stocks in the North Pacific: a North Pacific stock and an Eastern Pacific stock. However, the genetic analyses did not provide sufficient resolution to determine a boundary between these stocks.

5.4 Stock structure of striped marlin, *Kajikia audax*, based on fishery information from Taiwanese longline fisheries in the Pacific Ocean presented by Gerard DiNardo (ISC/09/BILLWG-3/09)

BILLWG Chairman Gerard DiNardo presented this working paper on behalf of Chinese Taipei. Catch and effort data with information on number of hooks per basket (HPB) from the Taiwanese tuna longline fleet are available from 1995-2007 and a generalized linear model (GLM) was applied to analyze the catch-rates of striped marlin in the Pacific Ocean. Main effects considered in the model included year, month, latitude, longitude, HPB, and two-way interactions among month, latitude, and longitude. ANOVA results showed that all factors are statistically significant except for latitude. The catch-rates of striped marlin predicted by the model fit very well to the observed nominal catch-rates. Higher values of model-predicted catch-rates occurred in the North and East Pacific compared to the Western-Central NP, which may suggest at least three stocks of striped marlin in the Pacific Ocean.

Discussion

The utility of these spatial CPUE plots to discern stock structure was discussed. The WG thanked Chinese Taipei and acknowledged their contribution.

5.5 Life History

Robert Humphreys reviewed biological information relative to the discussion on stock structure. Sampling of billfish for stock structure and life history studies is problematic as sampling is predominantly restricted to the base ports of fishing fleets. Virtually all of these ports are located along the coastal boundaries of the distribution of striped marlin in the Pacific (Japan, southern California, Mexico, Ecuador, New Zealand, and eastern Australia). Furthermore, it is very difficult and rarely successful to sample in spawning areas to obtain tissues from adults in spawning condition and their recently spawned progeny (larvae and YOY juveniles). Both of these situations were encountered in Purcell's study and restricted the breadth of available sampling throughout the stocks range in the Pacific.

Regarding the seasonal distribution of striped marlin in temperate waters in southern California and New Zealand, it should be noted that seasonal distributions also occur in the sub-tropics as striped marlin around Hawaii are typically absent from the coastal troll and offshore pelagic longline fishery during summer months. Other observations in the Hawaii area indicate that some striped marlin spawning is occurring offshore based on the collection of well-developed ovaries (eminent spawners) collected by at-sea observers in the Hawaii tuna longline fishery. However, larval billfish collections along the Kona coast of the Island of Hawaii during 1997-2006 indicate that striped marlin larvae are rare (n=7) and were collected only once out of 15 collection surveys. It appears that striped marlin larvae coincide with warmer SSTs. The occurrence of higher SSTs to the west of Hawaii compared to waters immediately adjacent to Hawaii may account for the apparent evidence of greater spawning activity offshore, presumable west of Hawaii.

5.6 Plausible Stock Structure Scenarios for the 2011 North Pacific Striped Marlin Stock Assessment

Possible stock structure scenarios were evaluated based on a review of presentations made to the working group. The WG agreed that there are at least two stocks in the North Pacific after reviewing all available data. There was agreement that more analysis would be needed to identify the exact locations of boundaries between stocks. The results presented were too complex (preliminary) to decide the exact positions of the stock boundaries. For example, the positions of the boundaries changed depending on the data and or method used. The WG agreed to the need for additional analysis of fishery data, using the results of genetic analysis as guidance, to delineate the two-stock scenario in the north Pacific. It was further agreed that stock structure for the 2011 striped marlin assessment will need to be resolved at the next meeting in April to maintain the approved assessment schedule. Two analytical approaches (Brodziak and Ishimura 2009, Hinton 2009) to delineate stock structure have been discussed in prior meetings and it was agreed that both would be applied to available data by the "developers' and results presented to the April 2010 ISC Billfish WG workshop. Barring any concrete determination, the fall back position would be to apply the established swordfish boundaries to striped marlin.

6.0 ECONOMIC RESEARCH

6.1 Does extending days of searching for fishing grounds and fishing operation add catch? Preliminary observations from the operations of Japanese coastal longline fisheries presented by Gakushi Ishimura (ISC/09/BILLWG-3/05)

The optimal length of a fishing trip plays a significant role in the operation of distant-water fisheries. While additional days of a fishing trip provide an opportunity to increase catch, additional fishing costs are incurred, and the market value of the fish already caught deteriorates (loss of freshness). Despite the recent increase in fuel price, the coastal longline vessels in Kesennuma, Japan have increased the average total days of a fishing trip by 25% compared to the average total days observed between 1996 and 2006. This study characterized the use of the additional days and provided a descriptive analysis on the effects of adding days on the average marginal productivity (CPUE), if the additional days were used for exploring fishing grounds and conducting fishing operation at fishing grounds. The results suggest that fishers may have failed to optimize the duration for exploring fishing grounds and that adding days devoted to fishing operations at fishing grounds would improve their marginal productivity. Moreover, the results suggest that predetermining fishing grounds for a fish trip prior to the departure from a port would improve marginal productivity.

Discussion

The Japanese coastal longline fishery operates over a wide area of the western North Pacific and the distribution patterns of its fishing grounds show extremely large seasonal variation as the fish population distribution changes. The optimum duration for exploring and operating in the fishing grounds by this fishery appears to change according to the seasonal distribution pattern of the target species. This suggests that further advances of this study will benefit from considering the seasonal distribution patterns of the target species in future analyses.

7.0 SWORDFISH

7.1 Age structured stock assessment of North Pacific Swordfish (Xiphias gladius) with Stock Synthesis under a Single Stock Scenario and Two-Stock Scenario presented by Dean Courtney (ISC/09/BILLWG-3/07 and ISC/09/BILLWG-3/08)

This presentation summarizes SS3 model runs for a North Pacific Swordfish (*Xiphias gladius*) stock assessment under a single stock scenario and a two stock scenario with Sub-Area 1 and Sub-Area 2. Model runs assuming a single north Pacific stock followed recommendations from a previous review of the assessment model by the ISC BILLWG (DiNardo et al. 2009). The results were compared to those from a Bayesian surplus production (BSP) model fit to the same data (Brodziak and Ishimura 2009, DiNardo et al. 2009). Sensitivity analyses runs were conducted to assess model fit to length composition data and to the independently estimated growth parameters form the Central North Pacific. Additional runs were conducted to test for global convergence. Modeling results from the single stock scenario adequately estimated selectivity for the major fisheries, fit CPUE series well enough to scale the absolute abundance estimates, and adequately fit length compositions from the major fisheries. The 2006 spawning biomass was estimated to be above spawning biomass at maximum sustainable yield (MSY) and the 2006 fishing mortality (F) below F_{MSY}.

The stock structure assumed for a two-stock scenario (Sub-Area 1 and Sub-Area 2) was based upon a diagonal boundary from Baja, California (25ºN x 110ºW) to approximately 170ºW at the equator and no mixing between (Fig 1). Model structure was similar to that used in the single stock scenario. Model results were compared to those from a 2-stock BSP model fit to the same data (Brodziak and Ishimura 2009, DiNardo et al. 2009). Stock Synthesis models for both Sub-Area 1 and Sub-Area 2 appeared to adequately estimate selectivity for the major fisheries and to fit CPUE series well enough to scale the absolute abundance estimates. The Sub-Area 1 model appeared to adequately fit length compositions from the major fisheries with some caveats. The Sub-Area 2 model had more limited length frequency data and had a relatively poorer fit to the limited length frequency data. Both models estimated ending year 2006 female spawning biomass above spawning biomass at maximum sustainable yield (MSY) and 2006 fishing mortality (F) below F_{MSY}. Model results from Sub-Area 1 indicated lower biomass and higher harvest rates (often outside 95% Bayesian credible intervals) than a BSP run on the same data. Model results from Sub-Area 1 were most consistent with BSP model results in recent years (1999 – 2006). Model results from Sub-Area 2 were more consistent with BSP results prior to 1990, deviating somewhat thereafter.

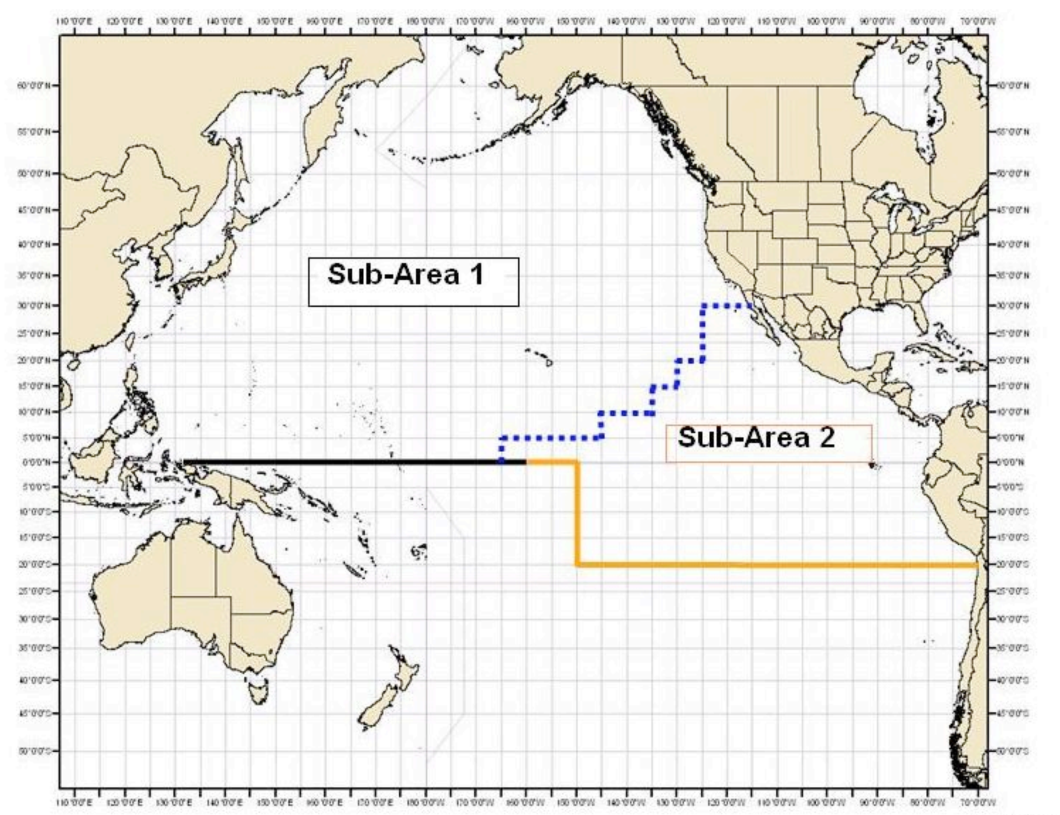

Figure 1. Stock Scenario-2, two North Pacific swordfish stocks north of the equator.

Discussion

It was noted that the results of the SS3 models were similar to those presented to the ISC Plenary in July 2009 based upon the BSP model. One difference was the high harvest rates in the early period estimated in SS3 which were not seen in the BSP model results. It was noted that BSP differs from SS3 in the way the model is started. SS3 assumed a fairly high initial equilibrium catch resulting in a lower initial stock size while the BSP assumed the model start at 90% of carrying capacity. However, results of the two approaches tended to converge in the recent time period, arguing that initial conditions were not influential on estimates of current stock status. Therefore the WG concluded that the results of the fully integrated assessment model confirmed the stock status presented to the ISC9 Plenary.

Of greater concern, the authors pointed out that the catch in Sub-Area 2 was incomplete and did not include all the catch from the equator to 20°S. The delinquent country was identified and data was provided during the workshop (Appendix A). It was further agreed that these data would be incorporated into the BSP two-stock model re-run to compute stock status. Results of the updated BSP model will be presented at the April 2010 ISC Billfish Working Group Workshop.

7.2 Overview of the data of skipper's note of Japanese surface longliners based in Kesennuma in the period between 2004 and 2009 presented by Ai Kimoto (ISC/09/BILLWG-3/06)

Japan's National Research Institute of Far Seas Fisheries has been collecting data recorded as skipper's notes from Japanese surface longliners since July 2004. The data includes details of the longline operations and biological information, and it is similar to that collected by observers. This document provides an overview of the data and preliminary analyses of fish schools and sex ratio at size. The data suggests that the catch of swordfish had been decreasing since 2004, mainly due to a decreasing catch of small sized fish. Results further suggest that the school size of swordfish was larger in late autumn to early spring (main fishing season) than in late spring to summer (spawning season). The results also suggested that the observed decrease in swordfish CPUE was not caused by a decrease in the number of fish in a school but instead, by the number of schools encountered in one set. Furthermore, the analysis of the sex ratio at size, expressed as a ratio of the number of female in the catch to the total swordfish catch, showed a monotonic increase in all quarters and areas. The results were different from similar studies in the Atlantic and Mediterranean Sea, suggesting that further study is needed to understand the observed changes.

Discussion

It was clarified that most vessels in the study were excluded (21 out of 35) because those skippers were reluctant to provide the detailed work needed in this study. It was also clarified that a "school" was any swordfish caught between radio buoys. The WG was undecided as to whether this metric actually estimated a school. Since sex-ratio data is available, the WG thought that the information from this study may be useful in distributing un-sexed catch-at-length data into sexes. The authors reiterated that the results were preliminary and further study is warranted.

8.0 WORLD BLUE MARLIN SYMPOSIUM

Gerard DiNardo discussed the status of the proposed World Blue Marlin Symposium tentatively scheduled for early 2011. Bishfish experts at ICCAT and IATTC have been contacted and have expressed interest in participating as members of the symposium steering committee. Contact with billfish experts representing the Indian Ocean RFMO still needs to be made. A venue has yet to be decided.

9.0 COOPERATIVE RESEARCH

9.1 Reproductive ecology and scientific inference of steepness: a fundamental metric of population dynamics and strategic fisheries management presented by Jon Brodziak (Mangel et al. 2009)

The relationship between the biomass of reproductively mature individuals (spawning stock) and the resulting offspring added to the population (recruitment), the stock–recruitment relationship, is a fundamental and challenging problem in all of population biology. The steepness of this relationship is commonly defined as the fraction of recruitment from an unfished population obtained when the spawning stock biomass is 20% of its unfished level. Since its introduction about 20 years ago, steepness has become widely used in fishery management, where it is usually treated as a statistical quantity. Here, we investigate the reproductive ecology of steepness, using both unstructured and age-structured models. We show that if one has sufficient information to construct a density-independent population model (maximum per capita productivity and natural mortality for the unstructured case or maximum per capita productivity, natural mortality and schedules of size and maturity at age for the structured model) then one can construct a point estimate for steepness. Thus, steepness cannot be chosen arbitrarily. If one assumes that the survival of recruited individuals fluctuates within populations, it is possible, by considering the early life history, to construct a prior distribution for steepness from this same demographic information. We develop the ideas for both compensatory (Beverton–Holt) and over-compensatory (Ricker) stock–recruitment relationships. We illustrate our ideas with an example concerning bluefin tuna (*Thunnus thynnus/orientalis*, Scombridae). We show that assuming a steepness is unity when recruitment is considered to be environmentally driven is not biologically consistent, is inconsistent with a precautionary approach, and leads to the wrong scientific inference (which also applies for assigning steepness any other single value).

<u>Discussion</u>

The WG questioned the assumption made regarding the stock-recruitment relationship. In the simulation analyses, the bluefin tuna stock-recruitment relationship was assumed to be compensatory (Beverton–Holt). Yet no data was presented to support this assumption. An alternative assumption for the stock-recruitment relationship is an over-compensatory function (Ricker), which was theoretically developed in the paper. The difference is that the range for steepness is from 0.2 to ∞ for the Ricker curve and from 0.2 to 1 the for Beverton–Holt curve. It was noted that the stock and recruitment is commonly assumed to be independent of stock size (steepness at 1 for Beverton–Holt curve) for many pelagic fish. In a recent Pacific bluefin tuna stock assessment, the steepness assumption was assumed to be 1. However, in this study, the probability distribution for steepness using both production model and age structured model showed a peak around 0.9. Given the estimated distribution for steepness, the WG agreed that the existing assessment model could be refined.

10.0 OTHER BUSINESS

10.1 Future meetings

The next scheduled intercessional BILLWG workshop is tentatively scheduled for 15-23 April 2010 in Hakodate, Japan, possibly hosted by Hokkaido University. The Chairman of the BILLWG, along with selected members of the WG will work with staff at Hokkaido University to finalize the arrangements. The dates of this workshop will accommodate participants that would also like to attend the PICES international symposium on "Climate Change Effects on Fish and Fisheries" being held 26-29 April 2010 in Sendai, Japan. The BILLWG workshop may include a special session in which BILLWG participants can provide short presentations to Hokkaido University staff and students.

11.0 ADJOURNMENT

The ISC BILLWG intercessional workshop was adjourned at 10:50am on December 4, 2009. The Chairman expressed his appreciation to all participants for their contributions and cooperation in completing a successful meeting.

12.0 REFERENCES

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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					
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	Grand Total
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 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
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		1,444		484	58	0	1,986	(8,937)
2008																														

[Shaded box] only one vessel fished so combined with Hawaii longline

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

[2] Catches by gear for 1952-1970 were estimated roughly using FAO statistics and other data. Catches for 1971-2002 are more reliably estimated.

[3] Contrains trolling and harpoon but majority of catch obtained by harpoon.

[4] For 1952-1970 "Other" refers to catches by net fishing and various unspecified gears.

[5] Offshore longline category includes some catches from harpoon and other fisheries but does not include catches unloaded in foreign ports.

[6] Estimated round weight of retained catch. Does not include discards.

[7] Unknown includes pole and line, purse seine, troll and troll/handline, half ring, and unspecified gears.

Attachment 1. List of Participants

Japan

Gakushi Ishimura
Centre for Sustainability Science
Hokkaido University
Kita 9 Nishi 8 Kita-ku
Sapporo, Hokkaido 060-0809
81-80-2621-5514, 81-11-706-4534 (fax)
gakugaku@aol.com

Minoru Kanaiwa
Tokyo University of Agriculture
196 Yasaka, Abashiri
Hokkaido, Japan 099-2493
81-152-48-3906, 81-152-48-2940 (fax)
m3kanaiw@bioindustry.nodai.ac.jp

Ai Kimoto
National Research Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
81-543-36-6035, 81-543-35-9642 (fax)
aikimoto@affrc.go.jp

Akiko Takano
National Research Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
81-54-336-6046, 81-54-335-9642
takanoa@affrc.go.jp

Kotaro Yokawa
National Research Inst. of Far Seas Fisheries
5-7-1 Orido, Shimizu
Shizuoka, Japan 424-8633
81-54-336-6035, 81-54-335-9642 (fax)
Yokawa@fra.affrc.go.jp

United States

Jon Brodziak
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822-2396
808-983-2964, 808-983-2902 (fax)
Jon.Brodziak@noaa.gov

Dean Courtney
NOAA/NMFS PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5345, 808-983-2902 (fax)
Dean.Courtney@noaa.gov

Gerard DiNardo
NOAA/NMFS PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5397, 808-983-2902 (fax)
Gerard.DiNardo@noaa.gov

Robert Humphreys
NOAA/NMFS PIFSC
99-193 Aiea Heights Drive, Suite 417
Aiea, Hawaii 96701-3911
808-983-5377, 808-983-2980 (fax)
Robert.Humphreys@noaa.gov

Russell Ito
NOAA/NMFS PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5324, 808-983-2902 (fax)
Russell.Ito@noaa.gov

Hui-Hua Lee
Joint Inst. of Marine and Atmospheric Research
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5352, 808-983-2902 (fax)
Huihua.Lee@noaa.gov

Kevin Piner
NOAA/NMFS PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5705, 808-983-2902 (fax)
Kevin.Piner@noaa.gov

Catherine Purcell
University of Southern California
3616 Trousdale Parkway, AHF 306
Los Angeles, CA 90089-0371
323-333-2360, 323-660-8874 (fax)
purcell.catherine@gmail.com

Gary Sakagawa
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
858-546-7177, 858-546-7177 (fax)
Gary.Sakagawa@noaa.gov

Darryl Tagami
NOAA/NMFS PIFSC
2570 Dole St.
Honolulu, HI 96822-2396
808-983-5745, 808-983-2902
Darryl.Tagami@noaa.gov

Lyn Wagatsuma
Joint Inst. of Marine and Atmospheric Research
2570 Dole St.
Honolulu, HI 96822-2396
808-983-2966, 808-983-2902 (fax)
Lyn.Wagatsuma@noaa.gov

IATTC

Michael Hinton
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Dr.
La Jolla, CA 92307-1508
858-546-7033, 858-546-7133 (fax)
mhinton@iattc.org

Attachment 2. Working Papers and Background Papers

WORKING PAPERS

ISC/09/BILLWG-3/01	Relationships between the hydrographic structure of the warm core ring and the longline catch of tuna and marlins, inferred from Fall 2009 Shoyo-maru. Kotaro Yokawa and Akiko Takano. (yokawa@fra.affrc.go.jp)
ISC/09/BILLWG-3/02	The analysis of stock structure for striped marlin in the North Pacific Ocean. Minoru Kanaiwa and Kotaro Yokawa. (m3kanaiw@bioindustry.nodai.ac.jp)
ISC/09/BILLWG-3/03	Preliminary analysis on possible stock boundary of striped marlin in the north Pacific using fisheries data of Japanese longliners. Momoko Ichinokawa and Kotaro Yokawa. (ichimomo@fra.affrc.go.jp)
ISC/09/BILLWG-3/04	Excerpts from Dissertation – Genetic Analysis of Population Structure in Striped Marlin, *Tetrapturus audax*, in the Pacific Ocean. Catherine Purcell. (Catherine.Purcell@noaa.gov)
ISC/09/BILLWG-3/05	Does extending days of searching fishing grounds and fishing operation add catch? Preliminary observations from the operations of Japanese coastal longline fisheries. Gakushi Ishimura, Koichiro Ito, and Kotaro Yokawa. (gakugaku@sgp.hokudai.ac.jp)
ISC/09/BILLWG-3/06	Overview of the skipper's note of Japanese surface longliners based in Kessennuma in the period between 2004 and 2009. Ai Kimoto and Kotaro Yokawa. (aikimoto@affrc.go.jp)
ISC/09/BILLWG-3/07	Preliminary 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/09/BILLWG-3/08	Age Structured Stock Assessment of North Pacific Swordfish (*Xiphias gladius*) with Stock Synthesis under a Single Stock Scenario. Dean Courtney and Kevin Piner. (Dean.Courtney@noaa.gov)
ISC/09/BILLWG-2/09	Stock structure of striped marlin, *Kajikia audax*, based on fishery information from Taiwanese longline fisheries in the Pacific Ocean. Chi-Lu Sun, Nan-Jay Su, and Su-Zan Yeh. (chilu@ntu.edu.tw)

BACKGROUND PAPERS

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)

Mangel, M., Brodziak, J., and DiNardo, G. 2009. Reproductive ecology and scientific inference of steepness: a fundamental metric of population dynamics and strategic fisheries management. Fish and Fisheries.

McDowell, J.R., and Graves, J.E. 2008. Population structure of striped marlin (*Kajikia audax*) in the Pacific Ocean based on analysis of microsatellites and mitochondrial DNA. Can. J. Fish. Aquat. Sci. 65: 1307-1320.

Reiss, H., Hoarau, G., Dickey-Collas, M., and Wolff, W. 2009. Genetic population structure of marine fish: mismatch between biological and fisheries management units. Fish and Fisheries 10: 361-395.

Attachment 3. Agenda

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

BILLFISH WORKING GROUP (BILLWG)

INTERCESSIONAL WORKSHOP ANNOUNCEMENT
AND INFORMATION PACKET

Meeting Site: Hawaii Imin International Conference Center
1777 East-West Road
Honolulu, HI 96848

Meeting Dates: November 30-December 4, 2009

Goal: Review status of North Pacific swordfish assessment using SS3, blue marlin symposium, and billfish economic research. Develop plausible stock structure scenarios for striped marlin in the North Pacific for use in stock assessments.

Draft Agenda:

November 30 (Monday), 0930-1000 – Registration

November 30 (Monday), 1000-1630

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

2. Adoption of Agenda & Assignment of Rapporteurs

3. Computing Facilities
    a. Access
    b. Security Issues

4. Status of Work Assignments and Meeting Summaries

5. Survey and Monitoring
    a. Fall 2009 Shoyo-Maru cruise

6. Spatiotemporal analysis of striped marlin CPUE

7. Striped Marlin Genetic Analysis

8. Plausible Stock Structure Scenarios – Discussion

December 1 (Tuesday), 1000-1600

9. Economic Research
    a. Spatial analysis of logbook-price data

10. North Pacific Swordfish
    a. Status of SS3 North Pacific swordfish assessment
    b. Sex-size data

December 2 (Wednesday), 1000-1600

11. Blue Marlin
    a. World blue marlin symposium

12. Cooperative Research
    a. Reproductive ecology and scientific inference of steepness

13. Plausible Stock Structure Scenarios-Discussion

December 3 (Thursday), 1000-1200

13. Plausible Stock Structure Scenarios-Discussion (continued)

14. Future Meetings

December 3 (Thursday), 1330-1630 – Rapporteurs complete sections

December 4 (Friday), 1000-1200

15. Clearing of Report

16. Adjournment

Appendix A. Updated Catch Statistics in Sub-Area 2

Eastern Pacific Ocean (EPO) swordfish catch data were updated for Stock Scenario-2 Sub-Area 2 at the December 2009 ISC BILLWG (Tables A.1 and A.2, Figures A.1 and A.2). Comparisons between the updated and initial catches are provided to assess the relevant differences (Table A.3, Figure A.3).

Updated Country Data

<u>Japan</u>
Sub-Area 2 swordfish catch in weight (mt) was updated for Japan Distant Water + Offshore Longline in the area 0° - 20° S and east of 150° W (Table A.2). In the period before 1971, only catch number data is available and they were multiplied by the average weight in 1971 - 1980 to estimate annual catch (mt).

<u>Chinese Taipei, Korea, and Spain</u>
For Chinese Taipei (TWN), Korea (KOR), and Spain (ESP), Sub-Area 2 swordfish catch in weight (mt) was estimated from gridded data held by the IATTC.

Gridded data for ESP was the total catch by stratum, while that of KOR and TWN was sample data reported from available logbooks scaled to catch. Annual total catch by flag from Sub-Area 2 for ESP was estimated as the sum of the total catch in weight (mt) by 5° latitude, 5° longitude, and month from IATTC 5x5 gridded data (G-Data).

Annual total catch by flag from Sub-Area 2 for KOR and TWN was estimated using (1) IATTC 5x5 G-Data, (2) reported annual total catch-by-flag and gear from the eastern Pacific Ocean (EPO; http://iattc.org/Catchbygear/IATTC-Catch-by-species1.htm), and (3) when catches were reported in numbers of fish, the estimated annual average weight of swordfish taken in Japanese longline fisheries in the EPO (Okamoto and Bayliff, 2003; Table 3, http://iattc.org/PDFFiles2/Bulletin-Vol.-22-No-4ENG.pdf).

For catches reported in the 5x5 G-Data by weight, or by weight and numbers, the sums (by flag and year) of the total catch by weight in Sub-Area 2 and in the EPO were obtained. Analogous sums were computed for those few catches reported only in numbers of fish. The annual catch by area reported only in numbers of fish was converted to catch in weight using the estimated annual average weight of swordfish, and then it was added to those catches which had been reported by weight.

The annual total catch in metric tons from subarea 2 for longline vessels of KOR and TWN was then estimated by flag-State as: [EPO annual total catch] × [G-Data catch, subarea 2] × [G-Data catch, EPO]$^{-1}$. Updated catch statistics for Chinese Taipei (TWN), Korea (KOR), and Spain (ESP) are included in Table A.2.

Further changes to these data will be incorporated into subsequent assessments.

References

DiNardo, G., and L. Wagatsuma. 2009. Report of the billfish working group workshop, International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean. 3-10 February 2009. Honolulu, Hawaii, USA. ISC/09/BILLWG-1/Report. 56 pp.

Okamoto, H. and W. H. Bayliff, 2003. A review of the Japanese longline fishery for tunas and billfishes in the eastern Pacific Ocean 1993-1997. Inter-American Tropical Tuna Commission. Bulletin Vol. 22, No. 4.

Table A.1. Boundary coordinates for Stock Scenario 2.

EPO Boundary North of Equator	
115 W	30 N
125 W	30 N
125 W	20 N
130 W	20 N
130 W	15 N
135 W	15 N
135 W	10 N
145 W	10 N
145 W	5 N
165 W	5 N
165 W	0 N
EPO Boundary South of Equator	
150 W	0 S
150 W	20 S
70 W	20 S

Table A.2. Annual total catch (mt) of swordfish in Sub-Area 2 (with updated catch).

Year	Japan[1)] Longline	Chinese Taipei[2)] Longline	Korea[2)] Longline	Spain[2)] Longline	Mexico All Gears	Grand Total
1951	1	-	-	-	-	1
1952	1	-	-	-	-	1
1953	2	-	-	-	-	2
1954	15	-	-	-	-	15
1955	12	-	-	-	-	12
1956	11	-	-	-	-	11
1957	168	-	-	-	-	168
1958	138	-	-	-	-	138
1959	98	-	-	-	-	98
1960	138	-	-	-	-	138
1961	645	-	-	-	-	645
1962	1,066	-	-	-	-	1,066
1963	2,228	-	-	-	-	2,228
1964	2,372	-	-	-	-	2,372
1965	1,304	-	-	-	-	1,304
1966	2,059	-	-	-	-	2,059
1967	1,440	21	-	-	-	1,461
1968	1,858	15	-	-	-	1,873
1969	7,281	5	-	-	-	7,286
1970	4,219	25	-	-	-	4,243
1971	1,790	14	-	-	-	1,804
1972	2,172	22	-	-	2	2,196
1973	3,612	18	-	-	4	3,634
1974	2,025	23	-	-	6	2,054
1975	2,330	19	9	-	-	2,359
1976	3,215	34	29	-	-	3,278
1977	3,745	28	33	-	-	3,806
1978	3,601	6	35	-	-	3,642
1979	2,746	25	18	-	7	2,796
1980	3,399	18	62	-	380	3,859
1981	2,952	27	153	-	1,575	4,707
1982	2,159	19	97	-	1,365	3,640
1983	2,693	7	65	-	120	2,885
1984	1,701	13	65	-	47	1,825
1985	1,816	10	91	-	18	1,936
1986	3,020	12	198	-	422	3,652
1987	3,718	22	334	-	550	4,625
1988	4,122	29	163	-	613	4,927
1989	3,080	107	151	-	690	4,028
1990	4,123	31	645	-	2,650	7,449
1991	4,171	44	696	-	861	5,772
1992	5,942	19	372	-	1,160	7,493
1993	4,430	64	385	-	812	5,690
1994	4,158	23	344	-	581	5,106
1995	3,494	14	399	-	437	4,343
1996	3,254	26	568	-	439	4,287
1997	4,202	29	707	6	2,365	7,310
1998	4,541	74	675	115	3,603	9,008
1999	2,588	63	561	29	1,136	4,377
2000	2,964	291	817	831	2,216	7,119
2001	5,313	2,152	517	245	780	9,008
2002	4,370	2,396	391	303	465	7,925
2003	4,192	1,747	182	534	671	7,327
2004	3,182	942	1,060	1,292	270	6,746
2005	2,421	746	287	717	235	4,405
2006	2,204	1,006	-	366	347	3,924

[1)] Annual total catch (mt) of swordfish caught by Japanese Offshore + Distant-Water Longline updated to include the area 0 - 20 S and east of 150 W. Japan catch in 2005 and 2006 is provisional.

[2)] Annual total catch (mt) of swordfish in Sub-area 2 for longline vessels of Spain (ESP), Korea (KOR), and Chinese Taipei (TWN) estimated from data held by the IATTC.

Table A.3. For comparison, initial estimates of annual total catch (mt) of swordfish in Sub-Area 2 are provided without updated catch.

Year	Japan Longline	Chinese Taipei Longline	Korea Longline	Mexico All Gears	Grand Total
1951	1	-	-	-	1
1952	1	-	-	-	1
1953	2	-	-	-	2
1954	15	-	-	-	15
1955	10	-	-	-	10
1956	8	-	-	-	8
1957	106	-	-	-	106
1958	71	-	-	-	71
1959	68	-	-	-	68
1960	97	-	-	-	97
1961	443	-	-	-	443
1962	768	-	-	-	768
1963	1,306	-	-	-	1,306
1964	1,397	-	-	-	1,397
1965	807	-	-	-	807
1966	1,115	-	-	-	1,115
1967	943	-	-	-	943
1968	1,246	-	-	-	1,246
1969	3,487	-	-	-	3,487
1970	2,368	-	-	-	2,368
1971	1,257	-	0	-	1,257
1972	1,470	-	0	2	1,472
1973	2,420	-	0	4	2,424
1974	1,353	-	0	6	1,359
1975	1,491	-	0	-	1,491
1976	1,900	-	0	-	1,900
1977	2,069	-	110	-	2,178
1978	1,781	-	34	-	1,815
1979	1,459	-	-	7	1,466
1980	1,592	-	32	380	2,004
1981	1,410	-	-	1,575	2,985
1982	1,097	-	24	1,365	2,486
1983	1,294	-	6	120	1,419
1984	826	-	24	47	897
1985	958	-	12	18	988
1986	1,508	-	5	422	1,934
1987	1,857	-	22	550	2,429
1988	1,857	-	14	613	2,484
1989	1,687	-	20	690	2,397
1990	1,931	-	31	2,650	4,611
1991	1,868	-	3	861	2,731
1992	2,530	-	4	1,160	3,694
1993	2,110	-	8	812	2,929
1994	1,939	-	33	581	2,553
1995	1,670	1	5	437	2,114
1996	1,735	4	8	439	2,186
1997	2,143	3	50	2,365	4,561
1998	2,153	15	77	3,603	5,847
1999	1,260	34	66	1,136	2,495
2000	1,671	213	101	2,216	4,201
2001	2,900	978	219	780	4,877
2002	2,193	1,545	220	465	4,423
2003	1,897	984	191	671	3,742
2004	1,446	708	205	270	2,629
2005[1)]	1,168	328	217	235	1,947
2006[1)]	1,138	-	239	347	1,724

[1)] Japan catch in 2005 and 2006 is provisional.

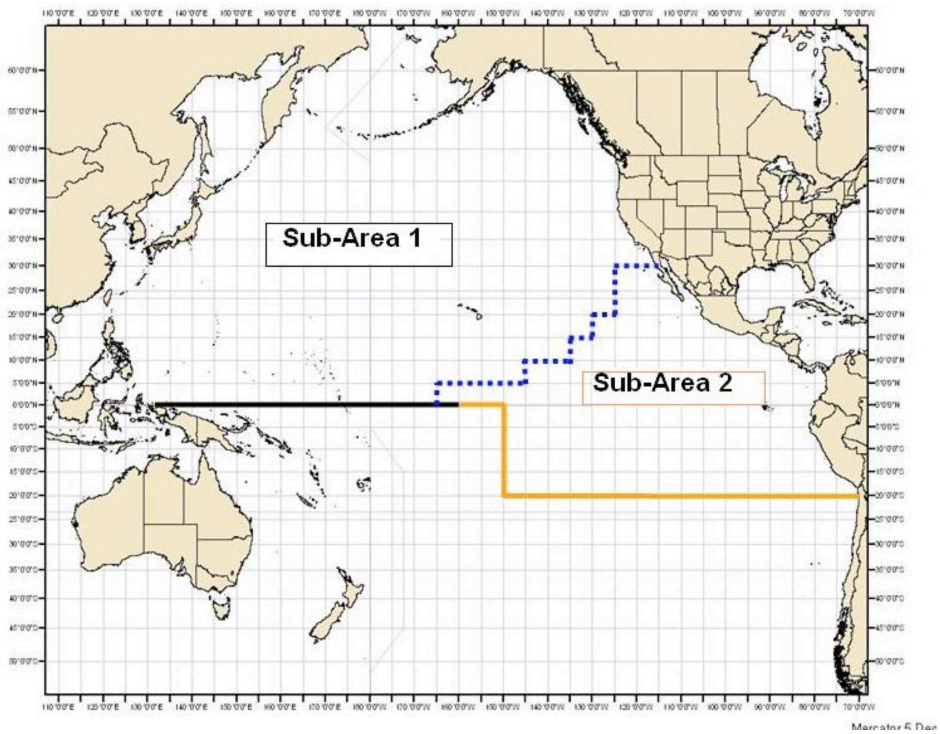

Figure A.1. Stock Scenario-2, two North Pacific swordfish stocks (DiNardo and Wagatsuma 2009).

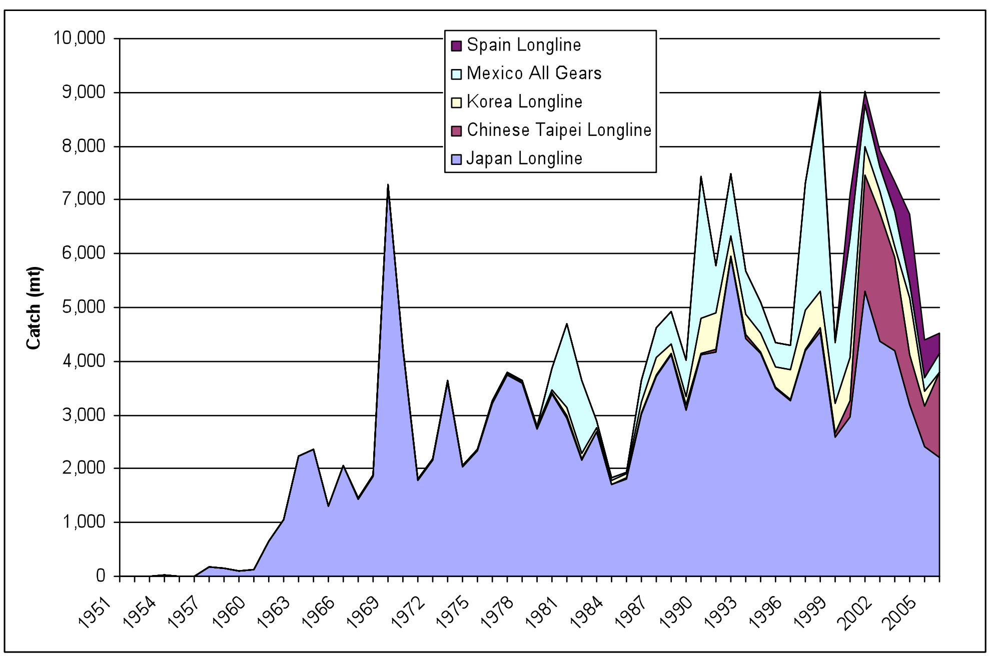

Figure A.2. Annual total catch (mt) of swordfish in Sub-Area 2 (with updated catch).

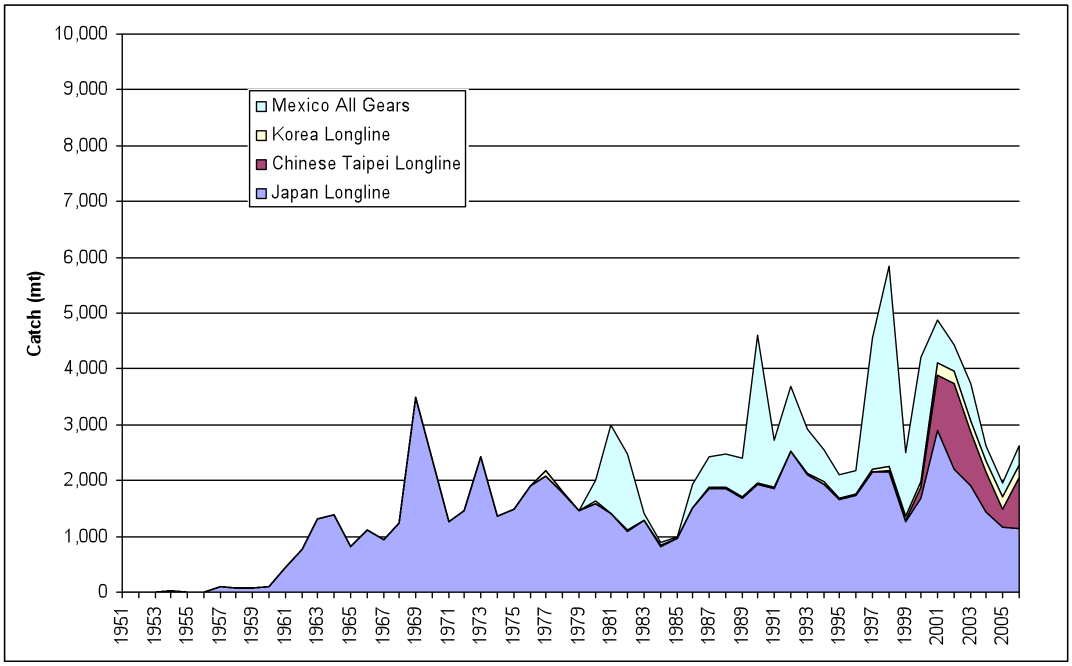

Figure A.3. For comparison, initial estimates of annual total catch (mt) of swordfish in Sub-Area 2 are provided without updated catch.