ANNEX 8

REPORT OF THE MARLIN AND SWORDFISH WORKING GROUP JOINT WORKSHOP

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

(March 19-26, 2007, Taipei, Taiwan)

1.0 INTRODUCTION

The joint intercessional workshop of the Marlin (MARWG) and Swordfish (SWOWG) Working Groups of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) was convened in Taipei, Taiwan from March 19-26, 2007. Goals of the MARWG intercessional workshop were 1) to review the North Pacific striped marlin stock assessment, 2) prioritize and conduct additional sensitivity analyses, and 3) determine status of stock. For the SWOWG intercessional workshop, the goals were 1) to complete compilation of fishery statistics, 2) review and agree on a provisional stock structure scenario, and 3) discuss standardized CPUE (catch-per-unit effort) time series in preparation for their future use in assessing the status of swordfish in the North Pacific.

Gerard DiNardo, Chair of the MARWG, and Robert Humphreys, Chair of the SWOWG, welcomed participants from United States of America (USA), Japan, Chinese-Taipei, and the Inter-American Tropical Tuna Commission (IATTC) (Attachment 1). Mr. James Sha, the Deputy Director General of the Fisheries Agency, and Dr. Ching-Sheng Chen, the Director of the Institute of Oceanography, National Taiwan University gave the welcoming remarks. Rapporteuring duties were assigned to Jon Brodziak, Shui-Kai Chang, Ramon Conser, Gerard DiNardo, Michael Hinton, Hitoshi Honda, Robert Humphreys, Momoko Ichinokawa, Russell Ito, Minoru Kanaiwa, Kevin Piner, Chi-Lu Sun, and Lyn Wagatsuma. Wagatsuma was assigned lead rapporteuring responsibilities. Working papers were distributed and numbered (Attachment 2), and the meeting agenda adopted (Attachment 3).

2.0 REVIEW OF ASSESSMENT & PRIORITIZATION OF ADDITIONAL SENSITIVITIES – STRIPED MARLIN

2.1 ISC/07/MARWG&SWOWG-1/01

Jon Brodziak presented a report describing the application and efficacy of a statistical procedure for predicting missing values of catch per unit effort in the Japanese distant water longline (DWLL) fleet in fishing Region 5 (see Fig. 1 for a delineation of Regions). CPUE data from the Japanese DWLL fleet provide regional indices of relative abundance of striped marlin. There are consistent CPUE time series for Regions 1 through 4 from the 1960s through the 2000s. For Region 5, there is a gap in CPUE values from 1992-2005. The lack of CPUE in Region 5 since 1992 limits the use of Region 5 CPUE as a component of a stock-wide average CPUE for the longline fleet. In this working paper (WP), the expectation maximization (EM) algorithm was applied to predict missing values of striped marlin CPUE in Region 5 using the covariance structure among regional CPUE series. Results of this analysis indicated that Region 5 CPUE would be predicted to decline from 1992-2005 based on the positive correlations between CPUE values in Regions 1 through 4 and Region 5 (Fig.2).

Figure 1. Area stratification used in the standardization of CPUE of striped marlin caught by Japanese distant-water longliners (upper panel) and area stratification scheme adopted for current assessment (lower panel). This definition is followed from the previous stock assessment.

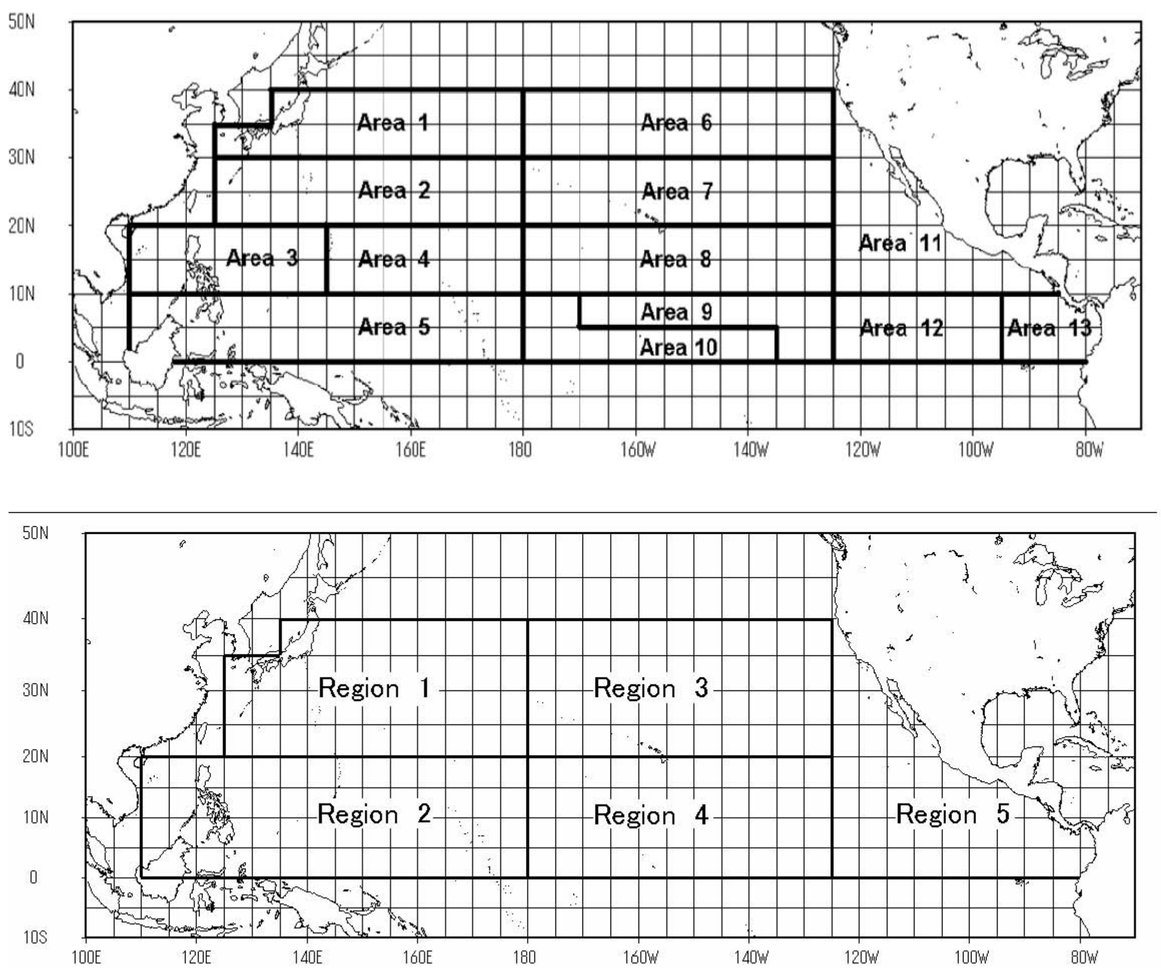
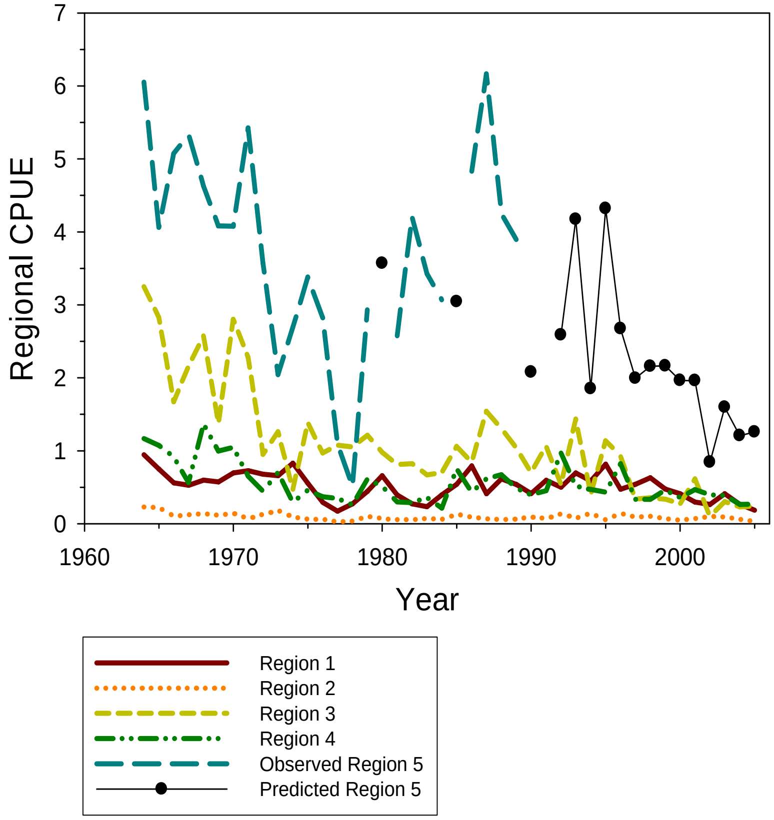


Figure 2. Observed Japanese Distant Water Longline Striped Marlin CPUE for Regions 1-5, 1964-2005, and Predicted CPUE for Region 5 Using the Full EM Algorithm



Discussion. The working group (WG) accepted the results as plausible predictions of missing Region 5 CPUE, but also requested to see alternative predictions based on a partial EM algorithm analysis. In this case, the partial EM analysis set the missing Region 5 CPUE values to equal the Region 5 mean CPUE, and fixed the covariance matrix estimate after one iteration using the mean value assumption. Results of the partial EM analysis indicated a smaller decline in Region 5 during 1992-2005. This scenario was also considered to be plausible given the fact that Region 5 was a higher density striped marlin habitat than the other regions as indicated by higher CPUE values. The WG also questioned whether a multivariate lognormal distribution might be a more appropriate distributional assumption for the standardized regional CPUE series. To address this issue, full and partial EM algorithm analyses were conducted on log-transformed CPUE series. Results of the lognormal analyses were generally similar to the normal distribution analyses. Since the univariate distributions of regional CPUE appeared to be closer to lognormal then normal distributions, the WG suggested using the lognormal predictions of missing Region 5 CPUE values in subsequent striped marlin analyses.

Kotaro Yokawa referred to a previous WP (ISC/06/MARWG&SWOWG-2/05) and reiterated that the Japanese DWLL fleet logbook data did not necessarily have consistent hooks per float (HPF) records prior to 1975. This was considered to have a potential non-random effect on fishery CPUE standardization. It was mentioned that in the late-1960s through the early-1970s, there was a change in fish targeting in the eastern Pacific, away from marlin, as well as a change in the logbook. The WG considered several approaches to dealing with this change in logbook reporting and revisited approaches discussed at previous meetings. The treatment of Region 5 CPUE was also discussed in relation to Yokawa's presentation of nominal longline CPUE in Region 5 which included some values from the mid 1990s.

2.2 ISC/07/MARWG&SWOWG-1/02

Kevin Piner presented the striped marlin stock assessment and sensitivity runs requested at the November 2006 WG workshop. In general, the modeling results indicated a long term decline in population biomass (age-1+). The sensitivity modeling results were based on trends in three indices of relative abundance in relation to a long-term decline in total catch. Sensitivity results indicated that catch length frequency data collected from the purse seine fishery operating in the Eastern Pacific Ocean (EPO) had a substantial influence on assessment estimates of growth and fishery selectivity patterns.

Discussion. The WG agreed to use length frequency data from Japanese fishing operations to estimate striped marlin abundance and fishing mortality in the assessment model. Quarterly length frequency data from the Japanese driftnet fleet in Region 1 were available from the early 1970s through 2004 (Fig.3). Length frequency data from the Japanese longline fishery are available in all regions during the same time period (Fig.4). Similarly, Japanese longline training and research fleet length frequency data were available from all regions during the 1970s through 2005, with the exception of Region 5 (Fig.5).

Figure 3. Region-specific availability of length frequency data for the North Pacific Japanese driftnet fishery.

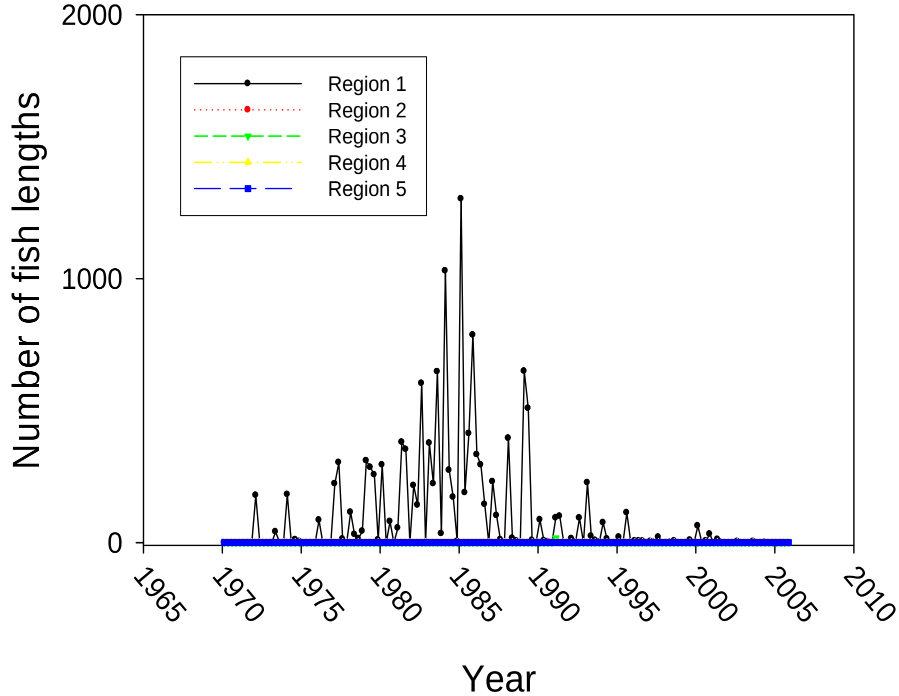


Figure 4. Region-specific availability of length frequency data for the North Pacific Japanese commercial longline fishery.

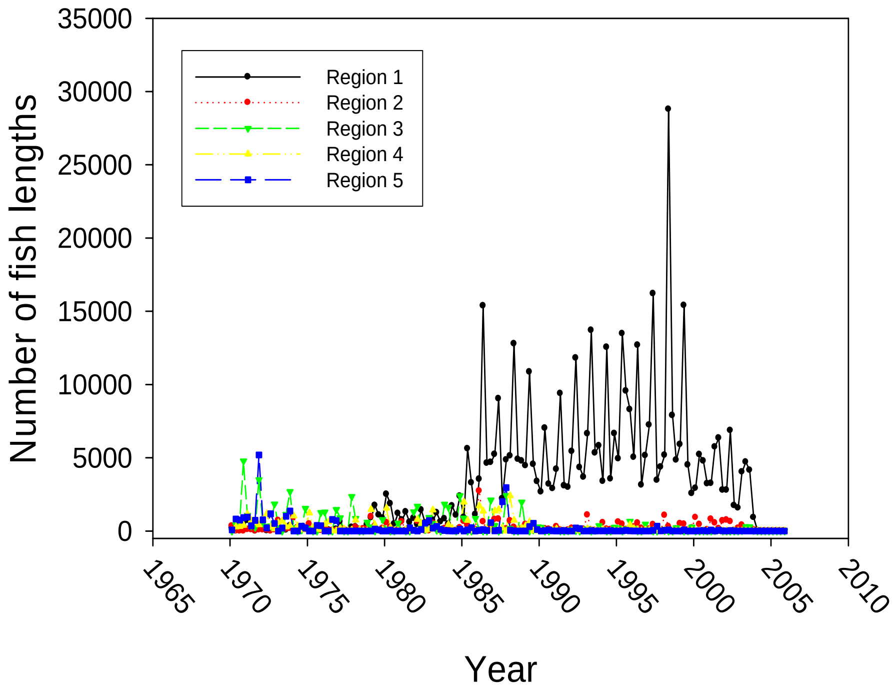
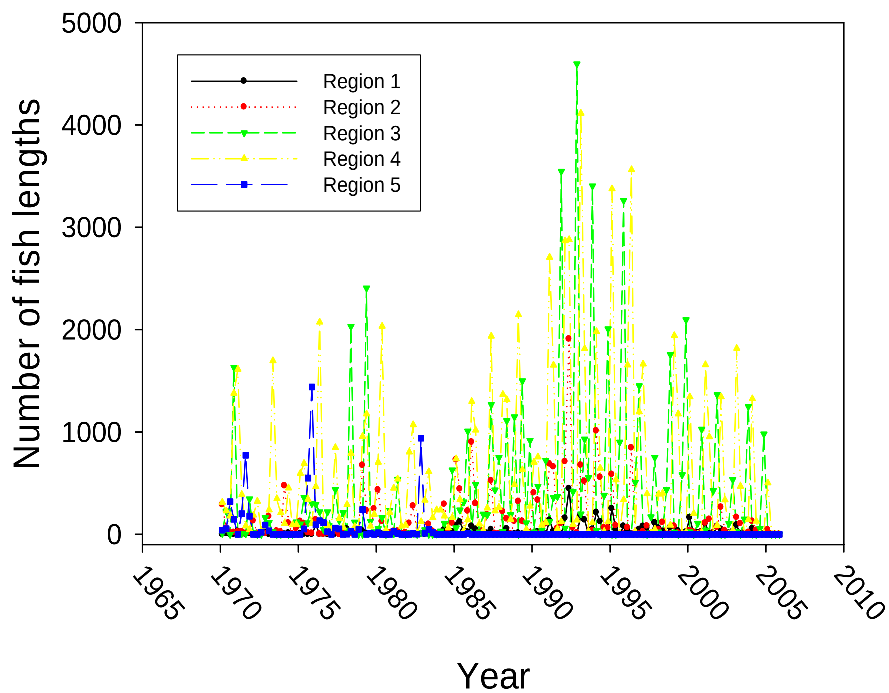
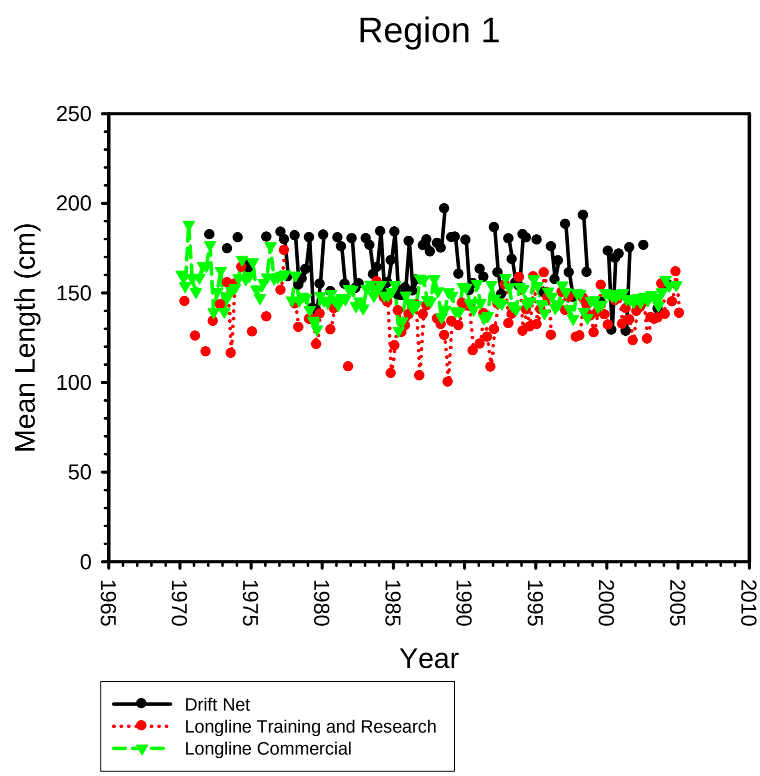


Figure 5. Region-specific availability of length frequency data from Japanese longline training and research vessels operating in the North Pacific.

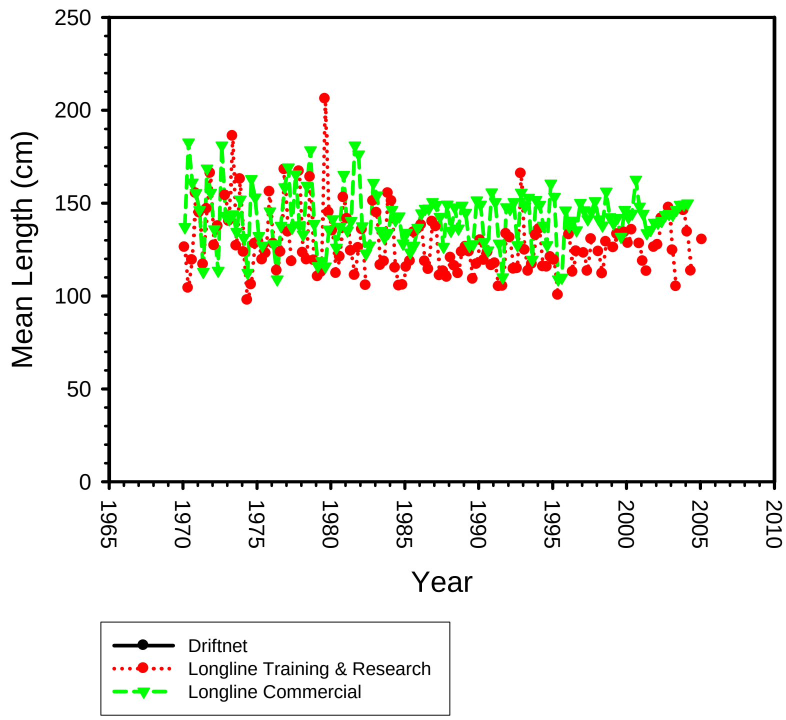


Quarterly length frequency data from Japanese fishing operations in fishing Regions 1 through 5 were used to characterize trends in the mean length of striped marlin catches in the stock assessment model. In Region 1, there was a moderate long-term decrease in mean length for the drift net and commercial longline fleets and a moderate increasing trend in mean length for the longline research fleet. There was a declining trend in commercial longline and research mean lengths in Region 2. In Regions 3, 4 and 5, there was a decreasing trend in mean length for the longline research fleet and a moderate increasing trend for the commercial longline fleet (Fig.6).

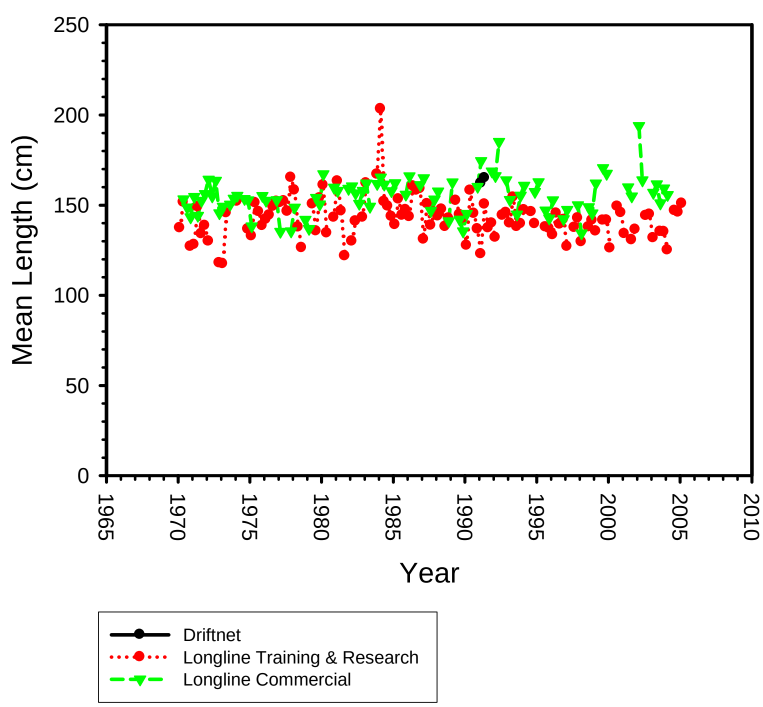
Figure 6. Region-specific annual mean lengths of striped marlin caught in the Japanese driftnet and commercial longline fisheries and on longline training and research vessels.



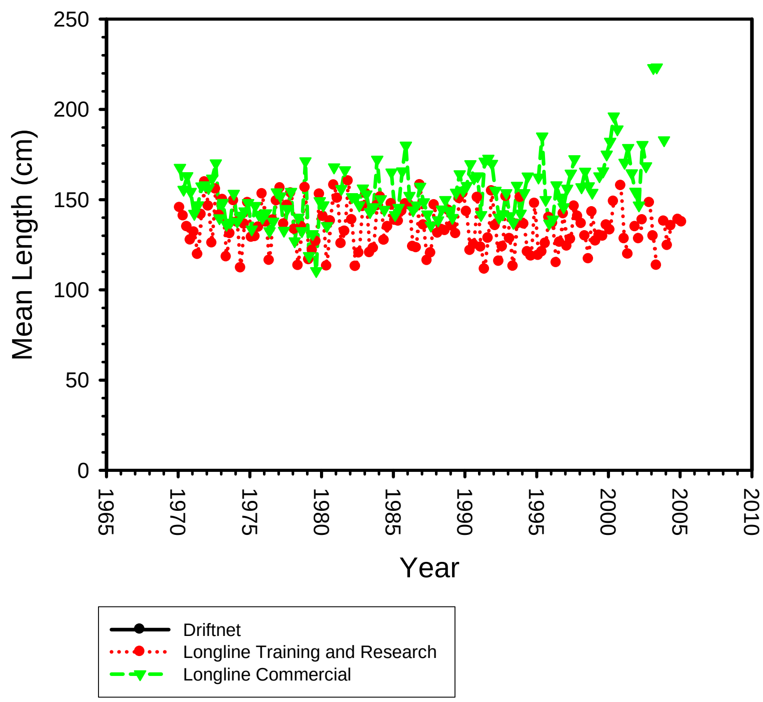
Region 2



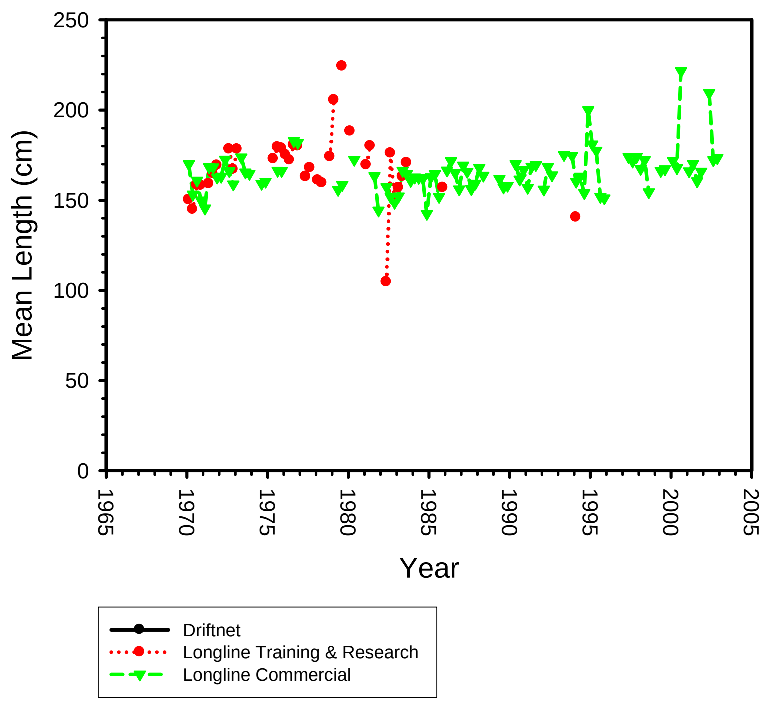
Region 3



Region 4



Region 5



The WG identified a base case striped marlin assessment model, based on results of sensitivity analyses. The assessment model was formulated using Stock Synthesis 2 (SS2). The inclusion of Japanese training vessel data was considered important because this was believed to provide an index of striped marlin recruitment. The WG also concluded that a stock-recruitment steepness value of h=0.7 was a reasonable value for the base case. The WG observed that the EPO purse seine captured relatively larger striped marlin than other fisheries. It was explained that the striped marlin pooled-sexes growth curve was estimated within the SS2 model to allow the model to fit the larger EPO fish. In this case, there were no age-length data of similar sizes in the published growth study used for the assessment. It was observed that fitting the growth model within SS2 produced dome-shaped selectivity pattern for several longline fisheries and it was suggested that this may not be a realistic selectivity pattern for these fisheries. It was also noted that the growth curve estimated within SS2 had a larger asymptotic size than the best published growth study and this was also a cause for concern. Overall, the WG reached consensus that the estimation of growth within the SS2 model was likely producing non-credible selectivity patterns in some fisheries and that the base case model should be modified to address this issue.

The WG accepted Piner's conclusions that model results were relatively insensitive to the initial equilibrium assumptions and starting point of the assessment model. The WG also agreed that the model was more sensitive to the value of natural mortality, stock-recruitment steepness and the inclusion of the Region 5 purse seine length frequency data.

The WG discussed ways of improving the base case model to account for the apparent sensitivities to parameter values. The WG suggested using the longline selectivity in Region 5 to represent the recreational fishery length frequency instead of using the purse seine data. The WG also suggested excluding the purse seine length frequency data since this fishery was a relatively minor component of the overall catches in Region 5. The WG documented that the purse seine percentage of the total Region 5 catch is minor to support this point.

The WG considered the Region 5 purse seine length frequency data and its effects on selectivity patterns in other fisheries. Since the purse seine fishery was a minor component of the Region 5 fishery and since the estimated growth curve was not consistent with published studies, and apparently caused the dome-shaped selectivity patterns in other fisheries, the WG concluded that the base case model should exclude or down weight the purse seine length frequency data.

Results of CPUE standardization of striped marlin caught by Japanese offshore and distant-water longliners were also revisited to clarify the existing problem of the estimated trend of abundance index from the view points of its use as the input for the stock assessment model. In the course of discussions, three major points were addressed;

- Sudden declines of the index occurred in 1970 – 1971 and the decline does not reflect an actual change in the level of abundance, rather it reflects change in gear efficiency caused by the change of target species of Japanese offshore and distant-

water longliners in the eastern side of the north Pacific (Regions 3 and 5).
- Estimated trend of index in the period after 1974 is likely more reliable than that in the period before 1975 because of improvement of the quality and the reliability of the log-book.
- The trend of the nominal CPUE in the region calculated by smaller number of data suggests that the level of stock in the Region 5 stayed at roughly similar high level of the 1960s.

The group agreed that the effects of these problems on the results of the stock analysis would be checked through sensitivity runs of the base case model.

The WG also discussed the treatment of Japanese DWLL CPUE. In Piner's initial presentation, the DWLL were treated as a stock-wide index, calculated as the average of standardized CPUE in Regions 1 through 4 and excluding Region 5. It was noted that it was probably important to include Region 5 CPUE in the model fitting procedure since this was a relatively high density area, as indexed by CPUE, and was the only area where reliable growth information was available. The downside of including Region 5 CPUE in a stock-wide index was that the standardized Region 5 CPUE is only available during 1964-1991. Thus, including Region 5 would require either truncating the stock-wide CPUE index in 1991 or predicting the values of Region 5 CPUE from 1992 onwards using the results of the EM algorithm analyses. The WG concluded that four possible ways to treat the DWLL CPUE data and Region 5 CPUE were: (i) fit Regions 1-4 averaged CPUE as a stock-wide index, as in the base case model; (ii) fit Regions 1-5 averaged CPUE with a 1964-1991 time frame; (iii) fit Regions 1-5 averaged CPUE with predicted values from EM analyses and a 1964-2005 time frame; or (iv) fit Regions 1-5 CPUE as separate regional indices for fitting using CPUE in Regions 1-4 during 1964-2005 and CPUE in Region 5 during 1964-1991. The decision on how to handle the Japanese DWLL CPUE data was considered to be contingent upon further model investigation.

To advance the current assessment model, the WG requested a set of three revised runs to investigate improvements to the base case assessment model. The first run (Run1) was formulated to evaluate the effects of the change in Japanese DWLL logbook data in 1975 by assuming two periods of catchability for the Regions 1-4 averaged CPUE (2Q model). Other than assuming different catchabilities during 1964-1974 and during 1975-2005, the formulation of Run1 was identical to the base case. In particular, both models included the EPO purse seine length frequency data as a likelihood component to be fit.

Results of Run1 indicated that the base case and Run1 gave similar results. The two-period catchability model had slightly higher estimates of stock biomass in the 1960s and 1970s. Otherwise, the models fits to the CPUE time series and other data sources were similar. As a result, the WG concluded that the model results were relatively insensitive to the treatment of the DWLL with separate catchabilities before and after 1975.

The second run (Run2) suggested by the WG was put forward as a potential improvement over the existing base case model. Run2 included the following features:

- Region 5 recreational catch data was assumed to have the same selectivity as the commercial DWLL fishery in Region 5
- The EPO purse seine length frequency data were excluded from the model fitting process although the EPO purse seine catch remained in other Region 5 fishery categories
- The growth parameters were fixed in the SS2 model using the growth study values from Melo-Barrera et al. (2003)
- The assessment time frame was set to start in 1952 using the same equilibrium catch as in the base case
- Recruitment deviations were estimated from 1970 onwards to better reflect the time period when length frequency data were available to measure relative year class strength
- The length frequency bins were rescaled to match the fact that the Japanese data were binned by 5 cm intervals, e.g., 1-5 cm was the 1-cm bin, 6-10 cm was the 6-cm bin, and so on
- Several longline fleet selectivity functions were fixed to be flat topped.

The results of Run2 were consistent with the base case. There was a consistent nonrandom pattern of positive and negative residuals in the DWLL residuals during the 1970s. There was also some patterning in the Region 5 length frequency residuals by fleet. The fitted selectivity functions from Run2 were more dome-shaped than might be expected for the DWLL fleets. This run also had a more pronounced increase in stock biomass in the early-1970s in comparison to Run1. Overall, the WG concluded that this run incorporated some positive changes but had some residual patterns that warranted further model revisions.

The third model run (Run3) was configured to fit the DWLL CPUE by region but otherwise had the same setup as Run2. This run investigated whether changing from fitting the DWLL at the regional scale had an impact on the nonrandom residual patterns observed in Run2.

The results of Run3 were generally consistent with Run2. The change to fitting regional DWLL CPUE series did not substantially change the DWLL CPUE residual patterns. There was also some nonrandom patterning in the Region 5 length frequency residuals and a more pronounced increase in stock biomass in the early-1970s in comparison to the base case model. Since the results of Run3 were similar to Run2, the WG considered which revisions from Run1, Run2, and Run3 should be incorporated into a new base case model.

Based on the results of Runs1-3, the WG decided on a new base case model structure which incorporated the following changes:

- Use 5-cm length frequency bins
- Fit recruitment deviations from around 1963 onwards
- Set several longline and other fleet selectivity patterns to be flat topped
- Fix growth parameters based on best available growth study
- Exclude Region 5 purse seine length frequency data

- Revise initial equilibrium catch to incorporate new estimates from Japan
- Start the assessment model in 1952
- Fit separate regional DWLL CPUE series

To determine the sensitivity of the model to the corrected data of Japan, the model was rerun using the old Japanese catch data and constituted model Run4. This run produced similar results and fits to the CPUE and length frequency data as in previous model runs.

The WG decided to forego additional model runs until all WP containing potential input data to the model were presented and discussed.

3.0 REVIEW AND FINALIZE DATA INPUT FILES – STRIPED MARLIN & SWORDFISH

3.1 ISC/07/MARWG&SWOWG-1/03

Russell Ito presented a report on the status of the U.S. Swordfish Fisheries in the North Pacific Ocean. Fisheries in the U.S. include harpoon, drift gillnet, and longline. The harpoon and drift gillnet fisheries are based in California; longline fisheries are based in Hawaii and California. The Hawaii-based longline fishery targeting swordfish began in 1988 and became the largest producer of swordfish of all U.S. North Pacific Ocean swordfish fisheries from 1990-2000 and 2005-2006. Fishing regulations were imposed in 1999 to minimize sea turtle interactions . The fishery was closed in April 2001 due to procedural issues stemming from sea turtle interactions, and reopened in April 2004 under a set of new regulations. Since reopening the fishery, the newly imposed regulations on the Hawaii-based swordfish longline fishery significantly impacted fishing operations, and subsequent CPUEs should be reviewed with caution. Swordfish CPUEs from swordfish-targeted trips increased significantly from 2004 to 2006. The California-based longline fishery targeting swordfish was closed in 2004 and remains closed.

Discussion. The WG agrees that the use of recent CPUE data from the Hawaii-based longline fishery should be viewed with caution due to changing management actions that likely affect CPUE. It was noted that the Hawaii longline swordfish fishery is monitored with 100% observer coverage (as mandated) to report on sea turtle interactions, and that this requirement also increases the biological information collected on this sector of Hawaii's longline fishery. It was noted that no information on swordfish discard rates were reported. Future country reports should include this information. Japanese training vessels catch small swordfish, and the swordfish data from these vessels may be a good indicator of recruitment. Why swordfish catches by the California gillnet fishery decreased over time was discussed and it was surmised that the cause is likely related more to increased regulations, i.e., time-area closures and gear restrictions, then due to bycatch issues.

3.2 ISC/07/MARWG&SWOWG-1/04

Gerard DiNardo presented a report on the status of México swordfish and marlin fisheries in the North Pacific Ocean. The WP provides a description of the Mexican billfish fisheries, including targets, location and availability of Category I, II, and III data. Six species of billfish are fished in Mexican Pacific waters including striped marlin, blue marlin, black marlin, short bill spearfish, sailfish, and swordfish. Of these species, only swordfish is fished commercially. All other species are the subject of recreational fisheries. Sport fisheries activities along the Mexican Pacific coast are concentrated in a specific designated fishing zone, which extends parallel to the Mexican Pacific coast, up to 50 nautical miles (nm) from the shore line. This was officially established in 1983, as a reserve zone only for recreational fishing. In 1987 two other billfish zones were established in México that excluded all longlining operations. One is around the coast and tip of the state of Baja California Sur, the other off the Gulf of Tehuantepec in Southern México. The majority of the marlin catch comes from the Gulf of California area (89%), the remainder coming from the Gulf of Tehuantepec area (11%). The total recreational catch of billfish (numbers) has increased since 1990 (first year of reported data) from approximately 12,000 to 33,000 fish in 2005. Recreational fishing effort has also been increasing during the same time period from approximately 4,000 fishing trips in 1990 to 37,000 trips in 2005. Striped marlin is the dominate species caught in the recreational fishery accounting for approximately 68% of the total catch. Sailfish account for 25% of the total recreational catch, followed blue marlin at 7% and black marlin at < 1%. Swordfish is occasionally caught in the recreational fishery, accounting for < 1% of the total recreational catch. The commercial swordfish fishery has two development phases. A longline fishery commenced in 1964 and was the sole fishery targeting swordfish until 1986 when a gillnet fishery commenced. The main ports for these fisheries include Ensenada, San Carlos, and some times La Paz and Mazatlán. Between 1980 and 2006 the catch of swordfish fluctuated from < 100 MT to 3,600 MT, with peaks in 1982 (1,575 mt), 1990 (2,650 mt), and 1998 (3,600 mt).

Discussion: Participants acknowledged the important contribution by Mexico despite their absence. There was discussion as to the relevance of combined billfish data series, and there was agreement to seek more detailed information including species specific annual catch and CPUE series. There was also agreement to ask that the swordfish catch, effort, and CPUE series be decomposed annually by gear. The Chair will contact Luis Fleischer (lead author) and relay the request.

3.3 ISC/07/MARWG&SWOWG-1/05

Shyh-Jiun Wang described Chinese Taipei's fisheries and associated catch of swordfish and striped marlin. There are no fisheries in Chinese Taipei that target billfish, except for the seasonal coastal harpoon fishery operating in waters off eastern Taiwan. Based on fishing grounds and gears, Chinese Taipei's fisheries are classified into coastal fisheries, offshore fisheries and distant-water tuna longline fisheries. Market records are the best information sources for estimating Category I data for Taiwan's coastal and offshore fisheries. Logbooks from the small tuna longline (STLL) fishery have been collected since 1997, and the recovery rate is too low to be compiled to Category II data. In the interim, sampling programs have been established to collect size measurements at local fishing ports from 2002 through 2005 on swordfish and striped marlin; and approximately 2,280 and 453 fish, respectively have been collected. The Fisheries Agency has launched a data improvement program for the domestic STLL fishery, which should result in significant improvements to the logbook coverage rate in the near future. Several sources of commercial information are available which estimate total catches of the Category I data for the DWLL fishery. Logbook data is collected at the set level and information collected include catch by species (number and weight), effort deployed, fishing location, as well as the size measurements from the first 30 fish caught each day. Categories II and III data are also compiled from this data set. A pilot observer program in the three oceans (Atlantic, Indian, and Pacific) was launched in 2001 with only 2 observers, increasing to 31 observers in 2006. The number of observers is anticipated to increase even further in 2007 to a total of 56 observers. Despite the increasing number of observers only 2 trips in the North Pacific were observed from 2005 to 2006.

Discussion. This is the first detailed report describing the catch and effort of Chinese Taipei billfish fisheries and the Chairman acknowledged its importance. It was noted that the quality and quantity of the logbook should improve with the addition of a VMS system being implemented on all DWLL vessels. It was also noted that the catch data submitted in this report is different from those submitted previously (Nov. 2006). Clarification was provided and the newly submitted data represent an update to the official data. It was highlighted that a small portion of the reported billfish catch that is landed frozen may come from either the South Pacific Ocean or Indian Ocean. This issue is currently being addressed and corrections to the reported catch estimates will be provided to the WG. It was noted that the sampling rate for size frequency data from the DWLL and coastal fisheries is low, and that the presented frequency histograms include all available data. At the request of the WG, Mr. Wang also provided catch statistics for the Chinese Taipei driftnet fishery.

3.4 ISC/07/MARWG&SWOWG-1/06

Wei-Chuan Chiang reported on the catch, sex ratio and size composition of striped marlin caught in waters off eastern Taiwan. Striped marlin in these waters are primarily taken by drift gill nets, secondarily by harpoons, and as incidental bycatch in the offshore longline fishery. Historical catch data of striped marlin in the eastern coastal and offshore waters of Taiwan was provided by the Shinkang Fishermen's Association, and covers the period June 1999 to February 2007. Biological data was collected monthly at Shinkang fishing port from November 2004 to December 2006. The weight-frequency distribution of the striped marlin by all gears combined ranged from 10 kg to 140 kg round weight (RW), with a mean weight of 40.74 kg and S.D. of 18.71 kg. The lower jaw fork length (LJFL) for males ranged from 121 to 243 cm while the LJFL for females ranged from 122 cm to 249 cm for females. RW ranged from 10 to 109 kg for males and 11 to 131 kg for females. The estimated sex ratio for all samples was 0.43 which differed significantly from the expected value of 0.5 or 1:1. Striped marlin length frequency distribution by gear type were significantly different Regardless of gear type, there was a slightly higher proportion of males in the catch, and the mean length of female striped marlin was larger than males. The mean length of striped marlin caught by drift gillnets was larger than the other gear types.

Discussion. Whether there was a way to sex fish based on external characteristics was discussed and it was determined that such characteristics do not exist. It was noted that an on going study to sex marlins based on tissue samples is being conducted by a PhD student of Dr. Hinton. The WG discussed whether double counting of size frequency samples could have occurred at Shinkang fishing port, thus biasing the data. It was confirmed that the study did not double count size data.

4.0 ABUNDANCE INDICES – STRIPED MARLIN & SWORDFISH

4.1 ISC/07/MARWG&SWOWG-1/07

Gerard DiNardo presented a report on swordfish catch rates in the Hawaii-based longline fishery from 1994-2006. The analyses used data gathered by the Hawaii Longline Observer Program of NOAA Fisheries. The results include a generalized additive model (GAM) of swordfish catch rates on observed sets, with the associated statistical and graphical output, standardized time series developed from the model, and a comparison with nominal catch data on these sets. Standardized catch rates were computed separately for shallow- (i.e., < 15 hooks per float) and deep (i.e., ≥ 15 hooks per float) longline sets, which generally correspond to swordfish- and tuna-targeted fishing. These rates were computed by setting all predictors other than the date of fishing to their respective mean values in the two subsets and then obtaining the back-transformed response from the GAM. These catch rates were then adjusted by the hook numbers and re-expressed as CPUE (swordfish per 1000 hooks). Between 1994 and 2006, swordfish catch data gathered by fishery observers revealed no apparent pattern of decline. There was a large difference in catch rates between the shallow- and deep-set sectors of the Hawaii-based longline fishery, reflecting the fact that swordfish is targeted by the former and taken incidentally in the latter, but the within-sector trends appear stable. As such, the observed sets provided no indication that this species is being exploited unsustainably in the Hawaii-based longline fishery.

Discussion: The WG acknowledged the important contribution by Bill Walsh despite his absence and discussed the reported high numbers of HPF used in the Hawaii longline fishery. It was confirmed that these observations were correct, and that the Hawaii longline vessels do use numbers of HPF greater than those of the Japanese longline fishery in an effort to get to depths to optimize catch of swordfish. There was discussion and agreement that the CPUE series should be re-expressed on an annual basis to be consistent and comparable with similar series from other Pacific Ocean swordfish fisheries.

4.2 ISC/07/MARWG&SWOWG-1/08

Chi-Lu Sun presented standardized catch rates for swordfish caught in the North Pacific Ocean by the DWLL fishery of Chinese Taipei. Catch rates were standardized using a general linear model (GLM) and cover the period 1995 through 2004. Standardized CPUEs were stable from 1995 to 2000, ranging between 0.08 and 0.19 fish per thousand hooks. The standardized CPUE increased to 0.3 fish per thousand hooks in 2001, decreased again to 0.2 fish per thousand hooks in 2003, and increased to its maximum of 0.32 fish per thousand hooks in 2004.

Discussion. The contribution of Taiwan was recognized as a welcome and important contribution to the WG. Much of the discussion focused on the independent variables used in the GLM. In particular, the inclusion of 1) catch rates of another species (bigeye and yellowfin tuna) as a means of incorporating species targeting and 2) SST data in to the model. Previous research suggests that this approach may result in biased CPUE estimates over time (Col. Vol. Sci. Pap. ICCAT, 46(1): p.210 (1997)). While the best approach to address targeting is to use HPF data, they are only available for the last two years. The WG recommended additional GLM analyses to assess the influence of catch rate data from other species on model output. The results of these model runs (exclusion of catch rate data from the GLM) suggested no major change in estimates of standardized CPUE, but a significant decrease in model R^2 was observed (0.43 to 0.29). A proposal was made by Chinese Taipei to extend the HPF series further back in time and would involve a collaborative research project between Chinese Taipei and Japan. In the interim, the WG recommended that catch rate data from the other species remain in the model as a means of incorporating targeting into the analysis. The inclusion of SST data into the analysis should be based on observed physiological or behavioral responses, since environmental data is often correlated with spatial and temporal factors that are generally incorporated into models. This issues was discussed by participants and the WG recommended SST data remain in the model.

4.3 ISC/07/MARWG&SWOWG-1/09

Kotaro Yokawa presented a preliminary analysis to assess the utility of using set-by-set data from Japanese coastal longliners operating in the Northwestern Pacific Ocean in future stock assessments. The set-by-set data used in this study were collected through logbooks by scientists at the National Research Institute of Far Seas Fisheries from 1994 to 2005. Logbook coverage rates ranged from between 80 to 95%, and is assumed to be sufficient for CPUE analysis. Traditional GLM methods were applied on the data to compute provisional estimates of standardized CPUE. A skewed, bimodal distribution pattern in the residuals, was observed and assumed to result from high numbers of sets with zero striped marlin catch. When gear configuration is accounted for in the standardization procedure (expressed as a categorical variable based on the number of HPF), the CPUE trend from the coastal longline fishery is different from trends observed in the Japanese offshore and distant-water longline fisheries. This difference is believed to be caused by the large number of categories (10) used in the classification of HPF of the coastal longliners. While there remain a variety of points of improvement to be investigated for this model, the estimated trend of the standardized CPUE is assumed to roughly reflect the trend of abundance of swordfish in the northwest Pacific for the period, which showed signs of increase in the most recent years.

Discussion. A difference was noted between the results for Region 1 in the previous report to the WG (Yokawa and Saito, 2004). It was explained that in the previous work, part of the coastal longline catch and effort was included in the DWLL. There are differences in the strategies in these fisheries, with more complexity in the coastal longline, including the ability to easily shift and redirect effort. It was explained that the coastal longline generally uses much fewer hooks per set than the DWLL. It is not clear at this time why the results are different: it is seen that the early part of the series agrees with the previous, and also it was observed that the DWLL was experiencing higher catch rates in 2005-2006. It was pointed out that the previous MFCL-based swordfish assessment (conducted in 2004) indicated there was no concern with swordfish, but that decreasing catch rates were observed. It was noted that at this time Figure 8 of ISC/07MAR&SWOWG-1/09 includes trends indicating recovery in catch rates, with current catch rates about 70% of the 1994 level. The general model structure was discussed with focus on a number of issues, including (1) the use of 10 categories of HPF [it was noted that the choice of 10 categories was based on the information shown in Figure 7 and that this was the first time this number had been used. It was also pointed out that a grouping of HPF in the right-hand-tail of the distribution would likely provide a similar fit with fewer parameters.]; (2) the observed distribution of residuals vs. underlying assumptions; and (3) the appearance in Figure 4 that HPF does not capture the effect of the gear configuration on the estimate of catch rate [it was noted that this needed investigation, but that one reason may be that catch rates of swordfish in swordfish targeting operations are about 10% higher than in operations targeting tunas. Additionally it was noted that there was little swordfish targeting in the coastal longline, and that only 10% of the DWLL operations target swordfish]. The coverage for the longline fishery was noted to be about 80% in the beginning of the series, increasing to about 95%-100% at present. The two modes in the residuals may be caused by relatively high numbers of zero-catch observations, which may be solved by the use of a Delta-lognormal GLM.

4.4 ISC/07/MARWG&SWOWG-1/10

Momoko Ichinokawa presented updates of standardized CPUE for swordfish caught by Japanese offshore and distant longliners in the principal fishing grounds of the North Pacific from 1975 to 2005. The standardization methodologies were similar to those used in the previous study by Saito and Yokawa (2004), which applied a traditional lognormal GLM on 5º x 5º aggregated data from Japanese longliners beginning in 1975. The overall CPUE in the main fishing grounds for swordfish did not change significantly during the last 10 years, which were proceeded by a decline beginning in 1985. However, CPUE trends in both the western and eastern Pacific were different from each other during the last decade. Further investigations will be needed to explore the observed differences, especially how differences in the horizontal distribution of swordfish habitat between these regions affects CPUE. In addition, because longline effort in the eastern Pacific have been changing drastically since 2000, more area stratification may be needed to improve the estimation of swordfish abundance indices in the Eastern Pacific.

Discussion. The WG noted that there was little change in model fit as the number of parameters was increased, and it was suggested that error bars be added to the fits to help understand the variability of catch rates from Japanese longline vessels operating in the principal fishing grounds for swordfish. It was also noted that these catch rate series were not appropriate for use in stock assessment because they focused on the principal fishing grounds and not the full spatial extent of swordfish. Availability of size frequency data was discussed, and determined that this information is most abundant from the western-central Pacific Ocean. It was noted that the general pattern of swordfish movements is north-south, and that as a result there may be regions of local depletion. A comparison of the northwest and southwest regions yielded the observation that there may not be size-frequency data to make comparisons between the regions.

4.5 ISC/07/MARWG&SWOWG-1/11

Minoru Kanaiwa presented an analysis on the effects of differing statistical distributions of the data on CPUE standardization procedures in Japanese longline fisheries. Preliminary results of the analysis suggests that the changing nature of Japanese fisheries may lead to differences in the observed error structure distributions, which could present significant problems when estimating abundance and stock status. The Japanese fisheries have changed over their history due to biological, political, and/or social reasons. At this time, the spatial coverage of data has been decreasing, and it is believed that this is one of the major reasons why error distributions stemming from the standardization process have changed. When standardizing CPUE it is generally assumed that the error distribution is constant over the series, which could result in biased results if the assumption is violated. In this study it was shown that it is likely that there is a non-zero probability that a bias will exist by use of both analytical and simulation methods.

Discussion. It was noted that this paper was presented to illustrate potential problems with modeling as the effort level of the Japanese fishery continues to decrease, while at the same time the vessels that remain are operated by the best skippers. It was noted that the example was conducted with a $N(\mu, \sigma^2)$ error structure assumption vs. the $\ln(N(\mu, \sigma^2))$ error structure that is normally assumed with catch-rate-data models. Following discussion on use of other error structures, particularly the $\Gamma(\alpha, \beta)$ distribution, it was recommended that the model be tested with alternative error structures. The point was also made that the model appears to allow for changes in targeting, gear, and other fisheries changes over time. Part of the character of changes, such as these, may not be captured in normal modeling approaches, e.g GLM with $N(\mu, \sigma^2)$ error structures, and this brings to attention the need to consider how to handle HPF data in GLM models.

4.6 ISC/07/MARWG&SWOWG-1/12

Minoru Kanaiwa reviewed the suite of statistical methods that are generally used to develop standardized metrics of CPUE (e.g., GLM), including their shortfalls, and identified an evaluation framework to identify the best standardization procedure. In typical applications there is no basis for choosing one CPUE standardization procedure over another and researchers generally use what's familiar to them or what has been used in the past. A rigorous statistical framework with appropriate diagnostics that applies model selection criteria would be beneficial to the standardization procedure. As a point of departure a simple weighting scheme was developed to choose the best model. And applied to illustrate potential benefits from such an approach. It was suggested that assembling small sets of "good data" (i.e. data for which all or nearly all information are available, such as information on the gear distribution/shape and oceanographic conditions associated with the fishing operations) proceed, and that the different standardization techniques be applied to these data to determine which technique works best. Acceptance criteria would need to be established and, as a point of departure, a small working group be formed to pursue this idea further.

Discussion. It was noted that there may be a reason to believe that the logbook and fisheries-based data may contain hidden biases and skewed distributions which are not normally captured in modeling. The approach here may help to clarify the existence and nature of problems in the Japanese data. Because of the issues raised in this discussion, there was a recommendation that multiple methods be used to standardize catch rate series. It was noted that within the investigation model, sub-models could be used to add flexibility, and to allow research to be easily restricted to plausible models to obtain robust, vs. outlier detection type, results. There was some discussion that the use of experimental controls and research was a good idea to follow. One of the issues to which this work would be directed would be to resolve the issue of how to use data for assessment of both target and bycatch species. A recommendation for formation of a small working group to analyze these modeling issues was made and the Chairman will work with the Japanese to ensure development of the small working group.

4.7 ISC/07/MARWG&SWOWG-1/14

Sheng-Ping Wang presented preliminary results of an age-structured model applied to striped marlin in the North Pacific. The age-structured model used was originally developed for sexual-dimorphic species and applied to swordfish in the North Pacific. The model was modified to eliminate the dimorphic growth component and was fit to the striped marlin catch, CPUE, and length frequency data of the fisheries operating in the North Pacific. Although the model estimations did not converge for some of the assumed pre-specified values of natural mortality and variance of recruitment deviation, the model did fit the observed data well for most cases. More biological information is necessary to advance development of this model.

Discussion. The question of major differences between this model and SS2 was raised, and it was explained that in this model growth is not estimated in the model. It was noted that a minor difference between this model and SS2 was in the reporting of reference points. It was also noted that this model uses age-based selectivity, much like MULTIFAN-CL, where the SS2 model uses a length-based selectivity. No reason was given for the observed lack of fit of the model as h increases to 1, but it was noted that this was under investigation.

5.0 DISCUSS "NEW" MODEL RUNS – STRIPED MARLIN

New runs (Run 5, 6 and 7) were presented on Thursday March 23rd. The new runs built upon Model 4 with the following additional changes.

1. Change the driftnet and other fisheries catch in Region 1 to reflect corrections presented at the meeting.
2. Change the equilibrium catch to 70,000 fish in the Japanese DWLL fleet Region 1 and 30,000 fish in the driftnet fishery Region 1.
3. Estimate selectivity patterns in blocks (1952-1979 and 1980-present).
4. In Run6 also estimate separate catchabilities for the Japanese DWLL fleets in the same block periods as the selectivity patterns.
5. In Run7 decouple the S/R function from recruitment estimates.

Run5 and Run6 Results:
The selectivity among fisheries indicate that bigger fish were caught in the post-1980 period in southern zones (Regions 2 and 4). This result conforms to our intuition about how bigeye fishing would have affected the size distribution of the catch. It was noted that there is less size data pre-1980 and those estimates are likely more uncertain.

The WG noted that estimating separate catchabilities (q) in Run6 does not visually change the selectivities patterns that were estimated. It was noted that the confidence intervals 95% for q's estimated within each series indicated that the catchability was different in the two periods. The exception was Region 1 where the catchabilities were not different. It was noted that Region 5 has higher q in early periods and 2-4 have higher q in later periods.

Estimating selectivity in blocks had the effect of improving the Region 1 CPUE fit as judged by the residual patterns. Other regions CPUE series are fit pretty much the same as in other runs. Model produces a best fit to Region 1, and it was noted that it was the area with the greatest catch. Overall, Model 6 (2-q model) residual patterns look better than the Run5 (1-q model) model fit.

The WG noted there was little difference between models in regards to the fits to the proportion at length data. There has been little sensitivity of the model across the different models presented.

The WG noted that recruitment is slightly higher with Run5 and 6 than in the base case. The surge in biomass in 1970s is smaller in Run5 and 6 than in the base case

A model that allowed recruitment deviations to vary from SR curve was briefly presented (Run7). It was noted that recruitment is more variable in recent years with a spike in 2004 or 2005, but the overall pattern of decreasing recruitment across time was similar.

The WG considered the question "What does the stock recruitment (SR) curve give us and what is the advantage of assuming an SR curve versus not assuming one?"

i. With SR curve there is not spike in recruitment in 2004

ii. With no SR curve then we do not have to assume h=0.7
iii. With an SR curve the recruitment series is smoother

The WG questioned the validity of the 2004 recruitment level. The WG suggested comparing the length frequency data in 2005 with other years exhibiting high recruitment (1976-77). If there was evidence of more small fish in 2005 (as in 1976) then perhaps the high recruitment estimate in 2004 may be real. It was also suggested that the estimated variability associated with the 2004 recruitment estimate be tabulated. The WG questioned whether the variability in recruitment was related to changes in fishing practices such as movement of the fleet across the Pacific Ocean and whether this would confound the recruitment signals in the data. The lack of length frequency observations prior to 1970 was noted.

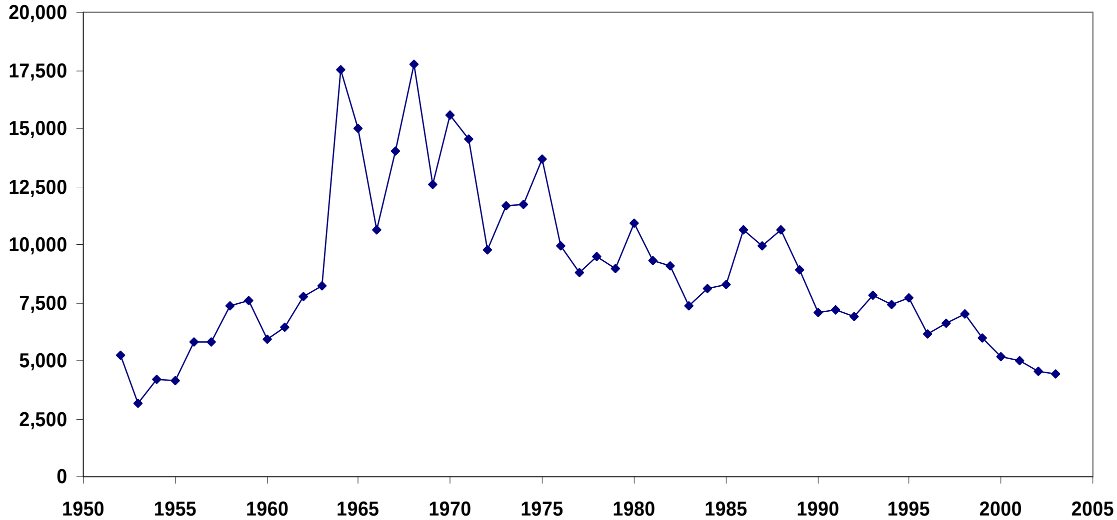
The WG reviewed the requested sensitivity runs. The results were consistent with previous model investigations. All models runs were consistent and showed a long-term decline in biomass. The run that represented environmentally-forced recruitment provided the greatest contrast with the base case. This run showed a different initial condition with lower stock biomass, but exhibited the similar long-term decline. The other sensitivity runs generally had higher initial biomass estimates associated with a larger long-term decline in biomass. From a practical point of view, the WG concluded that the sensitivity to model formulation can be bounded by the base case and the environmentally-forced recruitment run. The model run that allowed dome-shaped selectivity did not converge.

The WG reviewed some preliminary calculations of biological reference points for striped marlin. The growth curve, maturity at age probabilities, and fishery selectivities were taken from the base case assessment model for input to the yield-per-recruit and spawning-biomass-per-recruit calculations. The reference points were computed using the NOAA Fisheries Toolbox software YPR version 2.6.2 using a quarterly time step for age and a quarterly natural mortality rate of M=0.075. As a result, the output reference points, $F_{0.1}$, F_{MAX}, and $F_{\%MSP}$, were quarterly fishing mortality values. It was noted that the plus-group age was 10 years and that it would be useful to increase the plus-group age to cover fish that are over 200 cm EFL. The WG concluded that the reference point calculations were useful and should be refined to incorporate enough age groups to represent the size range of the catch. It was also suggested that selectivity from the environmentally-forced recruitment run could be used to characterize some of the uncertainty in the biological reference points. An alternative suggestion was to characterize the uncertainty in growth using the variability in the published growth curve. Overall, the WG concluded that the quarterly biological reference points would likely be useful for characterizing stock status, but did not recommend any particular reference point for striped marlin.

6.0 ADOPT ASSESSMENT AND CRAFT STOCK STATUS – STRIPED MARLIN

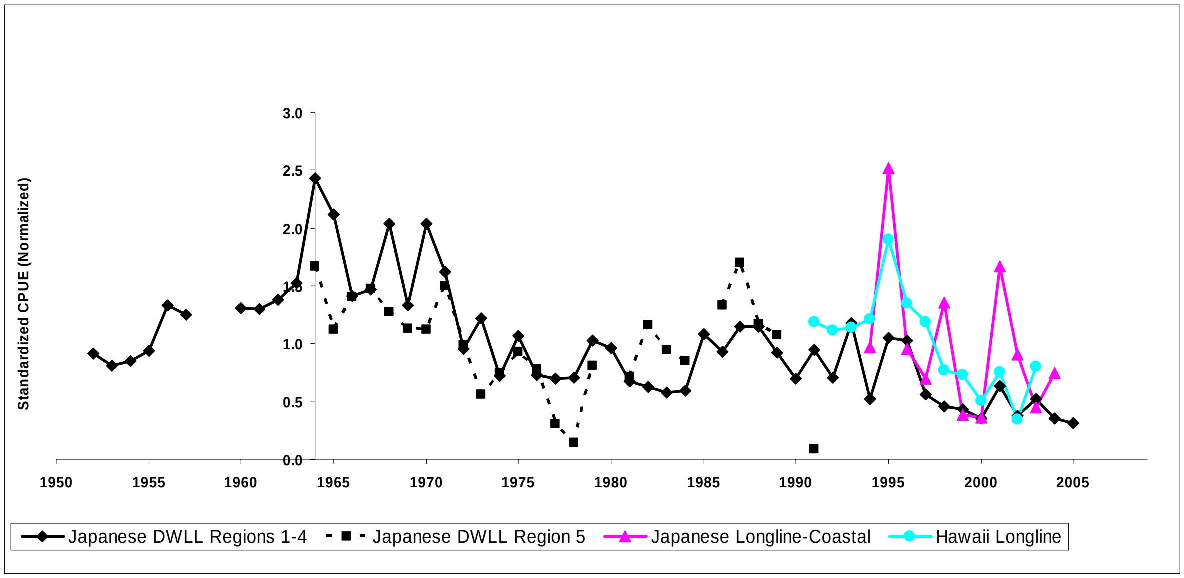
Striped marlin landings increased rapidly from a low level in 1953 to peak levels during 1964-70; then began a steady decline (with year-to-year fluctuation) through recent years (Fig.7). Recent landings have been comparable to those taken in the mid-1950's. The period of declining landings (after 1970) corresponds with the period in which the Japanese DWLL fishery transitioned to deeper fishing operations in order to better target bigeye tuna. However, the majority of Pacific-wide striped marlin landings in most years have been taken by the Japanese DWLL fishery in the northwest Pacific (Region 1) – an area north of the principal bigeye tuna fishing grounds.

Figure 7. Striped marlin landing (mt), 1952-2003



The available standardized CPUE indices for striped marlin (1962-2005; Fig.8) declined over the first decade (mid-1960's through mid-1970's); then exhibited a relatively flat trend (with year-to-year fluctuation) over the next two decades (mid-1970's through mid-1990's); and then generally declined (with year-to-year fluctuation) over the final decade (mid-1990's through mid-2000's). These CPUE indices – all derived from longline fisheries – can be considered roughly proportional to the number of spawners in the population (ages 5+); and are highly influential in the population modeling.

Figure 8. Striped marlin standardized CPUE, 1952-2005. CPUE indices prior to 1964 were not used in the assessment due to the rapid areal expansion of the Japanese DWLL fishery and limited logbook coverage during the startup years (1952-63).



Using the SS2 population model, extensive sensitivity analyses were carried out prior to the WG meeting using data available as of early March 2007 (ISC/07/MARWG&SWOWG-1/02). At this meeting, the WG updated several sources of input data and refined the SS2 modeling considerably; after which, an additional seven sensitivity runs were carried out. The sensitivity analyses indicated that the principal axis of uncertainty for the striped marlin stock assessment and status of stocks determination appears to be the underlying recruitment process – particularly in the early years (1952 through the late 1960's). Two recruitment scenarios were considered: (i) assuming that the recruitment process is driven by the standing stock of spawning biomass (SSB) the previous year with an assumed steepness of h=0.7 (Run1); and (ii) assuming that recruitment is largely environmentally-driven and independent of SSB at least until very low stock sizes are reached (Run2).

SSB estimates from both Run1 and Run2 are similar for the period 1970-2005 (Fig.9). During this period, length samples of the catch are available and these samples are used to better estimate the size/age structure of the striped marlin population – an important aspect when estimating SSB. These SSB estimates are robust to the assumed recruitment dynamics. It is also noteworthy that SSB during the period 1980-2005 exhibited relatively little year-to-year variability (both models). This is the period after which the Japanese DWLL fleet completed its transition to deeper fishing for bigeye tuna. This period was modeled (in SS2) with a separate selectivity from the earlier years to allow for concomitant change in the size/age structure of the striped marlin catch. Prior to 1970, however, Run1 and Run2 estimates of SSB differ markedly and are quite sensitive to the assumed recruitment dynamics. It is useful to consider the SSB level in 2005 relative to several earlier benchmark years (Table 1).

Figure 9. Spawning Stock Biomass (mt), 1952-2005.

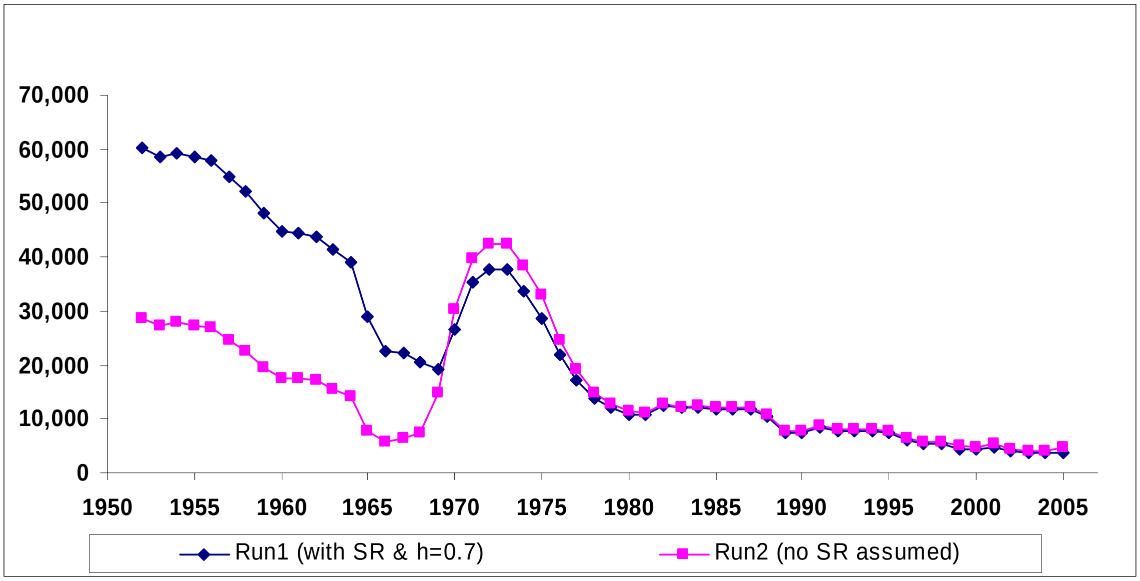


Table 1. SSB estimated in 2005 as a percentage of the SSB estimated in 1952, 1970, and 1980 for Run1 (with SR and h=0.7) and Run2 (no SR assumed).

	1952	**1970**	**1980**
Run1	6%	14%	35%
Run2	16%	15%	40%

As with the estimates of SSB, the fishing mortality rate estimates (F) on the spawning stock (ages 5+) over the period 1970-2003 are not greatly sensitive to the assumed recruitment dynamics (Fig.10). Run1 and Run2 estimates of F exhibit the same trend and approximately the same magnitude in most years of this period. The "current F", $0.7yr^{-1}$ (2001-03 average), is considerably greater than the corresponding F's in early decades (Table 2). Prior to 1970 (when length samples of the catch were not available), F estimates were more variable but the Run2 estimates were consistently greater than those from Run1.

Figure 10. Fishing Mortality Rate (F) on Spawners (Ages 5+), 1952-2003.

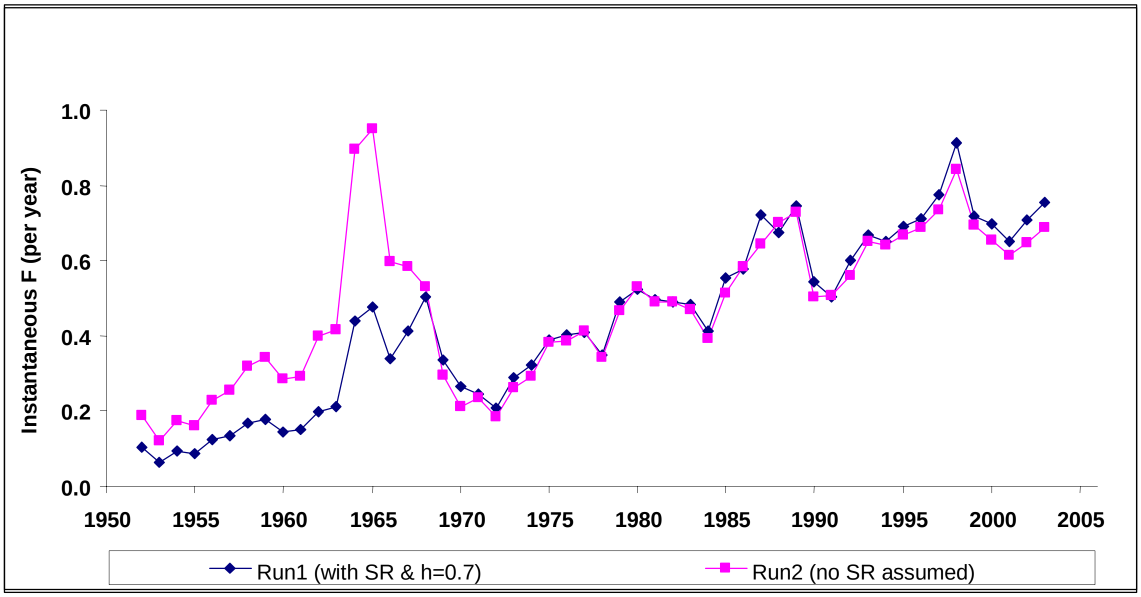
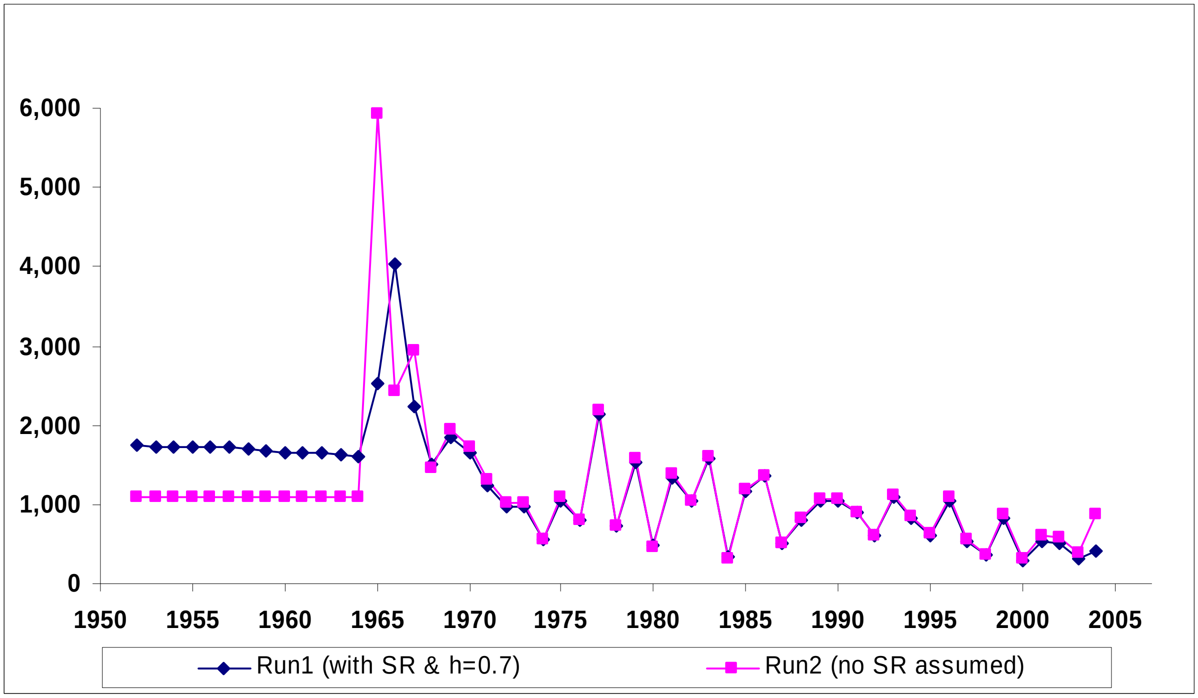


Table 2. Ratio of "current F" (2001-03) to the corresponding F estimated in earlier key years (1970 and 1980) for Run1 (with SR and h=0.7) and Run2 (no SR assumed). 1970 represents the start of the decade in which the Japanese DWLL fishery transitioned to deep-water longlining for bigeye tuna. By 1980, the transition was complete and bigeye has remained the principal target through recent years.

	1970	**1980**
Run1	2.9	1.4
Run2	3.3	1.3

As expected, striped marlin recruitment estimates (age 0) prior to 1970 are greatly influenced by the assumed recruitment dynamics, i.e. Run1 or Run2 (Fig.11). But after 1970, recruitment declined steadily (with year-to-year fluctuation) for both models. Recruitment in recent years has been approximately one-half the level estimated in the early 1970's.

Figure 11. Recruitment (Age 0 in 1000's), 1952-2004.



The status of striped marlin in the North Pacific Ocean is difficult to determine with certainty. The species is wide-ranging and vulnerable to longline and other fisheries in both coastal areas and on the high seas. However, it has not been consistently targeted by these fisheries and as bycatch, its catch rates (e.g. fish per 1000 hooks) in some parts of its range can be low enough to be considered "rare events." The possible effects of IUU catches throughout the assessment period (1952-2005) are not known. While some Japanese DWLL effort was directed at striped marlin (in Regions 3 and 5 during the early 1960's through the early 1970's), a large portion of the recorded striped marlin catch has been taken as bycatch in the Japanese DWLL fishery. The standardized CPUE from this fishery serves as a critical index of abundance for the stock assessment. However, the Japanese DWLL fishery has undergone significant structural and operational changes over the assessment period (e.g. increased targeting of bigeye); and while statistical models have been used to account for these changes, it is quite possible that some important effects have yet to be determined. Finally, a range of biological uncertainties (e.g. maturity schedule, growth rates, stock structure, etc.) further complicate interpretation of the fisheries and abundance data.

However, with these caveats in mind and focusing on the assessment results since 1970, there are aspects of the stock assessment that may be cause for concern regarding the status of the striped marlin in the North Pacific Ocean. Namely:

1. landings and indices of abundance have declined markedly since 1970 (Fig. 7 and 8);
2. estimates of recent SSB are low compared to earlier periods in the assessment time series, e.g. approximately 15% of the SSB in 1970 (Fig.9 and Table 1);

3. fishing mortality rates have increased steadily and current level ($F \approx 0.7\ yr^{-1}$) is not likely to be sustainable (Fig.10 and Table 2); and
4. recruitment has been steadily declining and there is no evidence that strong year-classes have or are about to enter the fishery (Fig.11).

It is imperative that biological reference points and control rules be developed to guide striped marlin management. Scientific efforts to improve data quality, biological understanding, and analysis methodology should be given high priority.

7.0 STOCK STRUCTURE – SWORDFISH

Robert Humphreys reviewed available biological information on larval distribution, young-of-year (YOY) juvenile occurrence, and tagging information for North Pacific swordfish. On either side of the equator in the western and central Pacific, high occurrence areas of swordfish larvae (as recorded in Nishikawa et al. 1985) occur in the subtropical and tropical regions below 30° latitude whereas highest swordfish fishery CPUEs are associated with areas above 30° latitude in both hemispheres. The absence of swordfish larvae recorded from along the entire Pacific coast of the Americas is probably a reflection of the lack of significant effort (few plankton surveys) and for the coastal areas off Peru and Chile, the lack of warmer water conditions ≥24°C.

Humphreys pointed out that observations of females in advanced reproductive development have been recorded within the Northeast Pacific Ocean (NEPO) as well as the occurrence of YOY juveniles (60-90 cm EFL) in the longline catches within the NEPO. As these YOY juveniles are likely not migratory during this early life history stage where accelerated linear growth occurs without substantial increases in body weight, their recorded occurrence in the NEPO is interpreted as evidence of spawning in the region.

Humphreys presented a brief review of tagging studies on swordfish. During the 1990s and early 2000s, both traditional dart tagging and PSAT tagging had been conducted in the area of Hawaii and north of Hawaii on the grounds of the Hawaii-based swordfish longline fishery. During 2000-2003, 28 swordfish were tagged with PSAT tags. Only a small fraction of these tags provided information and those that did released prematurely, typically after 2-3 weeks. Researchers in the Pacific and Atlantic are both encountering problems with attempts to achieve long-term deployments of PSAT tags on swordfish. Traditional tag-and-release studies of swordfish suffer from low tag recovery rates (typically 1% for swordfish and istiophorids) and this has also been encountered in the Hawaii tagging studies. Unlike long distance tag recoveries made previously for blue and black marlin in the Pacific, there have been no recoveries for swordfish that traversed more than halfway across the Pacific. Unfortunately, the lack of substantial tag returns and the short PSAT tag deployments have yet to provide enough information to help establish whether swordfish undergo long distance movement patterns in the Pacific.

7.1 ISC/07/MARWG&SWOWG-1/13

Michael Hinton presented information on the stock structure of swordfish in the North Pacific Ocean. Various studies of swordfish genetics have shown that there are between two and four stocks of swordfish in the Pacific. Analyses of stock status of swordfish in the Pacific have assumed a number of stock structures based on catch rate and catch distributions derived from longline fisheries covering various time periods. At this point, the best scientific evidence available, based on genetic and fisheries analyses, indicates that there are four stocks of swordfish in the Pacific, including one centered in the northeast Pacific and one centered in the northwest Pacific. Further genetic studies and analyses of fisheries data and oceanography are in progress.

Discussion. The WG agreed that it would be practical to consider any stock structure genetics evidence provisional. There is also a need to have additional tagging data and morphometric measures to complement the genetic evidence, and more temporal sampling in order to evaluate whether genetic patterns are consistent over time.

Statistical techniques that are currently available to estimate mixed population composition were also discussed. It should be possible to apply such techniques to the current genetic data that was presented. Unfortunately, this might take a considerable amount of time and expertise. As a pragmatic approach toward the need for the WG to proceed with a swordfish assessment under the auspices of the ISC, a single north Pacific swordfish stock will be assumed during the initial modeling work of the stock assessment

8.0 IDENTIFY ASSESSMENT MODELING PLATFORM - SWORDFISH

The group reviewed the submitted four abundance indices of the North Pacific swordfish, from the view point of their use for assessing the short term changes in stock level. While the coverage of data and the methods used in the estimation of these four abundance indices were different, the WG noted that these four indices are suitable for the evaluating stock levels changes.

The WG also recognized that an abundance index from the northeastern Pacific area was not available at the meeting, and IATTC was asked to submit it to the chairman by the 15th of June.

The WG briefly discussed possible stock assessment models to assess North Pacific swordfish and agreed it was premature due to missing data sets. The WG did agree the model selection will depend on the availability of data and testing multiple models should be used.

The major issues to be considered in the stock analysis of North Pacific swordfish are its differential growth by sex, as well as the possible existence of multiple stocks in the North Pacific Ocean. Because this is the first North Pacific-wide swordfish assessment within the ISC, the group agreed to start with a simple approach, i.e. a single north Pacific wide stock with similar growth by sex.

9.0 SCHEDULE TO COMPLETE ASSESSMENT – SWORDFISH

Robert Humphreys presented a work plan to complete a rigorous North Pacific swordfish stock assessment by July 2008. The timing of this assessment was discussed at the 6th Meeting of the ISC Plenary and subsequently endorsed. While some preparatory data activities were completed during this workshop, which will carry over to the July 2007 workshop meeting, the work plan fully commences in August 2007 and includes three workshop meetings; two intercessional workshop meetings (November 2007 & March 2008) and one workshop meeting just prior to the 8th Meeting of the ISC Plenary. (Area stratification will need to be defined at the July 2007 meeting.)

10.0 WORLD SWORDFISH MEETING

Gerard DiNardo provided an update on the World Swordfish Meeting. The goal of the meeting is to bring together scientists from a broad scope of disciplines to discuss our current state of knowledge. Possible meeting themes would include physiology, genetics, ecology, movement, life history, stock structure, stock status, management strategies, and the role of swordfish in the pelagic ecosystem. DiNardo discussed location options; including linking the meeting with an already planned meeting such as the World Fisheries Congress Meeting being held in Yokohama, Japan in late 2008 or the next International Billfish Symposium.

11.0 FUTURE WORKPLAN

11.1 Report Format

Gerard DiNardo reported that in future reports, a new section will be incorporated. This new section will include future work that will be the responsibility of the Chairman, as well as future work that the participants of the WG have agreed to complete. It will be made clear in future reports as to who will be responsible for the work, what it will entail, and when it should be available by.

11.2 Research Recommendations

Throughout the workshop, the WG identified a suite of potential research topics and those requiring a significant investment (both time and money) are listed below.

1) Expansion of data collection to cover all marlin species

With the completion of the striped marlin stock assessment, the focus of the MARWG will shift to blue marlin, possibly followed by another billfish species (e.g. sailfish). To facilitate this expansion in species, the WG recommended that member countries provide

Category I, II, and III data on all marlin species. These data should be collected and compiled by the ISC Statistics and MARWG, and each national correspondence should submit the data. The WG also encouraged members to submit all biological information on other marlins at the WG meetings.

2) Collection of Category I, II, and III data

Despite repeated attempts by the marlin and swordfish WG Chairs to acquire all Category I, II, and III data, some member countries have not provided fishery specific data, such as the high seas drift net fishery of Korea and Taiwan, and all fisheries of China. In addition, many non member countries of ISC such as Philippines, some mid American countries and FFA countries, and Spain are known to catch billfishes in the north Pacific. The lack of information of Category I, II and III data impedes stock assessment activities and decreases the reliability of the assessment outputs. The chairmen will continue to request the necessary data, but assistance from the ISC Chairman is required to resolve this issue.

3) Collection of biological information

Limited biological information on swordfish and marlins was reported. The group agreed to keep recommendations covering the collection of biological information of swordfish and marlins listed in previous meetings, and agreed to continue the working plan established during previous meetings to collect these data.

4) Improvement of reliability of estimated abundance indices

There were many issues raised during the meeting regarding the reliability of the reported abundance indices of striped marlin and swordfish. WG members should make every effort to improve the reliability of these abundance indices.

5) Fleet combined analysis of catch and effort data

The group noticed that the data of any single fleet does not cover the entire distribution area of swordfish and marlins in the north Pacific, especially in recent years, and different fleets adapt different fishing strategies in the north Pacific. The quality of data and information collected thought the logbook systems are also different among fleets using same gear. Such kind of complexity in the estimation of abundance/biomass indices could bias subsequent stock assessments. Thus, the group recognized that the analysis of fleets combined catch and effort data would have benefit for increasing the representation and reliability of the indices used in the assessment models. Scientists working on the analysis of catch and effort data should work together on this issue.

6) CPUE standardization WG (or committee)

To encourage the works recommended in items 4) and 5), and for the convenience of members working on the study of CPUE standardization, the group agreed to establish a small CPUE standardization committee. Kanaiwa and Yokawa, with the support and the advise of the ISC marlin and swordfish WG Chairs, will coordinate the activities of this committee. A work plan of for the committee will be discussed at the next WG meeting held in July, 2007. Possible items to be considered are listed in Attachment 4.

7) Management of fisheries in IATTC area

The upcoming swordfish stock assessment will treat fish in the North Pacific as a single stock. Currently, future swordfish assessments conducted by the IATTC will treat swordfish in the northern EPO as a separate stock. In an effort to optimize efforts among the organizations the WG was asked to produce results under an alternative stock structure scenario that included a separate northern EPO assessment that could be used by the IATTC. The WG discussed this request, and for practical reasons, agreed that this request should be covered in the course of evaluating the results of Pacific-wide stock assessments and preparing the management recommendation based on it.

11.3 Assignments

- Chairman
    - Contact Luis Fleischer, the contact for Mexican data on the marlin and swordfish fishery (ISC/07/MARWG&SWOWG-1/04), to request that the swordfish catch, effort, and CPUE series be decomposed annually by gear.
    - Contact William Walsh, the contact regarding swordfish catch rates in the Hawaii-based longline fishery (ISC/07/MARWG&SWOWG-1/07), to request that the CPUE serious should be re-expressed on an annual basis to be consistent and comparable with similar series fro other Pacific Ocean swordfish fisheries.
    - Explore options of linking the World Swordfish Meeting with an established meeting, such as the World Fisheries Congress Meeting or the next International Billfish Symposium.

- WG participants
    - The IATTC agreed to submit a swordfish abundance index from the northeastern Pacific area to the chairman by the June 15, 2007.

12.0 FUTURE MEETING

The next meeting for the ISC MARWG and SWOWG will be held in July 2007 preceding the ISC Plenary Meeting, in Pusan, Korea. The workshop will last 2 days and will be located at the Sangnam International House on the Busan National University campus. The Chairman will email the WG members about possible locations and dates for the November 2007 intercessional meeting.

13.0 ADJOURNMENT

The workshop was adjourned at 14:00 on 26 March 2007. The Chairman's expressed their appreciation to the rapporteurs and to all participants for their contributions and cooperation in completing a successful meeting. The Chairs recognized the efforts and contributions of our hosts (National Taiwan University and the Fisheries Agency) and expressed their appreciation to Dr Chi-Lu Sun for his gracious hospitality.

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[1,2]					Costa Rica[1]	Korea			Mexico			United States					
Year	Distant-water and Offshore Longline	Coastal Longline	Other Longline	Small Mesh Gillnet	Large Mesh Gillnet	Other[3]	Total	Distant-water Longline	High seas Drift Gillnet	Offshore Longline	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	0	1,564	5,187					-		-		0			0				23	23	5,210
1953	2,138		47	0	0	954	3,139					-		-		0			0				5	5	3,144
1954	3,068		52	0	0	1,088	4,208					-		-		0			0				16	16	4,224
1955	3,082		28	0	0	1,038	4,149					-		-		0			0				5	5	4,154
1956	3,729		59	0	0	1,996	5,785					-		-		0			0				34	34	5,819
1957	3,189		119	0	0	2,459	5,766					-		-		0			0				42	42	5,808
1958	4,106		277	0	3	2,914	7,301					-		-		0			0				59	59	7,360
1959	4,152		156	0	2	3,191	7,501					-		-		0			0				65	65	7,566
1960	3,862		101	0	4	1,937	5,905					-		-		0			0				30	30	5,935
1961	4,420		169	0	2	1,797	6,388					-		-		0			0				24	24	6,412
1962	5,739		110	0	8	1,912	7,770					-		-		0			0				5	5	7,775
1963	6,135		62	0	17	1,910	8,124					-		-		0			0				68	68	8,192
1964	14,304		42	0	2	2,344	16,691			560	199	759		-		0			0				58	58	17,508
1965	11,602		19	0	1	2,796	14,418			392	175	567		-		0			0				23	23	15,008
1966	8,419		112	0	2	1,573	10,106			356	157	513		-		0			0				36	36	10,655
1967	11,698		127	0	3	1,551	13,379	2		385	204	591		-		0			0				49	49	14,018
1968	15,913		230	0	3	1,040	17,186	1		332	208	541		-		0			0				51	51	17,778
1969	8,544	600	3	0	3	2,630	11,780	2		571	192	765		-		0			0				30	30	12,575
1970	12,996	690	181	0	3	1,029	14,899	0		495	189	684		-		0			0				18	18	15,601
1971	10,965	667	259	0	10	2,016	13,917	0		449	135	584		-		0			0				17	17	14,518
1972	7,006	837	145	0	243	990	9,221	9		380	126	515		-		0			0				21	21	9,757
1973	6,299	632	118	0	3,265	630	10,944	1		568	139	708		-		0			0				9	9	11,660
1974	6,625	327	49	0	3,112	775	10,888	24		650	118	792		-		0			0				55	55	11,735
1975	5,193	286	38	0	6,534	685	12,736	64		732	96	892		-		0			0				27	27	13,655
1976	4,996	244	34	0	3,561	571	9,406	32		347	140	519		-		0			0				31	31	9,956
1977	2,722	256	15	0	4,424	547	7,964	17		524	219	760		-		0			0				41	41	8,766
1978	2,464	243	27	0	5,593	418	8,745	0		618	78	696		-		0			0				37	37	9,478
1979	4,898	366	21	0	2,532	526	8,343	26		432	122	580		-		0			0				36	36	8,960
1980	5,871	607	5	0	3,467	537	10,488	61		223	132	416		-		0			0				33	33	10,937
1981	3,957	259	12	0	3,866	538	8,632	17		491	95	603		-		0			0				60	60	9,295
1982	5,211	270	13	0	2,351	655	8,500	7		397	138	542		-		0			0				41	41	9,083
1983	3,575	320	10	22	1,845	792	6,564	0		555	214	769		-		0			0				39	39	7,373
1984	3,335	386	9	76	2,257	719	6,782	0		965	339	1,304		-		0			0				36	36	8,122
1985	3,698	711	24	40	2,323	732	7,528	0		513	181	694		-		0			0				42	42	8,263
1986	5,178	901	33	48	3,536	571	10,267	0		179	148	327		-		0	-		0				19	19	10,614
1987	5,439	1,187	6	32	1,856	513	9,033	31		383	151	565		-		0	-		0	272	30	1	28	331	9,928
1988	5,768	752	7	54	2,157	668	9,406	7		457	169	633		-		0	-		0	504	54	1	30	589	10,628

Table 3. Continued

	Japan							Chinese Taipei[1,2]					Costa Rica[1]	Korea			Mexico			United States					
Year	Distant-water and Offshore Longline	Coastal Longline	Other Longline	Small Mesh Gillnet	Large Mesh Gillnet	Other[3]	Total	Distant-water Longline	High seas Drift Gillnet	Offshore Longline	Other	Total	Sport	Longline	High-seas Drift Gillnet	Total	Longline	Sport[1]	Total	Longline	Troll	Handline	Sport[1]	Total	Grand Total
1989	4,582	1,081	13	102	1,562	537	7,877	8		184	157	349		-		0	-		0	612	24	0	52	688	8,914
1990	2,298	1,125	3	19	1,926	545	5,916	2		137	256	395		-		0	-	181	181	538	27	0	23	588	7,079
1991	2,677	1,197	3	27	1,302	506	5,712	36		254	286	576	106	-		0	-	75	75	663	40	0	12	715	7,184
1992	2,757	1,247	10	35	1,169	302	5,520	1		219	197	417	281	-		0	-	142	142	459	38	1	25	523	6,884
1993	3,286	1,723	1	0	828	443	6,281	5		221	142	368	438	-		0	-	159	159	471	68	1	11	551	7,796
1994	2,911	1,284	1	0	1,443	383	6,022	1		137	196	334	521	-		0	-	179	179	326	34	0	17	377	7,433
1995	3,494	1,840	3	0	970	278	6,585	27		83	82	192	153	-		0	-	190	190	543	52	0	14	609	7,729
1996	1,951	1,836	4	0	703	152	4,646	26		162	47	235	122	348		348	-	237	237	418	54	1	20	493	6,081
1997	2,120	1,400	3	0	813	163	4,499	59		290	47	396	138	828		828	-	193	193	352	38	1	21	412	6,466
1998	1,784	1,975	2	0	1,092	304	5,157	90		205	50	345	144	519		519	-	345	345	378	26	0	23	427	6,937
1999	1,608	1,551	4	0	1,126	183	4,472	66		128	42	236	166	352		352	-	266	266	364	28	1	12	405	5,897
2000	1,152	1,109	8	0	1,062	297	3,628	153		161	55	369	97	436		436	-	312	312	200	14	1	10	225	5,067
2001	985	1,326	11	0	1,077	237	3,636	121		129	51	301	151	206		206	-	237	237	351	42	2		395	4,926
2002	764	795	5	0	1,264	291	3,119	251		226	29	506	76	153		153	-	305	305	226	29	0		255	4,414
2003	1,008	826	3	0	1,064	203	3,104	241		91	43	375	79	172		172	-	322	322	538	28	0		566	4,618
2004	(761)	(964)	(2)	(0)	(1,339)	(90)	(3,066)	261		95	24	380	(19)	(75)		(75)	-	-	0	(384)	(56)	(2)		(442)	(3,768)
2005	(803)						(803)	176		76	32	284	-	(115)		(115)	-	-	0	(377)	-	-		(377)	(1,465)

[1]Estimated from catch in number of fish.

[2]Data from assessment table.

[3]Contains 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]						Grand
															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	Other	Total	Longline	All Gears	Longline	Longline	Gill Net	Harpoon	Unknown[7]	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	13,611	-	-		-	-	-	-	-	-	-	-	-	13,611
1955	13,064	29	0	821	119	37	41	14,111	-	-		-	-	-	-	-	-	-	-	-	14,111
1956	14,596	10	0	775	66	31	7	15,485	-	-		-	-	-	-	-	-	-	-	-	15,485
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	18,268	-	-		-	-	-	-	-	-	-	-	-	18,268
1960	20,058	51	1	1,191	23	67	7	21,400	-	-		-	-	-	-	-	-	-	-	-	21,400
1961	19,715	51	2	1,335	19	15	11	21,147	-	-		-	-	-	-	-	-	-	-	-	21,147
1962	10,607	78	0	1,371	26	15	18	12,115	-	-		-	-	-	-	-	-	-	-	-	12,115
1963	10,322	98	0	747	43	17	16	11,243	-	-		-	-	-	-	-	-	-	-	-	11,243
1964	7,669	91	4	1,006	42	17	28	8,858	-	343	18	361	-	-	-	-	-	-	-	-	9,219
1965	8,742	119	0	1,908	26	14	182	10,991	-	358	10	368	-	-	-	-	-	-	-	-	11,359
1966	9,866	113	0	1,728	41	11	4	11,764	-	331	27	358	-	-	-	-	-	-	-	-	12,122
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	5	11,327	0	843	7	850	-	-	-	-	-	-	-	-	12,177
1970	7,324	427	0	1,748	36	9	1	9,545	-	904	5	909	-	-	5	-	-	612	10	627	11,081
1971	7,037	350	1	473	17	37	0	7,915	-	992	3	995	-	-	1	-	-	99	3	103	9,013
1972	6,796	531	55	282	20	1	1	7,686	-	862	11	873	-	2	0	-	-	171	4	175	8,736
1973	7,123	414	720	121	27	23	2	8,430	-	860	119	979	-	4	0	-	-	399	4	403	9,816
1974	5,983	654	1,304	190	27	16	1	8,175	1	880	136	1,017	-	6	0	-	-	406	22	428	9,626
1975	7,031	620	2,672	205	58	18	2	10,606	29	899	153	1,081	-	-	0	-	-	557	13	570	12,257
1976	8,054	750	3,488	313	170	14	1	12,790	23	613	194	830	-	-	0	-	-	42	13	55	13,675
1977	8,383	880	2,344	201	71	7	1	11,887	36	542	141	719	-	-	17	-	-	318	19	354	12,960
1978	8,001	1,031	2,475	130	110	22	1	11,770	-	546	12	558	-	-	9	-	-	1,699	13	1,721	14,049
1979	8,602	1,038	983	161	45	15	1	10,845	7	661	33	701	-	7	7	-	-	329	57	393	11,946
1980	6,005	849	1,746	398	30	15	1	9,045	10	603	76	689	-	380	5	-	160	566	62	793	10,907
1981	7,039	727	1,848	129	59	10	0	9,812	2	656	25	683	-	1,575	3	1	461	267	20	752	12,822
1982	6,064	874	1,257	195	58	7	0	8,546	1	855	49	905	-	1,365	5	2	911	156	43	1,117	11,933
1983	7,692	999	1,033	166	30	9	2	9,931	0	783	166	949	-	120	5	1	1,321	58	378	1,763	12,763
1984	7,177	1,177	1,053	117	98	13	0	9,635	-	733	264	997	-	47	3	14	2,101	96	678	2,892	13,571
1985	9,335	999	1,133	191	69	10	0	11,737	-	566	259	825	-	18	2	46	2,368	211	792	3,419	15,999
1986	8,721	1,037	1,264	123	47	9	0	11,201	-	456	211	667	-	422	2	4	1,594	236	696	2,532	14,822
1987	9,495	860	1,051	87	45	11	0	11,549	3	1328	190	1,521	-	550	24	4	1,287	211	300	1,826	15,446
1988	8,574	678	1,234	173	19	8	0	10,686	-	777	263	1,040	-	613	24	19	1,092	180	344	1,659	13,998

Table 4. Continued

	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	Other	Total	Longline	All Gears	Longline	Longline	Gill Net	Harpoon	Unknown[7]	Total	Grand Total
1989	6,690	752	1,596	362	21	10	0	9,431	50	1,491	38	1,579	-	690	218	29	1,050	54	224	1,575	13,275
1990	5,833	690	1,074	128	13	4	0	7,742	143	1,309	154	1,606	-	2,650	2,436	18	1,028	50	137	3,669	15,667
1991	4,809	807	498	153	20	5	0	6,292	40	1,390	180	1,610	-	861	4,508	39	836	16	137	5,536	14,299
1992	7,234	1,181	887	381	16	6	0	9,705	21	1,473	243	1,737	-	1,160	5,700	95	1,332	74	44	7,245	19,847
1993	8,298	1,394	292	309	43	4	1	10,341	54	1,174	310	1,538	-	812	5,909	165	1,400	169	36	7,679	20,370
1994	7,366	1,357	421	308	37	4	0	9,493	-	1,155	219	1,374	-	581	3,176	740	799	153	8	4,876	16,324
1995	6,422	1,387	561	440	17	7	0	8,834	50	1,135	225	1,410	-	437	2,713	279	755	96	31	3,874	14,555
1996	6,916	1,067	428	633	9	4	0	9,057	9	701	31	741	12	439	2,502	347	752	81	10	3,692	13,941
1997	7,002	1,214	365	396	11	5	0	8,993	15	1,358	61	1,434	246	2,365	2,881	664	707	84	3	4,339	17,377
1998	6,233	1,190	471	535	9	2	0	8,441	20	1,178	41	1,239	123	3,603	3,263	422	924	48	13	4,670	18,076
1999	5,557	1,049	724	461	2	5	0	7,798	70	1,385	61	1,516	104	1,136	3,100	1,333	606	81	2	5,122	15,676
2000	6,180	1,121	808	539	7	5	1	8,661	325	1,531	86	1,942	161	2,216	2,949	1,908	646	90	9	5,602	18,582
2001	6,932	908	732	255	5	15	0	8,848	1,039	1,691	91	2,821	349	780	220	1,763	375	52	5	2,415	15,213
2002	6,230	965	1,164	222	8	11	0	8,600	1,633	1,557	27	3,217	350	465	204	1,320	302	90	3	1,919	14,551
2003	5,352	1,039	1,198	167	10	4	0	7,770	1,084	2,196	11	3,291	311	671	147	1,812	216	107	0	2,282	14,325
2004	(6165)	1,454	1,339	33	33	23	1	(9,048)	884	1,828	16	2,728	(350)	270.1	(213)	(898)	182	89	(37)	(1,419)	(14,883)
2005	(6972)							(6,972)	437	1,813	26	2,276	(407)	234.5	(1,360)	-	219	73	(0)	(1,652)	(13,506)
2006														347.2							

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

[4]For 1952-1970 "Other" refers to catches by other baitfishing methods, trap nets, and various upspecified 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…(Al Coan to provide footnote)

Attachment 1. List of Participants

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Attachment 2. Working Papers and Background Papers

WORKING PAPERS

ISC/07/MARWG&SWOWG-1/01. Using the EM Algorithm to Predict Catch-Per-Unit Effort of Striped Marlin by the Japanese Distant Water Longline Fleet in Region 5. (J. Brodziak)

ISC/07/MARWG&SWOWG-1/02. SS2 Sensitivity Runs for Striped Marlin Assessment WG 2007. (K. Piner, R. Conser, G.DiNardo, J. Brodziak)

ISC/07/MARWG&SWOWG-1/03. U.S. Swordfish Fisheries in the North Pacific Ocean. (R.Y. Ito, A.L. Coan, Jr.)

ISC/07/MARWG&SWOWG-1/04. Mexican Progress Report on the Marlin and Swordfish Fishery. (L.A. Fleischer, A. Klett Traulsen, P.A. Ulloa Ramirez)

ISC/07/MARWG&SWOWG-1/05. Brief Description of Taiwan fisheries with incidental catch of swordfish and striped marlin in the North Pacific Ocean. (Fisheries Agency C.O.A., Overseas Fisheries Development Council)

ISC/07/MARWG&SWOWG-1/06. Sex Ratio and Size Composition of Striped Marlin (*Tetrapturus audax*) in Waters off Eastern Taiwan. (W.C. Chiang, C.L. Sun, S.Z. Yeh, W.Y. Chen, W.C. Su)

ISC/07/MARWG&SWOWG-1/07. Observed Swordfish (*Xiphias gladius*) Catch Rates in the Hawaii-based Longline Fishery, 1994-2006. (W. Walsh)

ISC/07/MARWG&SWOWG-1/08. Standardization of Taiwanese distant water tuna longline catch rates for swordfish in the North Pacific Ocean. (S.Z. Yeh, C.L. Sun, S.P. Wang, Y.J. Chang)

ISC/07/MARWG&SWOWG-1/09. Preliminary analysis of CPUE of swordfish caught by Japanese coastal longliners in the northwest Pacific. (K. Yokawa)

ISC/07/MARWG&SWOWG-1/10. Updates of standardized CPUE of swordfish caught by Japanese offshore and distant longliners in the North Pacific. (M. Ichinokawa, K. Yokawa)

ISC/07/MARWG&SWOWG-1/11. Preliminary result about the effect of the difference in data distribution. (M. Kanaiwa)

ISC/07/MARWG&SWOWG-1/12. Suggestion for evaluating statistical methods to estimate abundance indices. (M. Kanaiwa, Y. Takeuchi, M. Ichinokawa, K. Yokawa)

ISC/07/MARWG&SWOWG-1/13. Stock structure of swordfish in the north Pacific. (M.G. Hinton, J.R. Alvarado-Bremer)

ISC/07/MARWG&SWOWG-1/14. Test of the performance of age-structured model for striped marlin in the North Pacific. (S.P. Wang, C.L. Sun, S.Z. Yeh, G. DiNardo, W.C. Chiang, S.K. Chang)

BACKGROUND PAPERS

Benjamini, Y., Hochberg, Y. 1995. Controlling the False Discovery Rate: a Practical and Powerful Approach to Multiple Testing. Journal of the Royal Statistical Society B, Volume 57, No.1, pp.289-300.

Waples, R.S. 1998. Separating the Wheat from the Chaff: Patterns of Genetic Differentiation in High Gene Flow Species. The American Genetic Association, 89:438-450.

Working Papers for ISC joint intercessional MAR & SWO-WG Workshop in November 2006 (Shimizu, Japan):

Ito, R., Coan, A.L. Jr. 2006. U.S. Swordfish Fisheries in the North Pacific Ocean. Joint Intercessional Workshop of the ISC Marlin and Swordfish Working Group, Shimizu, Japan. ISC/06/MARWG&SWOWG-2/09.

Sun C.L., Yeh, S.Z., Wang, S.P. 2006. Standardization of Taiwanese Tuna Longline catch rates for striped marlin in the North Pacific Ocean. Joint Intercessional Workshop of the ISC Marlin and Swordfish Working Group, Shimizu, Japan. ISC/06/MARWG&SWOWG-2/06.

Sun C.L., Yeh, S.Z., Wang S.P., Chang Y.J., Chiang W.C. 2006. An update on landing and sex-specific size composition data of striped marlin and swordfish in the Taiwanese offshore and coastal fisheries. Joint Intercessional Workshop of the ISC Marlin and Swordfish Working Group, Shimizu, Japan. ISC/06/MARWG&SWOWG-2/02.

Uchiyama, J.H., Humphreys, R.L.Jr. 2006. Updated review table of vital rates and life history parameters for striped marlin, swordfish, and blue marlin in the North Pacific Ocean. Joint Intercessional Workshop of the ISC Marlin and Swordfish Working Group, Shimizu, Japan. ISC/06/MARWG&SWOWG-2/03.

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Ito, R.Y., Coan, A.L. Jr. 2006. U.S. Swordfish Fisheries in the North Pacific Ocean. Joint Intercessional Workshop of the ISC Marlin and Swordfish Working Groups, Shimizu, Japan. ISC/06/MAR&SWO-WGs/08

Kleiber, P., Yokawa, K. 2004. MULTIFAN-CL assessment of swordfish in the North Pacific. Meeting of the ISC Swordfish Working Group, Honolulu, HI. ISC/04/SWO-WG/07

Kohin S., Conser, R., Sakagawa, G. 2006. Biological reference points for use by ISC. 4th Meeting of the ISC Plenary, La Jolla, California. ISC/06/PLENARY/15

Labelle, M. 2002. An operational model to evaluate assessment and management procedures for the North Pacific swordfish fishery. U.S. Dept. Commer., NOAA Tech Memo, NOAA-TM-NMFS-SWFSC-341, 53p.

Maunder, M.N., Hinton, M.G. 2006. Estimating relative abundance from catch and effort data, using neural networks. Inter-Amer. Trop. Tuna Comm. Special Rep. 15, 20p.

Punt, A.E., Campbell, R.A., Smith, A.D.M. 2001. Evaluating empirical indicators and reference points for fisheries management: application to the broadbill swordfish fishery off eastern Australia. Mar. Freshwater Res., 52:819-832.

Reeb, C.A., Arcangeli, L., Block, B.A. 2000. Structure and migration corridors in Pacific populations of the swordfish *Xiphias gladius*, as inferred through analyses of mitochondrial DNA. Mar. Biol., 136:1123-1131.

Report of the ISC Swordfish Working Group Joint Meeting (January 29 and 31, 2004, Honolulu, Hawaii).

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Report of the ISC Marlin and Swordfish Working Group Joint Meeting (March 20-22, 2006, La Jolla, California, U.S.A.).

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Saito, Yokawa, K. 2004. Estimation of abundance index of swordfish caught by Japanese longliner in the North Pacific 1956-2002. Meeting of the ISC Swordfish Working Group, Honolulu, HI. ISC/04/SWO-WG/04.

Sosa-Nishizaki, O., Shimizu, M. 1991. Spatial and temporal CPUE trends and stock unit inferred from them for the Pacific swordfish caught by the Japanese tuna longline fishery. Bull. Natl. Res. Inst. Far Seas Fish., no. 28, pp.75-89.

Uchiyama, J.H., DeMartini, E.E., Williams, H.A. 1999. Length-weight interrelationships for swordfish, *Xiphias gladius* L., caught in the central North Pacific. NOAA-TM-NMFS-SWFSC-284.

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Yokawa, K. 2004. Estimation of abundance index of swordfish caught by Japanese longliners by the Habitat model. Meeting of the ISC Swordfish Working Group, Honolulu, HI. ISC/04/SWO-WG/05.

Yokawa, K. 2004. Comparison of three abundance indices estimated by catch and effort data of Japanese offshore and distant water longliners. Meeting of the ISC Swordfish Working Group, Honolulu, HI. ISC/04/SWO-WG/06.

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Yong, M.Y.Y., Wetherall, J.A. 1980. Estimates of the catch and effort by foreign tuna longliners and baitboats in the fishery conservation zone of the central and western Pacific, 1965-77. NOAA-TM-NMFS-WSFC-2.

Attachment 3. Agenda

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

MARLIN AND SWORDFISH WORKING GROUP WORKSHOP

National Taiwan University (NTU)
Institute of Oceanography
1, Sect. 4, Roosevelt Rd.
Taipei, Taiwan

March 19-26, 2007

March 19 (Monday), 0930-1000 – Registration

March 19 (Monday), 1000-1700

1. Opening of Joint Intercessional MARWG & SWOWG Meeting
    a. Welcoming Remarks –
        i. Dr. Sha, Deputy Director General of Fisheries Administration
        ii. Dr. Chen – Director of NTU Institute of Oceanography
    b. Introductions

2. Adoption of Agenda & Assignment of Rapporteurs

3. Computing Facilities
    a. Access
    b. Security Issues

4. Data Confidentiality Protocols

5. Review of Striped Marlin Assessment & Prioritization of Additional Sensitivities
    a. Review CPUE Standardization Workshop, Honolulu, HI February 2007
    b. Reference points

Reception for Meeting Participants

March 20 (Tuesday), 0900-1600

6. Review and Finalize Data Input Files – Striped Marlin & Swordfish
    a. Country/Organization Reports
    b. Catch and Effort

c. Size (length or weight) Data
d. Biological Data

7. Abundance Indices
a. Standardization Approach
b. Relative Importance of CPUE Series (weightings)

March 21 (Wednesday), 0900-1700

7. Abundance Indices (continued)
a. Standardization Approach
b. Relative Importance of CPUE Series (weightings)

8. Swordfish Stock Structure
a. Review Available Information
b. Agreement on Stock Structure Scenario for Assessments

9. Identify Assessment Modeling Platform

10. Schedule to Complete North Pacific Swordfish Assessment

March 22 (Thursday), 0900-1700

11. Discuss "New" Striped Marlin Model Runs

March 23 (Friday), 0900-1600

12. Assessment results for July 2007 Plenary

13. World Swordfish Meeting

14. Future Workplan

15. Future Meeting

Dinner at Local Restaurant for Meeting Participants

March 24 (Saturday), 0900-1200
(Rapporteurs "Stay" after 1200 to Complete Assignments)

16. Adopt Striped Marlin Assessment and Craft Stock Status

March 25 (Sunday), No Meeting – Finalize Report and Circulate

March 26 (Monday), 0900-1600

16. Finalize Report
17. Adjournment

Attachment 4. Task list for the small working group of CPUE standardization

1) Assemble data containing detailed information of longline operations from observer programs, survey records, and training vessel operation records for the variation of new methods and the evaluation of factors affecting trends of CPUE. Items to be examined are included in the following:

- Effect of historical changes of fishing depth and spatial coverage of data on CPUE
- Factors affecting CPUE
  - Start and end time of gear setting and retrieving
  - Start and end location of gear setting and retrieving
  - Number of hooked branch line, length of float and branch line, shortening ratio, and length of main line between floats
  - Materials of main and branch lines
  - Target species
  - Catch information of other species than object one as a proxy of gear configuration or target species
  - Environmental factors (water temperature, moon age, depth of water, current velocity, depth of mixed layer, wind velocity, etc.)
  - Underwater movement of longline gear
  - Vertical distribution pattern of CPUE and vertical distribution probability of fish
  - Hooked time of fish
  - Total number of hooks deployed in single operation
  - Total horizontal distance covered by the longline gear
  - Others as identified
- Biology data of caught fish
  - Species
  - Age
  - Size of fish
  - Sex
  - Stomach contents of fish
  - Maturity of fish
  - Others as identified

Because the availability of data listed above is usually limited and not enough for qualitative analysis, cooperative studies among members should be beneficial in producing more reliable results.

2) Review and compare statistical models used in CPUE standardization
- GLM
  - Lognormal distribution such as log (CPUE+const)~year+month(or season)+HPB+location(lot lan, cells and/or area)+(Interaction term)+error

    - Catch model with negative-binomial distribution, etc.
    - Delta-model (1st binomial etc. for zero or non-zero catch data; 2nd lognormal distribution etc. for positive catch)
- HBS
- statHBS
- mixing method
- Algorithm used in statistical packages
- Others as identified

The final goal of this study is to prepare a general guideline for the statistical approach to catch and effort data.

Short term interests for the working group:

- Effects of different resolutions in oceanographic and fishery data on the results of CPUE standardization
- Evaluate possible biases using information of species composition instead of HPB information on standardized CPUE
- Accuracy of estimation for gear setting by using species composition of catch
- Area stratification effect
- Effects on standardized CPUE of detailed gear configuration information other than hooks per basket
- Methods of selecting different statistical models for standardizing CPUE (such as information criteria and cross validation)
- Review and set criteria to evaluate standardization methods