ANNEX 4

REPORT OF THE SIXTH MEETING OF THE INTERNATIONAL SCIENTIFIC COMMITTEE FOR TUNA AND TUNA-LIKE SPECIES IN THE NORTH PACIFIC OCEAN

Plenary Session, March 23-27, 2006
La Jolla, California U.S.A.

Report of the Marlin and Swordfish Working Groups Joint-Meeting (August 29 – September 2, 2005, Shimizu, Japan)

1.0 INTRODUCTION

The first joint intercessional meeting 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 was convened in Shimizu, Japan from August 29 – September 2, 2005. The purpose of the meeting was to bring together scientists conducting research common to both Pacific marlins and swordfish, review information concerning marlin resources in the North Pacific, including the quality and limitations of existing data, and develop a work plan to support stock assessments, with emphasis during this meeting on striped marlin. Gerard DiNardo, Chairman of the MARWG and Robert Humphreys, chairman of the SWOWG, welcomed participants (Attachment 1) and appointed Suzy Kohin, Jerry Wetherall, Keith Bigelow, Kevin Piner, Harumi Yamada, Koji Uosaki, Kotaro Yokawa, and Minoru Kanaiwa as rapporteurs. Working and information papers were distributed (Attachment 2) and the meeting agenda adopted (Attachment 3).

2.0 FISHERIES STATISTICS REVIEW

2.1 Status Report from Statistics Working Group

Harumi Yamada reviewed the roles and responsibilities of the ISC Statistical Working Group (STATWG), as well as procedures for data handling and submissions (ISC/05/MARWG&SWOWG/Info-01). The STATWG is responsible for cataloging, storing, and maintaining Categories I, II and III data from each ISC country member in a secure database. The submission formats for each data category, and procedures for data accessibility, were provided in the past reports of the STATWG. While the current database is offline and not accessible via the internet, there are plans to develop an online system by March 2006. At this point in time only Category I data are stored in the ISC database. These data were initially collected from National Reports submitted at the ISC plenary meetings in March 2005, and includes updated data provided by Canada and Japan as of July 1, 2005.

There was significant discussion on the proposed architecture of the database(s) and formats of submitted data; particularly on whether the STATWG had adopted a workable standardized data resolution format. It was determined that a standardized resolution for submitted fishery dependent data has been established at 5° × 5° for longline data and 1° × 1° for purse seine data. There was concern that the current ISC data submission formats may create excessive work for many of the organizations/countries required to submit data. It was suggested that the STATWG review the types and format of requested data in an effort to ensure that (1) the requested information are necessary for stock assessments, (2) the submission formats are sensible, and (3) procedures are in place to monitor the collection and archiving of these data.

It was also recognized that the ISC database may lack information from non-member countries. There is a need to compile a list of all nations which may have billfish catch data and ensure that data from non-ISC countries is included in the ISC database. SPC and FAO currently collect billfish catch information from many of the ISC non-member countries, and these databases may provide the necessary data. However, data from the FAO yearbook landings may have little value as they are not separated by fishing gear and the bulk of the reported billfish catch are summarized as an unclassified category (i.e., marlins). The value of all data should be reviewed carefully before incorporation into assessment models.

2.2 Review of the ISC Albacore Working Group Database

Atilio (Al) Coan presented a paper describing the ISC Albacore Working Group Database (ISC/05/MARWG&SWOWG/02). The purpose of the paper was to describe data collection and data management practices of the ISC Albacore Working Group Database, and to identify which data could prove useful to the Swordfish and Marlin Working Groups. The Database was established in 1975 with the purpose of promoting and accelerating research on North Pacific albacore through international data exchange and cooperative research. There are three data types collected: Category I (landings statistics and number of vessels); Category II (geo-referenced catch and effort data summarized from logbook) and Category III (size composition data). There are two submission requirements for these data, one in April for preliminary Category I data and the other, three months prior to any Albacore Working Group meeting for all three data Categories. Metadata are developed for each data Category and are contained in the database. Category I landings data is summarized by country, gear and year, and date back to 1952. Category I vessels data date back to 1971 and are available by country, gear, year and vessel size class. Category II data are summarized by country, gear, month, year, and area (5° × 5° for longline fisheries (catch in number of fish and effort in hooks) and 1° × 1° for surface fisheries (catch in metric tons and effort in days fished or poles) and date back to 1952. Category III data date back to 1951 and have the same spatial data resolutions as Category II data. The Database exists on an ftp website and ISC Albacore Working Group members can access the data with an account number and password. The data are in Excel file structures for Category I data, and in flat file structures with accompanying information on formats for Categories II and III data.

There are two types of data in the Albacore Working Group Database that may be of use to the Swordfish and Marlin Working Groups: Category I - number of longline vessels, and Category II – geo-referenced effort data for longline fisheries. The following tasks should be considered by the Marlin and Swordfish Working Groups as they move to develop a database.

- Select a data manager to maintain the marlin and swordfish databases
- Review and revise data submission requirements (deadlines for submissions and higher resolution data)
- Develop any needed data screening procedures
- Update Korea longline Category II data for 1995-2004
- If needed, obtain Japan/Chinese-Taipei longline Category II data for the South Pacific
- Develop Category I data table
- Develop Category II data table
- Develop Category III data table

The group acknowledged that the Albacore Working Group Database appears to be well managed and well suited for albacore assessment scientists. However, there was concern that there may not be enough detailed information in the database on fishing operations, such as depth of longline sets or targeted species, to meet the needs of the Marlin and Swordfish Working Groups. Those data are available, but not in a summarized form within the Albacore Database. Scientists requiring detailed information on fishing operations for CPUE standardizations, or for other analyses, will need to extract the detailed data from logbooks and observer data in order to obtain the relevant information. The discussion turned to the more general question of how the Marlin and Swordfish Working Group Databases would be managed, and whether the Statistics Working Group would be responsible. The group generally agreed with the recommendations (tasks) presented above as outlined in the working paper.

2.3 Country Report-Product Form Conversions (Category I Data)

2.3.1 U.S.A.

Russell Ito summarized the historical trends and recent developments for U.S. commercial fisheries that catch marlins (Istiophoridae) in the North Pacific Ocean (ISC/05/MARWG&SWOWG/03 and ISC/05/MARWG&SWOWG/05). Marlins are targeted and taken incidentally by both commercial and recreational fisheries. Only U.S. commercial fisheries for marlins (categorized into three distinct gear types: longline, troll, and handline) were discussed. An overview was given for trends in the number of vessels, total catch, and species composition of the marlin landings for each of the fisheries. Recent developments (2004 and first half of 2005) for swordfish catches by the Hawaii-based longline fishery were also presented. Product form conversion ratios (raising factors) for the Hawaii billfish catch were also discussed. If fish were processed, raising factors were applied to the nominal weight of each fish landed to estimate its whole weight. Raising factors used were specific to the type of processing, degree of processing, and species of fish.

The Group feels that further research needs to be conducted in order to update the conversion factors currently being used. The current conversion factors (processed weight to round weight) being used in Hawaii differ from those used on the U.S. west coast, and they were apparently based on market standards derived several decades ago. No scientific documentation specifically supports use of the various conversion factors. The Working Group felt there may be a way to conduct a study either (1) on board Japanese research and training vessels, (2) through U.S. observer programs, (3) through dedicated research cruises, or (4) by purchasing whole fish prior to processing. Funding will be an issue, but there was a consensus that the work is important. Furthermore, it will be important to establish conversion factors in several areas and for all fisheries because there may be local differences in how the fish are processed. Age-class specific and/or sex-specific differences should also be examined.

2.3.2 Chinese-Taipei

Chi-Lu Sun presented a paper describing the relationships between the metrics of lower-jaw-fork-length (LJFL) and eye-fork-length (EFL) for blue marlin, black marlin, striped marlin, sailfish and swordfish from eastern Chinese-Taipei waters (ISC/05/MARWG&SWOWG/04). Presently, a standardized length metric has not been adopted and some fisheries use LJFL, while others use EFL. To facilitate integration of these data, a conversion from one metric to the other is required. Specimens were sampled from the catches of Chinese-Taipei offshore and coastal fisheries from June 2004 to July 2005.

Participants expressed a need for such research and subsequent discussions focused on whether a similar study could help resolve the uncertainty associated with weight conversion factors (processed weight to round weight) identified during previous discussions. Apparently some of the Chinese-Taipei fisheries land billfish intact, thus providing another opportunity to conduct a length conversion study.

2.3.3 Japan

Kotaro Yokawa presented billfish catch data provided by Japan and the conversions used (verbal report only). While logbook data of Japanese offshore and distant-water longliners are available since 1952, the quality of catch weight information of this data has changed historically. Data on billfish catch number are available for 1952-1970, estimated catch weight information are available for 1971-1993, and total catch weight by species and by operation are available since 1994. Estimation of catch weight of billfishes for the period 1971-1993 is based on catch number information in the logbook and estimated average weight by area, season, and period, which was collected from commercial, research, and training vessels.

Annual catch weights of billfishes by fishery other than the offshore and distant-water longline fisheries are available in yearbooks of fisheries and aquaculture production statistics of Japan which is compiled by the Statistics Department of the Ministry of Agriculture, Forestry and Fishery. This information originates from landing information reported for each fishing port. Problems associated with these statistics are:

a) Catch of blue marlin and black marlin are combined.
b) Catch of sailfish and spearfish are combined prior to 1994; catch data for sailfish only are available since 1995.

The discussion by participants again focused on how to confirm that appropriate product conversions are being applied. Earlier in the time series, total catch was recorded in number, so there was no need for the conversion factors, or a simple conversion factor was applied. Now, the conversion factors are from observers or training boats. Clearly further research would help to cover all areas and fisheries.

2.3.4 Summary remarks on Category I data and product form conversions

In correspondence following this meeting, one of the participants noted the inconsistent meaning attached to the term “conversion factor”. Besides it’s use in reference to converting processed to round weight, conversion factor was also used at times in conversions of catch in weight to catch in numbers or from one unit of measure to another. Greater clarity and consistency is needed to alleviate further confusion regarding which type of conversion factor is being referred to, its parameter values, and which flag and/or state a particular conversion factor is associated with. In whatever manner the data are processed, the ISC Databases need to be carefully annotated so that any changes that have been made in a fishery (e.g. switching from shallow setting to deeper), or in fish processing, have been explicitly documented.

2.4 Catch and Effort Data (Category II Data)

2.4.1 Japan

Kotaro Yokawa presented a review of the Japan coastal longline and drift net fisheries (verbal report only). The coastal longline fishery is conducted by vessels smaller than 20 tons in the northwest Pacific. Logbook reporting for this fishery commenced in 1994. The coverage of logbook data is believed to range from 80-90%. Information, though limited, suggests that the fishing methods used in this fishery are different from those used in the offshore and distant-water longline fisheries. For example, some coastal longline fishermen use live bait, as well as a lower shortening ratio (60 – 70%). This information suggests that data from the offshore and distant-water longline fleets should be treated separately from the coastal fleets when studying CPUE.

Billfish catches by the Japan large mesh drift net fishery decreased in 1993 when a moratorium on the high-seas drift net fishery was implemented. Coastal drift net catches started to increase again toward the end of the 1990’s. NRIFSF stopped collecting logbooks from this fishery in 1993, but resumed logbook collections in April 2005. In recent years, most of the drift net vessels fish during the summer (June – August) in areas north of the Kuroshio current (35-45°N, 140-150°E) where warm Kuroshio derived water covers the surface. The main target species of these fisheries are swordfish and striped marlin, as well as salmon shark.

2.4.2 U.S.A.

Russell Ito described the marlin catch composition and area of operation of the Hawaii-based commercial fisheries (ISC/05/MARWG&SWOWG/05). The Hawaii-based longline fleet fished the largest area of all U.S. commercial fisheries for marlins; from the equator to 40^{o} N latitude and from 140^{o} W to 175^{o} W longitude in 2004. The geographic distributions of catch for both striped marlin and blue marlin in 2004 showed that highest catches occurred east of Johnston Island. Logbook data used to monitor the fishery are available since November 1990. Based on these data, the nominal catch per unit effort (CPUE) of striped marlin and blue marlin, measured in number of fish per 1000 hooks for tuna-targeted trips, declined after 1992. While changes in CPUE have been observed they may not be related to changes in abundance. Factors other than fishing could have contributed to the observed changes in CPUE, including increased regulations, shifts in targeting strategy, gear modifications, and changes in fishing area. Based on a comparison of logbook data to market data, there appears to also be a problem with misidentification of some of the marlin species.

The troll and handline fleets are comprised of small vessels which limit the range of their effort to inside the U.S. 200 mile EEZ. CPUE in the troll fishery is measured as kg of fish caught per trip. The nominal CPUE for blue marlin was higher than the CPUE for striped marlin and trended downward after 1996.

The Working Group was concerned about the misidentification problem which could greatly affect the catch information for striped and blue marlin from these fisheries. There was a consensus that the logbook data should be corrected for the misidentification problems and incorporated into the official Category I and II statistics. Discard data may be particularly prone to misidentification problems because in many cases the fish are cut off the line without getting a careful look at them. Because marlin can be landed and marketed in Hawaii under a traditional fishery, logbooks have been verified for retained fish by market information. The Working Group noticed that a decline in nominal CPUE of the longline fishery began around 1994, however since 1994 there has been an increase in regulations, areas of operation have changed, and setting depth has changed, all of which may have affected the catch and contributed to the observed decline in CPUE.

Al Coan described data from three U.S. west coast based commercial fisheries and a recreational tagging and angler survey database (ISC/05/MARWG&SWOWG/06). Category I landings and vessel data are collected from the longline, gillnet and harpoon fisheries. These data are from the Pacific Fisheries Information (PacFIN) System and date back to 1981. Coverage is 100% from landing receipts for swordfish only, as marlin catches cannot be landed on the U.S. west coast. Landings are in processed weights, and a conversion factor (scalar (1.45) to convert from processed weight to total weight) is applied. Landings from the gillnet fishery dominated until 1999, after which longline landings became more prominent. The highest landings from all fisheries combined occurred in 1985 when 3,400 t of swordfish were landed. The fleet of longline, gillnet and harpoon vessels combined was largest in 1981 at 410 vessels, and decreased to 107 in 2004.

Category II data for harpoon fisheries date back to 1974, for gillnet fisheries to 1981, and for longline fisheries to 1991. Coverage for all fisheries is 100% through mandatory state or federal logbook programs. Category II data contain the exact position and dates of catches and sets, as well as detailed information on the operations and gear used. Effort for the gillnet fishery is in sets, for the harpoon fishery in days fished, and for the longline fishery in number of hooks. Catches for gillnet, longline, and harpoon fisheries is in number of fish. Harpoon and gillnet fishery catches also have estimated weight provided. Longline logbooks also record the number of striped, blue and black marlin caught, but their catch is low (<50 fish/year) and most are discarded. Observer data are also collected from gillnet (20% coverage) and longline (100% coverage) fisheries. The data collected by observers are very similar to Category II data collected by logbooks for these fisheries. Observer data are used to verify species compositions, dates, and positions from logbooks. Observers also monitor protected species interactions. While gillnet fishery logbook data show only swordfish being caught, observer data show that small quantities of marlin are also caught and released (<17/year).

In the ensuing discussion, it was pointed out that there appears to be a difference in information recorded between logbooks and observer reports; this suggests that verification studies are necessary, as has been done in Hawaii. There was a suggestion that the SWFSC Billfish Tagging Database may provide useful information for calculating mortality and/or growth rates from tag returns of striped and blue marlin, however, the Group concluded that, because the tagging efforts were not consistently carried out across areas and time, the information is unlikely to provide reliable estimates.

2.4.3 Chinese-Taipei

Chi-Lu Sun described the category II data available from the Chinese-Taipei fisheries (ISC/05/MARWG&SWOWG/07). Billfishes are incidentally caught in the distant-water and offshore tuna longline fisheries of Chinese-Taipei. Also, the offshore gillnet and the coastal harpoon fisheries catch a small amount of billfishes in the waters of Chinese-Taipei. For the distant water tuna longline fishery, the main fishing grounds are in the central and southern regions of the Pacific; albacore are the target species and billfish are a bycatch. In recent years, however, a higher proportion of the fleets targeted tropical tuna species for the Japanese frozen sashimi market. It was noted that the catch of swordfish from the distant water longline fishery increased sharply in recent years.

In the offshore tuna longline fishery based in Chinese-Taipei, blue marlin is the dominant billfish caught with catches fluctuating between 1,200 tons (1985) and 4,850 tons (1997). For the coastal harpoon fishery, sailfish is the primary target species and major catches occur during the summer season. Black marlin is the secondary target, and is caught primarily during the winter. In the winter season of the harpoon fishery, blue and black marlins are the primary targets and constitute the major catches.

Among the billfish species, Dr. Sun's team at National Taiwan University (NTU) has completed studies on population dynamics and stock assessment for swordfish and sailfish and are currently conducting a stock assessment study on blue marlin. Through collaborations with the Fisheries Research Institute (FRI) of Council of Agriculture (COA), and funding from the Fisheries Agency of COA, they are also studying the age and growth and reproductive biology of black marlin, and collecting biological data from striped marlin. A billfish tagging program is also being conducted by FRI. More results from billfish studies are expected in the near future.

Participants acknowledged the biological and assessment research conducted by Dr. Sun's team. This research should continue and will prove useful as we move to more comprehensive assessments.

The working group noted that swordfish CPUE increased dramatically in 2003 and that the increase does not appear to be caused by an increase in effort targeting swordfish. However, further analyses of these data are necessary to elucidate causes for the increase. Currently, the spatial resolution of Chinese-Taipei logbook data is 5° × 5° and Dr. Sun noted that Chinese-Taipei is asking its fishermen to record data at its actual position. The group strongly encourages the collection of finer scale position data.

2.5 Size Composition Data (Category III Data)

2.5.1 Japan

Hirokazu Saito reported on Japan's sexed length data for striped and blue marlin caught by offshore and distant water longliners between 1975 and 2004 (ISC/05/MARWG&SWOWG/08). The results suggest that it may be possible to separate Japanese longline data by age-groups, sex and quarter for striped marlin. For blue marlin it will be difficult to separate age-groups from the Japanese longline data, and only a few female samples were measured making any separation by sex unlikely. Differences in striped marlin sex ratios were observed between commercial fishing vessels and training vessels, and Saito suggested that the sex ratio data should be compared with other databases to assess the extent and causes for the observed differences.

Working Group participants discussed the sex ratio information and hypothesized that movement could be contributing to some of the discrepancies. It was noted that there is a lack of weight data in this report; historically the weight data were collected portside. Saito is currently compiling the weight data so that information should be available in the near future. In addition, Japan has another database from onboard measurements by JAMARC, and the two institutes are working to combine their data into the NRIFSF database. Researchers from PIFSC indicated that they have collected size information in the same area, and these data should also be incorporated into the database. Currently, the number of training vessel trips is declining, and trips are staying closer to home ports because of climbing fuel costs. If the decline persists the utility of this data source will likely diminish in the future. It was suggested that Mexico may have some data, and the Working Group should inquire about such information. The discussion turned to the feasibility of obtaining Pacific-wide Category III data, either through fisheries cooperation or cooperative research efforts. While there was overwhelming support for such a program, it will require significant coordination among ISC member countries. Such a program should be discussed at the March 2006 ISC Plenary Meeting.

Kotaro Yokawa presented the extent of the swordfish size (length and weight) data collected by Japanese commercial longline, research, and training vessels that was reviewed for their use in stock assessments (ISC/05/MARWG&SWOWG/09). The result of the analysis indicates that estimation of catch-at-size may be possible, but only for areas in the northwest Pacific (west of dateline) for the period of 1975 – 2003. In areas east of the dateline, limited length and/or weight frequency information are available. Results from this study also indicated that in most areas, length data from the commercial, research, and training vessels typically do not overlap. Because length frequencies of swordfish change by season and area, size data collected by different sources should be treated with care in subsequent assessments.

The Working Group noted that the size data from training vessels is sex specific, and in some cases recruitment of strong year classes is apparent in years when there is good sampling. Perhaps growth can be estimated from modal size progression when sampling has been adequate. Japanese scientists are trying to get fishermen to cooperate and collect a larger number of size samples. Currently, less length data is available from vessels fishing farther from Japan. It was noted that the data can be identified by trip from the logbook data, and that fisheries operating in equatorial areas are more likely to take young-of-the-year fish. In Hawaii, observers are collecting information on the small fish, under 80 cm EFL, although few of these small fish show up in the landings. These fish are either consumed onboard or discarded, contributing to a lack of size landings data for small fish.

2.5.2 U.S.A.

Jerry Wetherall provided information on the size composition of billfish catches by the Hawaii-based longline fleet (ISC/05/MARWG&SWOWG/10). Data are available from two primary sources: National Marine Fisheries Service (NMFS) observer data and records of landings at Honolulu wholesale fish markets. Observer data, collected since 1994 from a subset of longline fishing trips, consist of eye-fork-length (EFL) measurements and associated detailed fishing operational data including catch location. Because fishermen typically gut swordfish at sea, observers have often been able to determine the sex of individuals. A recent federal requirement that all billfish be landed gilled and gutted should make sex-determination more feasible for all billfish species.

The landings data also include weight records of fish delivered to the Honolulu fish auction that were subsequently sampled by staff of NMFS and the Hawaii Division of Aquatic Resources (HDAR) on an irregular basis from the late 1940’s through 2002.

From 1960-1970, such sampling also included extensive sex determination. Sampling was suspended during the 1970's, and resumed in 1984. Since 2000, wholesale fish buyers have been required to report to HDAR the weight of each fish purchased. This includes all auction sales transactions; accordingly, sampling at the fish auction was phased out in 2002. For fish landed in processed form, conversion factors are used to estimate whole weight.

Al Coan presented the available Category III data for harpoon, gillnet and longline fisheries that operate off the U.S. west coast (ISC/05/MARWG&SWOWG/06). The data are from port sampling (1981-1999) and observer sampling for gillnet (1990-2004) and longline fisheries (unavailable at this time). Port samplers collect cleithrum length and dressed weight for swordfish only. Observers collect fork, eye-to-fork and cleithrum lengths, but no weights, for swordfish and marlin. Port samplers recorded the sex of only 4 swordfish while observers recorded the sex of 1,229 swordfish, 3 striped marlin, and 1 blue marlin. Sample sizes are too small for marlin catches and harpoon fishery swordfish catches to adequately determine the size composition of these fish. Sample sizes for swordfish from gillnet and longline fisheries are probably large enough to determine size compositions by year and possibly quarter. However, sample sizes are probably not sufficient for finer stratification (e.g., month or area). Lengths and weights are also collected from recreational fisheries off the west coast through a tagging program, and from fishing clubs, although the data have not yet been summarized.

2.5.3 Chinese-Taipei

Chi-Lu Sun described the availability of sexed size data for billfishes from Chinese-Taipei fisheries and results of provisional analyses on these data (ISC/05/MARWG&SWOWG/11). Swordfish, striped marlin, blue marlin, black marlin and sailfish have been collected from the catches of Chinese-Taipei offshore longline, offshore gillnet and coastal harpoon fisheries landed at three fishing ports from 1997 to 2005. For each species, length distributions were constructed, and both length-weight relationships and sex ratios at observed lengths computed. For all billfish, provisional results suggest (1) females grew to a larger body length than the males, (2) length-weight relationships were not significantly different between the females and the males, and (3) for each species the proportion of females increased with body length. In fact, all samples having lengths larger than 210 cm for swordfish, 280 cm for blue marlin, 270 cm for black marlin and 230 cm for sailfish, were females.

The participants acknowledged the importance of this research and encouraged continuation of fishery-dependent sampling of Chinese-Taipei's commercial fisheries. In this study, size data is expressed as LJFL, while the ISC has adopted EFL as the standard unit of measure. The working group would be interested in seeing these results with respect to EFL, if possible, since that is the agreed upon unit of measure for ISC Working Groups. Working group participants were surprised to see such a large number of black marlin recorded in the catch. In general, any longline catch of black marlin is rare, and the only fishing ground known for this species is in the Coral Sea. It was noted that the catch of black marlin reported in the Chinese-Taipei fisheries came from the South China

Sea and eastern coastal waters of Chinese-Taipei, predominately in the winter months. At present the reason for their presence in these areas is not known.

2.5.4 Inter-American Tropical Tuna Commission (IATTC)

Michael Hinton reported that IATTC observers aboard purse seine vessels in the Eastern Pacific Ocean (EPO) have been collecting length frequency samples of marlins, sailfish, and swordfish since 1990. Length samples are also available for swordfish delivered from the Ensenada (Mexico) fleet to the San Diego market. These latter samples, and other samples which are available, arise from ad hoc studies, such as those for genetic or other biological research. Few length samples have associated sex information, with the exception of those animals collected for genetic studies.

2.6 Discussion Summary

The Marlin and Swordfish Working Group participants identified several common concerns pertaining to the quality and quantity of available data to facilitate billfish stock assessments. Many of the concerns stem from the fact that billfish are a bycatch species in most commercial fisheries. Target species will be a factor to consider when standardizing catch per unit effort data. Misidentification of billfish, particularly the striped, blue, and black marlins, is common in many of the fisheries. In addition, many nations have not collected species-specific information for billfish catch, but rather combine all billfish species together, or with other bycatch species (i.e. shark catch) when reporting catch. Data verification is a necessary step to ensure accurate estimates of catch. Finally, the ISC Statistics Working Group will need to develop procedures for obtaining Category I and II data from countries not participating in the ISC. For fisheries operating in the Atlantic, ICCAT funds data collection programs in several countries to the amount of $50,000-$100,000 annually. Currently this approach can not be adopted in the ISC due to a lack of funding. The Working Groups can identify the main sources of uncertainty in each of the data categories and develop effective data collection programs should funding become available. In the meantime, we should look to other institutions that maintain similar data to augment our data base. The SPC maintains a large database of logbooks from many of the Pacific Rim distant water fishing nations, and it may be able to provide much of the missing information for this database. Coastal artisanal fisheries will probably be the most problematic. However, recent analyses of the SPC database point to potential deficiencies that need to be rectified. Another potential database is maintained by FAO, but caution is recommended when using these data. There was concern that FAO international data is not reliable, although the FAO regional data may be reliable. Clearly, it will be difficult for the Working Groups to proceed with assessments if data are not reliable. The reliability of these external data sets is recognized by the Working Groups, and we encourage the adoption of a suite of uniform protocols for sharing and verifying these databases between all ISC working groups.

During the meeting, a data table was developed to identify available data (Category I-III) for the upcoming striped marlin assessment (see Table 1). While Category II data are available from some nations at the set level not all of the set-by-set data may be made available to the Working Groups. If assessment scientists have needs for higher resolution data, the Group recommended that a 1-2 page request be submitted to the member nation with each request for data, indicating how the data would be used.

3.0 BIOLOGICAL DATA

3.1 Biological Information Data Matrix

Robert Humphreys introduced the topic of biological data with a review table of vital rates and life history parameters (ISC/05/MARWG&SWOWG/12). Information on our current knowledge of life history parameters and vital rates for striped marlin, swordfish, and blue marlin in the North Pacific was compiled from various literature sources. In tabular form, the state of our current information and existing data gaps in the life histories of these species could be more readily evaluated. Length-weight relationships exist for all three species, however, the regressions fitted for striped marlin have considerably lower r^2 values and need to be further analyzed. Age and growth (von Bertalanffy) models based on hardpart studies currently exist only for swordfish and are based on recently completed studies. Estimates of the natural mortality rate for all three species remain unresolved. Little information exists for age at maturity, size at 50% maturity, and age/size-specific fecundity for striped and blue marlin. Adult vertical distribution data now exists for all three species based on a variety of electronic tag studies conducted in the North Pacific. Swordfish are capable of daytime dives down to 800 meters while striped and blue marlin typically reside in the mixed layer with limited excursions below the thermocline. The apparent absence of spawning activity in the eastern North Pacific for swordfish and blue marlin may need further study in light of the recent discovery of striped marlin larvae in coastal waters off Mexico. Current data from tag-recapture and pop-up tags may indicate more limited horizontal movements for striped marlin and swordfish compared to blue marlin. Confirmation of the parameters for weight on length relationship for eastern north Pacific striped marlin may be needed since the reported regression formulas use negative values, as shown in Table 2 of the working paper (ISC/05/MARWG&SWOWG/12). Information regarding spawning grounds for (north) Pacific billfishes was introduced based on larval distributions derived from Nishikawa et al. (1985).

3.2 Movement Studies

Hirokazu Saito reported on the vertical distribution patterns of five striped marlin based on archival pop-up tag data collected in the eastern Pacific Ocean in 2004 (ISC/05/MARWG&SWOWG/13). Results from four of five tagged fish captured off Mexico show similar bimodal vertical distribution patterns, with modes at 0 ºC and -6 to -10 ºC in temperature relative to the sea surface temperature (Δtemp). This suggests that striped marlin in the southwest off Mexico dived slightly deeper (0 to -15ºC in Δtemp) than that reported by Brill and Lutcavage (2001) (-8ºC in Δtemp).

Working group discussions focused on two of the four individuals that exhibited larger proportions of time in the thermocline, within waters 6 to 8 degrees cooler than the mixed layer. While striped marlin spend about 70% of the time in the mixed layer, these individuals may be chasing prey within the thermocline. No individuals went deeper than 15°C cooler than the mixed layer, which may be a physiological constraint. All participants agreed that more tagging data is required before making generalizations about habitat utilization.

Kotaro Yokawa reported on the vertical distribution pattern of CPUE for striped marlin (ISC/05/MARWG&SWOWG/14). CPUE by depth was estimated using data collected by a longline research cruise to evaluate the vertical distribution probability of striped marlin estimated by Saito's past tracking studies. The vertical distribution probabilities are currently used as an input parameter for the statistical and biological habitat model.

The results of this study indicated that catchabilities of striped marlin caught on longline gear changes by depth. Results also suggest that the hooking behavior of striped marlin on longline gear is regulated by depth rather than by relative temperature to the thermocline.

Of the 199 striped marlin caught in the study, none were hooked during deployment or retrieval of the longline. Yokawa indicated that the large vessel size and noise may have contributed to the small sample size. There was a pronounced difference in the depth distribution and habitat of striped marlin from the PSAT study (described by Saito) compared to longline (TDR and hook timer) monitoring; this difference may reflect their actual vulnerability to the fishing gear.

Tamaki Shimose reported on the spawning season and reproductive characteristics of the blue marlin *Makaira nigricans* (ISC/05/MARWG&SWOWG/15). This study was based on an examination of 718 female and 384 male specimens landed on Yonaguni Island, southwestern Japan from February 2003 to February 2005. The mean LJFL of females (234±24 cm, mean±SD) exceeded that of males (191±12 cm). The spawning season was estimated to occur from May to September around Yonaguni Island based on the histological examination of ovaries and the presence of empty follicles. Gonadal somatic index (GSI) of both sexes provided a good indicator of spawning activity, although the histological evaluation of reproductive stage in males did not provide useful information since a high proportion of spermatozoa were present year- round. Condition factors for both sexes decreased during the spawning period as a result of energy expended during reproduction. While females dominated the sample, even during the spawning season, mature females were rarely observed. First maturity was estimated to be 183 cm LJFL for females. Ripe egg diameter was about 1.2 mm, and females were thought to spawn in batches at least 3 times per spawning season. Blue marlin are thought to leave Yonaguni Island after spawning in the autumn.

There have been differences among previous studies (Erdman, 1968 and Hopper, 1990) regarding the blue marlin sex ratio associated with spawning activity. The results of the present study show that the number of females present was greater than that of males (65% females) and this result differs from the results of previously published studies. However, the proportion of females in an advanced reproductive condition (eminent spawners) was small; whereas most of the males examined were reproductively mature. This indicates the female to male ratio of spawning individuals is less than 20% which is similar to the published results of Carol Hopper for blue marlin off the Kona coast of Hawaii. This difference in sex ratio among regions might depend on the magnitude of spawning activity. Shimose clarified his estimation method for batch fecundity by stating that they are derived from counts on a small subsample of the ovary which is then extrapolated to the entire ovary size. The spawning interval of blue marlin in this study remains unknown; only three of the 63 individuals had post-ovulatory follicles (POF) present, indicating that spawning frequency may be low.

Michael Hinton summarized the results of two unpublished genetics manuscripts on the population structure of striped marlin (McDowell & Grave, *in prep*) and swordfish (Alvarado-Bremer et al., submitted) in the Pacific Ocean. Preliminary results suggest distinct populations of swordfish in the (1) north-eastern Pacific Ocean (Ecuador to Mexico), (2) north-central Pacific Ocean (Hawaii), (3) south-western Pacific (Australia), and (4) south-eastern Pacific (Chile). These results also suggest that the south-central Pacific (French Polynesia) region acts as a mixing area. The results of these studies are consistent with a stock structure hypothesis for swordfish that proposed a stock division at 5˚S latitude in the eastern Pacific based on the analysis of fisheries CPUE data, biological information, and oceanographic data (Hinton and Deriso 1998, Hinton 2003).

The swordfish population structure studies were not reviewed in-depth by the working group. Further discussion on swordfish stock structure was deferred to the 2006 ISC Swordfish Working Group meeting to allow time for discussion of striped marlin issues pivotal to the upcoming stock assessment meeting. It was noted that a presentation on Pacific swordfish genetics that includes more data is slated for the upcoming 4th International Billfish Symposium.

Discussions turned to striped marlin and focused on clarifying stock structure considerations for the upcoming ISC striped marlin assessment. Preliminary unpublished genetic results suggest four populations of striped marlin in the Pacific: (1) Japan, Chinese-Taipei, Hawaii and California as one contiguous stock, (2) an Australia stock, (3) a Mexico stock, and (4) an Ecuador stock. A previous study by Graves and McDowell (1994) also suggested the possibility of a separate Mexico stock. As the ISC has responsibility for the North Pacific, subsequent assessments could consider a two stock hypothesis (Japan, Chinese-Taipei, Hawaii and California; Mexico). There was considerable discussion on a 2 stock hypothesis, but because of the disposition of the stock structure information (preliminary and unpublished) participants thought it was premature to consider a 2 stock hypothesis. A separate Mexico population suggests no genetic mixing with the geographically adjacent North Pacific and Ecuador populations. There is no geographical delineation between the North Pacific and Mexico populations and currently available genetics information alone may not be helpful in determining a boundary. The boundary may also be shifting seasonally. If two populations mix in a particular area it may be difficult to construct catch rate series from these separate populations. As a result of these concerns it was recommended that the North Pacific striped marlin stock assessment consider a single, spatially-structured stock across the North Pacific (north of the equator).

In an effort to advance future stock assessments, Michael Hinton also presented a research initiative that may provide information on stock structure and distribution required for management of individual stocks of striped marlin in the eastern and northern Pacific Ocean. The initiative will incorporate available data of multiple types, including fisheries biology, fine-scale fisheries data, tagging, and physical oceanography. This approach has been successfully applied to a number of species, including swordfish in the North Pacific (Hinton and Deriso, 1998). While working group participants recognize the importance of stock structure when conducting assessments, the efficacy of the proposed research initiative to provide such information was questioned. After much discussion, and noting the listing of this item in the 2004 work plan of the ISC Marlin Working Group, the participants agreed to move forward with the initiative under the auspices of the ISC, and recommended that a proposal be developed that specifically identifies data needs, methodology, and anticipated products. The participants further agreed that a timeline should be included in the proposal. Hinton, with assistance from other working group scientists, agreed to take the lead and develop the proposal. When completed, the proposal will be circulated amongst the working groups for review and comment.

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4.0. ABUNDANCE INDICES

4.1 Habitat Models

Keith Bigelow presented an overview of habitat models and their application to standardizing time series of longline CPUE (verbal report only). Standardization of CPUE statistics for use in stock assessments has been accomplished in various ways, including generalized linear models (GLM), deterministic habitat based models (HBS), and most recently, statistical habitat models (statHBS). HBS models combine assumptions about fish distribution, habitat, and gear distribution. The deterministic HBS approach has been criticized on various grounds, but has been applied in several instances. For example, it was used with Pacific bigeye tuna, incorporating archival PSAT tag data from NRIFSF, SPC, NMFS, and CSIRO. Distributions of the time bigeye tuna spend at various temperatures in defined spatial compartments were estimated and incorporated into a spatially structured assessment model.

HBS models have been superseded by statistical habitat models (statHBS). In this more sophisticated approach, models are fitted to fishery data and habitat data, and parameters estimated in a maximum likelihood framework. Using cross-validation, statHBS models have been shown to have superior performance compared with deterministic HBS models, GLM, and other approaches at estimating effective fishing effort. So far, statHBS models have generally been applied to fairly large spatial strata, defined using fisheries data and in consideration of ecological provinces. Future work is needed to incorporate other factors such as oxygen, depth of scattering layer, depth and gradient of the thermocline, and fish behavior. Extensions of statHBS models to include categorical variables (e.g., month or area), continuous variables like latitude, current shear, and other factors would be desirable.

Discussions focused on the difficulty involved in explicitly modeling fish behavior and incorporation of such behavior into habitat models. StatHBS models, however, can be used to take behavioral effects into account. For example, high shark catches on longline sets in some areas can cause tuna in the area to avoid the gear or cause fishing vessels to move to other areas where sharks are not as prevalent. In such cases, the effects of high shark catches could best be modeled statistically (statHBS) rather than through an explicit model of functional behavior or responses (deterministic HBS).

4.2 CPUE Standardization

Kotaro Yokawa presented information on the operational patterns of Japanese offshore and distant-water longline vessels in the North Pacific with emphasis on billfish catches (ISC/05/MARWG&SWOWG/16). The study was based on similar work in the Atlantic Ocean that examined the effects of temporal and spatial variations in the number of hooks per float (HPF) and changes in spatial coverage of the fishery on estimation of billfish CPUE trends. In the Atlantic study, a simulation model was developed incorporating Atlantic billfish habitat preferences, oceanographic variations, and billfish abundance.

Analysis of data generated from the simulation model showed that a failure to take into account such patterns can lead to biases when GLMs are used to standardize longline CPUE. Indices of abundance derived from nominal CPUE or simple GLM models exaggerated the true (simulated) decline in abundance whereas GLM models incorporating HPF information captured the true trend.

In the Pacific, target species of longline vessels operating in different areas have not changed over time but gear configurations have changed from shallow to deeper set gear (more hooks per float). In addition, the same gear configurations (in terms of hooks per float) are used in different fishing areas and seasons and in targeting different species. Such factors have to be taken into account when standardizing CPUE. Another factor that needs to be taken into account is time of day; night time sets in the northwestern parts of the fishing grounds indicate operations targeting swordfish, whereas day time sets are associated with targeting of striped marlin and other species. With respect to effects of spatial coverage of the fleet, there have been significant declines in effort in several areas of the North Pacific which should be taken into account in CPUE standardization. Preferably, several methods of standardization should be used and results compared to help reveal possible biases. Standardization should be undertaken separately, rather than as part of an integrated stock assessment model.

During the discussion, it was pointed out that the simulation model developed for billfish in the Atlantic Ocean could be adapted for billfish species in the Pacific Ocean by incorporating appropriate changes in the habitat model and other functional components. In addition, the model could be improved by incorporating information about other species, especially ones targeted by the fishery.

Minoru Kanaiwa presented preliminary results of a striped marlin CPUE standardization using a statistical habitat model (statHBS) (ISC/05/MARWG&SWOWG/17). The statHBS was applied to data from the Japanese longline fishery from 1975 to 2001 to derive a standardized CPUE index of abundance (sCPUE) and establish habitat preference. The study also investigated the sensitivity of the results to various factors. The three main results of the sensitivity analysis were: 1) changing the starting year of the data set used for the analysis did not alter the annual trend of sCPUE but did change the estimated habitat preference; 2) the specified prior distribution for habitat preference did not affect the results of either sCPUE trend or habitat preference; and 3) the sCPUE trends and habitat preferences estimated for sub-regions were not homogeneous. In particular, the International Date Line appears to be a turning point with respect to the sCPUE annual trend; west of the date line the sCPUE trend is upward or stable, while east of the date line it is downward. It was suggested that additional work is needed regarding the proper treatment of zero catch observations, given the relatively high frequency of those records. Other work is needed to determine what information is best for defining a prior distribution for habitat preference, and how to better categorize the data for analysis (e.g., by number of hooks between floats and target species).

In the discussion, the point was made that the analysis showed that the habitat (relative temperature) preference was not sensitive to the prior. However, the observed behavior of striped marlin suggests that the lower range of relative temperature could be changed to go lower than -8ºC. If these lower temperatures are used, then some added affects might be evident. With respect to the elimination of 0-catch records, the data used were summarized in 5 X 5 degree areas. Under these circumstances, about 10-15% of the areas had zero catch. Further work is needed on the best way to treat records with zero catch.

Kotaro Yokawa presented results of a trial study to standardize striped marlin CPUE from the Japanese large-mesh driftnet fishery using GLM approaches (ISC/05/MARWG&SWOWG/18). Using logbook data from 1977 to 1993, the GLM model included several predictors: year, quarter, fishing area, mesh size, year by quarter interaction and area by quarter interaction. Standardized CPUE declined from 1977 through 1983 and then increased through 1992 when the moratorium on large-scale high-seas driftnet fishing began. Although striped marlin is one of the targeted species in the drift net fishery, there are also other targets such as swordfish, albacore, and skipjack. The effects of targeting might well change the CPUE standardization for striped marlin, but the catch records do not directly indicate the targeted species. Other available information, such as the catch of other species, may provide some indication of the target species. Further work on this problem would be helpful.

The discussion afterward helped clarify that the collection of logbook data for the large-mesh driftnet fishery ended after 1993, but is starting again. For the interim period, there is no catch-effort information for the fishery, but catch (landings) records are available from prefectural governments and are included in the tabled Category I statistics for striped marlin and other species. The GLM analysis produced a rather narrow confidence region around the predicted striped marlin standardized CPUE. The narrowness of the confidence region is a reflection of the large number of data points used in the analysis. However, the confidence region does not reflect the full uncertainty regarding the CPUE time series as an index of abundance. This will need to be considered if this CPUE time series is used in stock assessment models.

4.3 Model Description of Longline Fishing Gear Configuration

Sayaka Koyama described a study of movements of longline gear during fishing operations and described changes in the shape of the gear, including the shortening ratio, using a newly developed buoy with a built-in Global Positioning System (GPS) (ISC/05/MARWG&SWOWG/19). Thirty research longline sets using these GPS buoys were made in the northeast Pacific. The buoys enabled measurement of the distance between floats and surface current during the entire gear deployment. An Acoustic Doppler Current Profiler (ADCP) provided a current-depth profile beginning at time of gear set. In 80% of the monitored sets the shortening ratio affected the depth of hooks, particularly hooks near the center of the basket and those on deeper set gear. Hook depth on deep sets also fluctuated more than on shallow sets because of the greater distance between floats on deep set gear and the effects of current shear on hooks deeper in the water column. The study was not able to determine a relationship between current shear and shoaling of the gear because the ADCP information was limited to the time at which the gear was deployed. Further research on this topic is necessary.

During the discussion, Koyama clarified that although the GPS buoys provided information on surface currents throughout each longline set, data on subsurface currents was only available at the time and location of gear setting. Thus, the vertical component of flow during the entirety of each longline set was only roughly approximated.

5.0 STOCK ASSESSMENT MODELS AND DATA REQUIREMENTS

5.1 Stock Assessment Models and Limitations

Kevin Piner presented an overview of past assessment approaches used to determine stock status of billfishes (verbal report only). Due to limited data availability, most billfish stocks have been assessed using simple models (biomass dynamics). However, some recent assessments have used more complicated length-based or age-structured models. There are advantages and disadvantages to both parsimonious and complex assessment models, therefore a combination of both approaches may be advisable.

The working group discussed the appropriate level of model complexity to use in billfish assessments. The group did not endorse any single level of model complexity, but preferred using multiple assessment approaches with different levels of complexity. Appropriate models and levels of complexity should be based upon data availability.

5.2 Candidate Reference Points and Model Verification

Ray Conser presented an overview of the biological reference points used in fisheries management (verbal report only). Two types of biological reference points are commonly used for fisheries management.

(1) **Overfishing:** reference points that compare the current fishing mortality rate (F_t) to an agreed F reference point (F_{ref}). Overfishing on the stock occurs whenever $F_t > F_{ref}$.

(2) **Overfished:** reference points that compare some measure of stock biomass (B_t) to an agreed B reference point (B_{ref}). Spawning stock biomass (SSB) is often used as an important measure of stock biomass. The stock is considered to be overfished whenever $SSB_t < SSB_{ref}$.

Maximum sustainable yield (MSY) reference points (e.g. F_{MSY} and SSB_{MSY}) are natural reference points for fisheries management and in particular, have been formalized in the charters of international commissions (e.g. ICCAT and IATTC) and in domestic fisheries management legislation (e.g. U.S.A.). MSY reference points are also fundamental parameters (or derived parameters) for surplus production models, which have a long history of use in the management of tunas and tuna-like species worldwide. However, when age-structured models are used for stock assessment, MSY proxies are often used rather than MSY *per se*. The most commonly used proxies are those based on equilibrium SSB per recruit analyses, e.g. $F_{30\%}$., $F_{40\%}$, etc. MSY proxies tend to be more robust to estimation error in stock assessment models, particularly in the stock-recruit parameters.

Determination of the most appropriate biological reference points for Pacific marlins and swordfish will probably require simulation studies designed to compare the use of proxy vs. MSY-based reference points, and if proxies are determined to be preferable, the best proxy to use for management.

The working group noted that international fisheries management bodies (e.g. IATTC and ICCAT) use MSY based reference points, as their conventions define MSY as the management objective. It was pointed out that the ISC is not a regulatory fishery body with a convention or management authority.

Conser also described validation procedures for assessment models, and the importance of this step for successful fisheries management. As model complexity increases, verification becomes increasingly more difficult. A practical paradigm for model verification consists of addressing the following four questions.

(1) Has the model been coded correctly?
(2) Are model results consistent with the structural assumptions (diagnostics)?
(3) Do other models give similar results? If not, why not?
(4) Does the model reproduce known results from simulation analyses?

The working group recognized that effective model verification through simulation can be problematic if the simulation model is mis-specified. Low level operational models may not be the best tools for model verification. Instead, structural simulation models, designed to test a models assumptions and structure more directly, should be used.

5.3 Alternative Assessment Models

5.3.1 MULTIFAN-CL

Pierre Kleiber presented an overview of MULTIFAN-CL and the changes that have been made to it in the past year (verbal report only). MULTIFAN-CL is a statistical, size-based, age-structured, and spatial-structured stock assessment model. It accommodates variable, region-specific recruitment, fleet-specific selectivity and time varying catchability. Fleet characteristics can be grouped if desired to reduce the number of fitted parameters. Input data consists of catch, effort, size samples, and tag recoveries if available. Sample data can be by length, by weight, or both. Strata with missing catch, or effort, or sample data are accommodated appropriately. Bayesian priors can be applied to many of the basic parameters as well as to various derived parameters. Model fitting proceeds in phases and can be orchestrated by a "do-it-all" file that specifies properties and order of the phases.

Output from MULTIFAN-CL is voluminous, consisting of a variety of diagnostic results as well as assessment information. The latter includes various MSY-related reference points, such as F/Fmsy and B/Bmsy. Also available are fishery impact results which are estimates of abundance trajectories under hypothetical regimes of reduced, or eliminated, fishing effort. Statistical uncertainty is estimable from the inverse of Hessian matrix and from likelihood profiles.

MULTIFAN-CL is accompanied by various utilities to aid in constructing input files and visualizing and interpreting output files. This includes two function packages for the statistical and graphics program, R. A user guide for MULTIFAN-CL is available.

Several developments and improvements to MULTIFAN-CL occurred in the past year. Selectivity can now be specified by cubic spline curves, thereby reducing the number of parameters to estimate. The system for projecting biomass estimates into the future has been improved. Seasonality and regional variation in recruitment has been included in the process of estimating the age distribution at the start of the time series. More flexibility in specifying recruitment seasonality has been incorporated as well as output to facilitate likelihood profiling. Improvements and updates are continually made to the R graphics and other utilities and also to the User Guide.

The working group discussed the importance of modeling sexually dimorphic growth, and sex-specific natural mortality in billfishes may be important. Changing the model structure of MULTIFAN-CL to include sex-specific growth and natural mortality will be an improvement over the existing model. The working group also discussed the desirability for assessment models to include MCMC capabilities to quantify parameter uncertainty. The current MULTIFAN-CL model is not capable of doing the Bayesian integration using MCMC, but alternative methods to express uncertainty are currently being used.

5.3.2 Bayesian Production Model

Shelley Clarke presented a Bayesian surplus production model that was applied to blue shark (*Prionace glauca*) in the North Pacific and used to estimate current and future values of stock assessment reference points (ISC/05/MARWG&SWOWG/20). Several of the issues faced when selecting an assessment methodology for blue shark are expected to be encountered when assessing other non-target highly migratory species. This model's main strengths lie in the simplicity of its data requirements (catch data and at least one annual catch rate series) and its ability to incorporate existing information in the form of prior probability distributions for estimated parameters. This function facilitates fitting to time series that are less informative or have incomplete catch histories. The model was successfully fit to one series of blue shark catch rate data, resulting in model parameter and stock reference point estimates which are consistent with previous findings for this species.

The working group discussed the relevance of this assessment method to data limited billfish species. The use of informative priors on key parameters (in particular *r*) may be necessary to improve model behavior when the CPUE series is not very informative. Work toward developing an informative prior for *r* will be important for billfish assessments in the North Pacific.

5.4 Formal Peer-Review Process of ISC Stock Assessments

Gerard DiNardo presented a proposal calling for the ISC to establish a formal stock assessment peer-review process. As assessment results become more contentious, or assessment models more complex, questions concerning the validity of the results will likely increase. Subjecting the assessments to a review process that is both transparent and open would likely mediate many of the concerns.

DiNardo noted that the impetus for establishing this process in the ISC, and monitoring progress in all working groups, lies with the ISC Plenary. Endorsement of this proposal would however provide a clear message to the Plenary regarding the importance of this issue and the need for them to act.

The working group endorsed this proposal and recommends it be presented at the 2006 ISC Plenary meeting.

6.0 WORKING GROUP RESEARCH PLANS

Based on the presentations and discussions, the 2004 work plans were updated to address critical needs for research to support marlin and swordfish stock assessments (Attachments 4 and 5). The working group agreed on the fundamental importance of establishing a comprehensive database of billfish fishery data and making it accessible to Marlin and Swordfish Working Group scientists engaged in stock assessments and related research.

7.0 FUTURE MEETINGS, WORKSHOPS, AND SYMPOSIA

7.1 First World Symposium on Swordfish

Gerard DiNardo presented a proposal for a World Symposium on Swordfish to convene in 2007. This symposium would mark the first world-wide gathering of scientists to discuss developments in ecological, biological, and resource assessment research on swordfish. Potential sponsoring organizations might include FAO and ICCAT. The location of the symposium has yet to be decided, but an Atlantic Ocean local would be preferable.

Participants endorsed the idea of a World Symposium and an Atlantic Ocean venue. Gaining sponsorship takes time and keeping to the proposed schedule (2007) requires immediate action. It was decided that the chairs of the Swordfish and Marlin Working Groups will work with Makoto (Peter) Miyake to develop proposals for submission to potential sponsors. It was further decided that working group participants should discuss the proposed symposium with their respective agency/organization and that the proposal be presented at the 2006 ISC Plenary meeting.

7.2 November 2005 Striped Marlin Workshop

Gerard DiNardo presented details of the PIFSC hosted North Pacific striped marlin stock assessment workshop scheduled for November 15-21, 2005. Workshop participants will review submitted information and compile the sets of data to be used in the workshop. Participation is open to scientists from ISC member countries and organizations, as well as invited scientists.

The working group endorsed the November striped marlin workshop and recommended that stock assessments be conducted using an integrated model (MULTIFAN-CL) and a biomass dynamic model (Bayesian surplus production). For the November workshop the assessments will consider a single, spatially-structured, stock across the North Pacific (north of the equator).

The working group further recommends that prior to the November assessment workshop each country provide standardized CPUE series (indices of abundance) and documentation describing the methods used to derive the series to the Marlin Working Group chair. Each country should also provide category III data for the assessment meeting.

Progress reports on data availability should be sent to Gerard DiNardo within 30 days from the end of this meeting. Data should be compiled in the standard ISC format, and in a 1^o x 1^o degree spatial scale if possible.

7.3 Working Group Meetings Schedules

Gerard DiNardo presented a proposed schedule for future working group meetings and assessment workshops. DiNardo pointed out the benefits of joint Marlin and Swordfish Working Group meetings, and a dedicated cooperative stock assessment workshop. Participants agreed that two joint working groups meetings should occur annually, one coincident with the ISC Plenary Meeting, the other an intercessional meeting. It was further agreed that for the time being a dedicated stock assessment workshop during the winter months was beneficial. Once assessments on the major billfish stocks have been completed (striped marlin, swordfish, and blue marlin) the need for a dedicated assessment workshop should be reviewed. The next joint meeting of the Marlin and Swordfish Working Groups will occur on 21-22 March 2006, prior to the 6^{th} meeting of the ISC Plenary in La Jolla, California U.S.A. A 5-day intercessional joint meeting of these two working groups is tentatively scheduled to occur sometime during the late August to early September 2006 time period with the location to be determined. The working group chairs will work with the ISC membership to identify a host country/organization. The participants also agreed to the following stock assessment workshop schedule: 2005, striped marlin; 2006, swordfish; 2007, blue marlin.

8.0 CLEARING THE REPORT

The Chairmen's and rapporteurs' compiled a draft report of the meeting from available authors' paper summaries and rapporteurs' reports. Copies of the draft report were circulated to all participants for review, comment, and approval. A complete draft of the report will be distributed by the Chairmen's for approval and final adoption.

9.0 ADJOURNMENT

The meeting was adjourned at 15:00 on 2 September 2005. The Chairmen thanked all participants for their cooperation in making this a successful meeting, and expressed their appreciation to the NRIFSF for their support and gracious hospitality.

Table 1. List of potential data sources (by country and organization) under consideration for use at the November 2005 striped marlin stock assessment.

Fishery/Source	Data Cat.	Spatial Scale	Japan	USA California	USA Hawaii	IATTC	Chinese-Taipei	Mexico	Korea	SPC	China
Country/Organ. (Data Contact)			Yokawa	Skillman	Skillman	Hinton	Chang	Dreyfus	Moon	Lawson	?
Distant Longline	**I** **II** **III**	1º x 1º	Yes 1960s→ EFL, proc. Wt			No Yes, Time? No	NPALBWG 5º x 5º No		NPALBWG 5º x 5º No	Ask? Ask? Ask?	Ask? Ask? Ask?
Offshore Longline	**I** **II** **III**	1º x 1º	Yes 1960s→ EFL, proc. Wt	Yes 1990→ No	Yes 1991→ No	Partial Time? No	Yes No? No			Ask? Ask? Ask?	Ask? Ask? Ask?
Coastal Longline	**I** **II** **III**	1º x 1º	Yes 1994→? EFL, proc. Wt			Yes 1º x 1º lit Little	Partial No? No	Ask? Ask? Ask?			
High-Seas Drift Net/Large Mesh	**I** **II** **III**	1º x 1º	Yes 1960-92 EFL (Observer)				Yes? ? No				
Coastal Gill-Net	**I** **II** **III**		Partial 1970s→ None					Ask? Ask? Ask?			
Purse Seine	**I** **II** **III**					Yes 1º x 1º EFL				? ? ?	
State Records	**I**				1948→						
Fishing Clubs	**III**		RW only 1986→	RW Wt. only 1950? →							
Research/ Training Cruises	**III**		EFL, Wt, Sex		EFL, Wt, by Sex 1950s→						
Market Samples	**III**				1960→ Auction EFL, Wt.		EFL, Wt., Sex				
Observers	**III**			EFL	EFL	EFL	2004→?	Ask?			

Attachment 1. List of the Participants

Chinese-Taipei

Chi-Lu Sun
Institute of Oceanography
National Taiwan University
1, Sect. 4, Roosevelt Rd., Taipei, Taiwan, 106
886-2-23629842 (tel&fax)
chilu@ntu.edu.tw

Japan

Norihisa Baba
National Research Institute of Far Seas Fisheries
5-7-1, Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6037, 81-543-35-9642 (fax)
norihisa@fra.affrc.go.jp

Masashi Ikeda
Resources and Environment Research Division
Fisheries Agency, Government of Japan
1-2-1, Kasumigaseki, Chiyoda-ku
Tokyo, 100-8907, Japan
81-3-3501-5098, 81-3-3592-0759 (fax)
masashi_ikeda@nm.maff.go.jp

Minoru Kanaiwa
Japan NUS Co., ltd
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6039, 81-543-35-9642 (fax)
kanaiwa@fra.affrc.go.jp

Sayaka Koyama
Hokkaido University
3-1, Minato, Hakodate, Hokkaido, Japan, 041-0821
81-138-40-8830, 81-138-40-8832 (fax)
sayaka-mumu@mesh.fish.hokudai.ac.jp

Naozumi Miyabe
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6074, 81-543-35-9642 (fax)
miyabe@fra.affrc.go.jp

Makoto P. Miyake
Scientific Adviser, Japan Tuna
3-3-4, Shimorenjaku, Mitaka-Shi, Tokyo, Japan
81-422-46-3917, 81-422-43-7089 (fax)
p.m.miyake@gamma.ocn.ne.jp

Fumihito Muto
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6034, 81-543-35-9642 (fax)
mtf@fra.affrc.go.jp

Hiroaki Okamoto
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6044, 81-543-35-9642 (fax)
okamoto@fra.affrc.go.jp

Hirokazu Saito
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6035, 81-543-35-9642 (fax)
hisaito@fra.affrc.go.jp

Yasuko Semba
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6045, 81-543-35-9642 (fax)
senbamak@fra.affrc.go.jp

Tamaki Shimose
University of the Ryukyus
717-5-508, Minamiuebaru, Okinawa, Japan, 901-2424
tamaki_shimose@yahoo.co.jp

Mio Takahashi
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6035, 81-543-35-9642 (fax)
m.takahashi@fra.affrc.go.jp

Yukio Takeuchi
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6039, 81-543-35-9642 (fax)
yukiot@fra.affrc.go.jp

Yuji Uozumi
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6011, 81-543-35-9642 (fax)
uozumi@fra.affrc.go.jp

Koji Uosaki
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6032, 81-543-35-9642 (fax)
uosaki@fra.affrc.go.jp

Harumi Yamada
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6034, 81-543-35-9642 (fax)
hyamada@fra.affrc.go.jp

Kotaro Yokawa
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6035, 81-543-35-9642 (fax)
yokawa@fra.affrc.go.jp

United States

Keith Bigelow
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822-2396
1-808-983-5388, 808-983-2902 (fax)
Keith.Bigelow@noaa.gov

Shelley Clarke
Joint Institute for Marine and Atmospheric Research, University of Hawaii
National Research Institute of Far Seas Fisheries
5-7-1 Orido, Shimizu, Shizuoka, Japan, 424-8633
81-543-36-6046, 81-543-35-9642 (fax)
sclarke@fra.affrc.go.jp

Atilio (Al) Coan
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
1-858-546-7079, 858-546-7003 (fax)
al.coan@noaa.gov

Ramon Conser
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
1-858-546-5688, 858-546-7003 (fax)
rconser@ucsd.edu

Gerard DiNardo
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822-2396
1-808-983-5397, 1-808-983-2902 (fax)
Gerard.Dinardo@noaa.gov

Robert Humphreys
NOAA/NMFS PIFSC WestLAB
Suite 417, 99-193 Aiea Heights Drive
Aiea, HI 96701-3119
1-808-983-5377, 808-983-2902 (fax)
Robert.Humphreys@noaa.gov

Russell Ito
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822-2396
1-808-983-5324, 808-983-2902 (fax)
Russell.Ito@noaa.gov

Pierre Kleiber
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822-2396
1-808-983-5399, 808-983-2902 (fax)
Pierre.Kleiber@noaa.gov

Suzanne Kohin
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
1-858-546-7104, 858-546-7003 (fax)
Suzanne.Kohin@noaa.gov

Kevin Piner
NOAA/NMFS SWFSC
8604 La Jolla Shores Dr.
La Jolla, CA 92037
1-858-546-5613, 858-546-7003 (fax)
Kevin.Piner@noaa.gov

Jerry Wetherall
NOAA/NMFS PIFSC
2570 Dole Street
Honolulu, HI 96822-2396
1-808-983-5386, 808-983-2902 (fax)
Jerry.Wetherall@noaa.gov

IATTC

Michael G. Hinton
Inter-American Tropical Tuna Commission
8604 La Jolla Shores Drive
La Jolla, CA 92307-1508
1-858-546-7033, 858-546-7133 (fax)
mhinton@iattc.org

Attachment 2. Working and Information papers submitted at the August 29 – September 2, 2005 Joint Session of the ISC Marlin and Swordfish Working Groups

ISC/05/MARWG&SWOWG/01. Status of ISC Data Base Inventory for the Fisheries Related with Marlins and Swordfish. Harumi Yamada, Mio Takahashi and Fumihito Muto

ISC/05/MARWG&SWOWG/02. Review of the ISC Albacore Working Group Data Base. Atilio L. Coan Jr.

ISC/05/MARWG&SWOWG/03. Review of Product Form Conversion Ratios for the Hawaii Billfish Catch. Russell Y. Ito

ISC/05/MARWG&SWOWG/04. LJFL and EFL relationship for the billfishes caught by the Chinese-Taipei offshore and coastal fisheries. N.J. Su, C.L. Sun, S.Z. Yeh, W.C. Chiang, S.P. Wang, and C.H. Liu.

ISC/05/MARWG&SWOWG/05. U.S. Commercial Fisheries for Marlins in the North Pacific Ocean. Russell Y. Ito and William A. Walsh.

ISC/05/MARWG&SWOWG/06. U.S. West Coast fisheries and data collections for swordfish and striped, blue and black marlin. Atilio L. Coan Jr.

ISC/05/MARWG&SWOWG/07. A review of Chinese-Taipei's billfish fishery in the Pacific Ocean. C.L. Sun, S.Z. Yeh, S.P. Wang, W.C. Chiang, and N.J. Su.

ISC/05/MARWG&SWOWG/08. Review of Japan's size data for striped and blue marlin caught by offshore and distant water longliners. Hirokazu Saito.

ISC/05/MARWG&SWOWG/09. Review of size data of swordfish caught by Japanese longliners in the North Pacific. Kotaro Yokawa.

ISC/05/MARWG&SWOWG/10. Size Composition Data for Billfishes Caught by the Hawaii-based U.S. Longline Fleet: Data Collection, Sample Sizes, and other Metadata. Jerry Wetherall and Brent Miyamoto.

ISC/05/MARWG&SWOWG/11. Analysis of the sexed size data of billfishes from the Chinese-Taipei’s offshore and coastal fisheries. Wang, S.P., C.L. Sun, S.Z. Yeh, W.C. Chiang, N.J. Su, and C.H. Liu.

ISC/05/MARWG&SWOWG/12. Review Table of Vital Rates and Life History Parameters for Striped Marlin, Swordfish, and Blue Marlin in the North Pacific Ocean. James H. Uchiyama and Robert L. Humphreys, Jr.

ISC/05/MARWG&SWOWG/13. Vertical distribution pattern of striped marlin estimated using pop-up tag data. Hirokazu Saito and Kotaro Yokawa

ISC/05/MARWG&SWOWG/14. Vertical distribution pattern of CPUE for striped marlin in the North Pacific estimated by the with data of the time, depth and temperature recorders collected through a longline research cruise of Shoyo-maru in 2004 in the north east Pacific, preliminary results. Kotaro Yokawa, Minoru Kanaiwa, Yukio Takeuchi, and Hirokasu Saito

ISC/05/MARWG&SWOWG/15. Reproductive biology of the blue marlin *Makaira nigricans* around Yonaguni Island, southwestern Japan. Tamaki Shimose, Maki Fujita, Hirokazu Saito, Kotaro Yokawa and Katsunori Tachihara

ISC/05/MARWG&SWOWG/16. Operation patterns of Japanese offshore and distant-water longliners in the North Pacific, with emphasis on the billfishes. Kotaro Yokawa

ISC/05/MARWG&SWOWG/17. Preliminary results of striped marlin CPUE standardization using a statistical habitat model. Minoru Kanaiwa, Yukio Takeuchi, Hirokazu Saito and Kotaro Yokawa

ISC/05/MARWG&SWOWG/18. Standardized CPUE of striped marlin caught by Japanese large-mesh drift fishery in the North Pacific for the periods between 1977 and 1993. Kotaro Yokawa

ISC/05/MARWG&SWOWG/19. Monitor of the change of shortening ratio of longliner gear during an operation using a newly developed buoy with a built-in GPS. Sayaka Koyama, Susumu Shimizu, Kotaro Yokawa and Hirokazu Saito

ISC/05/MARWG&SWOWG/20. Application of a Bayesian surplus production model to blue shark (*Prionace glauca*) in the North Pacific. Shelley Clarke and Murdoch McAllister

ISC/05/MARWG&SWOWG/Info-01. Report of Statistics Working Group Interim Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean January 23-24, 2002 Nagasaki, Japan

For Presentation only:

Microsatellite and mitchondrial DNA analyses of striped marlin (*Tetrapturus audax*) population structure in the Pacific Ocean. Jan R.McDowell and John E. Graves

Genetic heterogeneity of Pacific swordfish (*Xiphias gladius* L.) revealed by the analysis of ldh-A sequences. Jaime R. Alvarado-Bremer, Michael G. Hinton and Thomas. W. Greig

Attachment 3. Agenda

Report of the Marlin and Swordfish Working Groups Joint-Meeting (August 29 – September 2, 2005, Shimizu, Japan)

<u>Chairs: Gerard DiNardo and Robert Humphreys</u>

<u>August 29 (*Monday*), 1230-1700</u>
Opening

1. Registration and Distribution of Documents

2. Opening of Intercessional Meeting — DiNardo/Humphreys
   a. Introductions

   b. Welcome Remarks NRIFSF Deputy Director — Yuji Uozumi

3. Agenda — DiNardo/Humphreys

   a. Review and Adoption of Agenda

   b. Appointment of Rapporteurs

4. Fisheries Statistics Review

   a. Update from Statistics Working Group — Yamada

   b. Billfish Database Structure — Coan

   c. Annual Catches (whole animal weight) Verses Landings by Major Gear Type (Category I)
      - Review of product form conversions (e.g., gilled-and-gutted to whole weight) and discard estimation — Ito, Sun, Yokawa

   d. Catch and Effort data (Category II)

      1. Report of Japanese billfish catches and current research in the north Pacific — Yokawa

      - United States — Ito/Coan

      - Chinese-Taipei — Sun

<u>AGENDA: August 30 (*Tuesday*), 0900-1630</u>

4. Fisheries Statistics (C*ont.*)	
e. Length Frequency Data (Category III)	
1. Review of Japanese size data of striped and blue marlin caught by offshore and distant water longliners.	Saito
2. Results of analysis of Japanese sexed size data of swordfish caught by Japanese offshore surface longliners.	Yokawa
• United States	Wetherall/Coan
• Chinese-Taipei	Sun
• IATTC	Hinton
f. Fisheries Statistics Wrap-up	Humphreys/ DiNardo
Sanctioned data sets for assessments	
5. Biological Data Available information and identification of Information gaps	
a. Biological Information Data Matrix	Humphreys
b. Biological Working Paper Presentations	
1. Vertical distribution pattern of striped marlin estimated using pop-up tag data	Saito
2. Vertical distribution pattern of CPUE of striped marlin estimated using longline research data.	Yokawa
3. Result of gonad sample analysis of blue marlin caught by coastal bait boat in a southwestern island of Japan.	Shimose
4. Stock Structure	Hinton
c. Biological Data Wrap-up	Humphreys
Sanctioned data sets for assessments	

Reception: 1730-2000 (*NRIFSF*)- Welcome reception with guests and friends

AGENDA: August 31 (*Wednesday*), 0900-1700

6. Abundance Indices
   a. Standardization Techniques

1. Preliminary results of striped marlin CPUE standardization by GLM and biological habitat model.	Yokawa
2. Preliminary results of striped marlin CPUE standardization by statistical habitat model.	Kanaiwa
3. Habitat model	Bigelow/Hinton
4. Review of CPUE of striped marlin caught by Japanese large mesh drift fishery.	Yokawa
5. Progress report of a trial to construct a model to describe underwater movements longline hooks for the inputs of the habitat models.	Koyama

7. Stock Assessment Models and Data Requirements

a. Recent Assessment Models and Limitations	Piner
b. Candidate Reference Points and Model Verification	Conser
c. Alternative Assessment Models	
• MULTIFAN_CL (Improvements)	Kleiber
• Bayesian Production Model	Clarke
d. Identify Candidate Models (Based on available data)	Takeuchi/ DiNardo
e. Formal review process for stock assessments	DiNardo

AGENDA: September 1 (*Thursday*), 0900-1200

8. Working Group Research Plans	DiNardo/

Prioritize research needs, develop realistic research plans, identify collaborations, and establish timelines and products	Humphreys
9. Future Meetings and Symposia a. First World Symposium on Swordfish (Atlantic Ocean, Pacific Ocean, Mediterranean Sea, etc.), FAO, Rome, Italy or 3rd International Pacific Swordfish Symposium	DiNardo/ Humphreys
b. Nov. 2005 Striped Marlin Assessment Workshop	
c. Working Group meeting schedules	

<u>September 1 (*Thursday*), 1300-1700</u>

10. Report Preparation
   a. Rapporteurs and others complete sections

   b. Draft Report Completed

Dinner: 1900 (Banquet at local restaurant)

<u>AGENDA: September 2 (*Friday*), 1100-1500</u>

11. Clearing of Meeting Report	DiNardo/ Humphreys
12. Adjournment	

Attachment 4. 2005 Work Plan of the ISC Marlin Working Group

Objective	Research Project	Collaborators
1. Conduct biological and Oceanographic research in support of improved stock assessment	MOVEMENT: a) Estimate patterns of movement using conventional tags	Kohin, Holts, Saito
	b) Determine patterns of movement, behavior and post release mortality using PSAT tags	Musyl, Saito, PIFSC
	STOCK STRUCTURE: a) Assess stock structure of striped marlin using genetic techniques	Hinton, Purcell (USC)., PIFSC, NRIFSF
	b) Assess stock structure using fisheries data and oceanography	Hinton, PIFSC, NRIFSF
	AGE AND GROWTH: a) Continue to evaluate regional differences in size and sex Ratio, and potential biases	Saito, PIFSC, NTU
	b) Proceed with hard parts based age and growth study	PIFSC, NRIFSF, NTU
	c) Assemble conversion relationships among various length and/or weight measurements	PIFSC, NRIFSF, NTU
2. Develop and apply stock assessment models	Develop and apply spatially-explicit models of stock and fishery dynamics incorporating effects of environment, gear, fishing practices, fleet dynamics, and other factors	Kleiber, NRIFSF, IATTC, DiNardo, Conser, Clarke
3. Develop comprehensive marlin fishery database	a) Construct abundance indices for fisheries	Among all scientists
	b) Collect and incorporate marlin fishery statistics from North Pacific countries not yet included in the database	All ISC member nations, MARLIN-WG, ISC Database Administrator

Attachment 5. 2005 Work Plan of the ISC Swordfish Working Group

Objective	Research Project	Collaborators
1. Conduct biological and oceanographic research in support of improved stock assessment	AGE AND GROWTH	
	a) Continue to validate regional differences in age and growth, and aging of larger animals	Humphreys, Sun
	b) Continue studies on regional sex ratio differences by size	PIFSC, Sun, Yokawa
	c) Expand collection of data on size- and sex-composition of catch	PIFSC, Yokawa, Sun
	MOVEMENT	
	a) Estimate patterns of movement and growth rates using conventional tags	Kohin, Saito, Holts
	b) Determine patterns of movement and behavior using archival and PSAT tags	Musyl, Saito, PIFSC
	STOCK STRUCTURE	
	a) Collect samples of young swordfish from specific areas	IATTC, Yokawa, Humphreys
	b) Assess the use of otolith elemental composition to uniquely identify geographically separate nursery areas in juvenile swordfish	Humphreys, Yokawa, IATTC
	FISHERIES OCEANOGRAPHY	
	a) Assess stock structure using fisheries data and oceanography	Hinton, PIFSC, NRIFSF

Attachment 5. Future Work Plan of the Swordfish Working Group (continued).

Objective	Research Project	Collaborators
2. Develop and apply stock assessment models	a) Develop and apply spatially-explicit models of stock and fishery dynamics incorporating effects of environment, gear, fishing practices, fleet dynamics, and other factors. b) Develop sex-specific age-structured model	Kleiber, Bigelow, NRIFSF, IATTC, NTU NRIFSF, Conser, Kleiber, Sun
3. Develop, test, and apply basin-scale swordfish simulation model (low priority)	Use simulator to help develop and evaluate stock assessment models	Kleiber, Bigelow, Hinton, NRIFSF, Sun
4. Develop comprehensive swordfish fishery database	a) Construct abundance indices for major fisheries in the North Pacific b) Incorporate swordfish statistics for all fisheries catching swordfish in the North Pacific but not yet included in the database.	Among all scientists ISC Database Administrator