Annex 6

REPORT OF THE ALBACORE WORKING GROUP WORKSHOP

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

February 28 – March 6, 2008
La Jolla, California USA

1.0. INTRODUCTION

The *International Scientific Committee - Albacore Working Group* (ISC-ALBWG) Meeting was held at the Southwest Fisheries Science Center in La Jolla, California, USA from February 28 to March 6, 2008.

A total of 17 participants from Canada, Japan, Chinese Taipei, the United States (USA), and the Inter-American Tropical Tuna Commission (IATTC) attended the workshop (Appendix 1). Max Stocker served as chairperson for the Meeting. A provisional agenda that was circulated prior to the workshop received minor revisions and was adopted (Appendix 2). A total of 11 working documents were presented (Appendix 3). Paul Crone, Ray Conser, John Childers, John Holmes, Yukio Takeuchi, Chiee-Young Chen, and Naozumi Miyabe served as rapporteurs.

The charge for the Meeting was to submit data for updating Table 1 (Category 1 statistics, i.e., updates for total catch); review input data associated with an alternative stock assessment model (namely, Stock Synthesis 2 or SS2); review and further refine SS2 baseline models (in the context of potentially using SS2 for the next stock assessment); develop prototype ‘Kobe’ plots using results from the last (2006) assessment; consider recent requests for additional projections associated with the assessment; and finally, to develop general work plans for 2008-10 in preparation for the next stock assessment (early 2010).

2.0. REVIEW OF RECENT FISHERIES

Albacore tuna (*Thunnus alalunga*) is a valuable species with a long history of exploitation in the North Pacific Ocean. During the past five years, fisheries based in Japan accounted for 63.2% of the total harvest, followed by fisheries in the United States (16.9%), Canada (7.4%), and Chinese Taipei (6.8%). Other countries catching North Pacific albacore contributed 5.7% and included Korea, Mexico, Tonga, Belize, Cook Islands, and longline catches from vessels flying flags of convenience (Table 1). The total catch of albacore for all nations combined peaked at a record high of 127,376 metric tons (mt) in 1999, but has declined over the course of the last several years and has averaged roughly 86,000 mt since 2000 (Figure 1); the preliminary 2007 total harvest of approximately 86,900 mt was 28.7% higher than the total 2006 harvest.

While various fishing gears have been employed over the years to harvest albacore in the North Pacific Ocean, the main gears used over the last five years were longline (35.5%), pole-and-line (34.0%), and troll (22.9%), see Figure 2. Other fishing operations used since the mid-1990s included purse seine, gill net, recreational, and unspecified gears, which collectively, accounted for roughly 7.6% of the total catch of albacore from the North Pacific Ocean.

2.1. Canada

John Holmes presented a summary of catch, effort, and catch-per-unit-effort (CPUE) data for the Canadian north Pacific albacore tuna fishery in 2007 (**ISC/08/ALBWG/01**). The Canadian fishery for albacore in the North Pacific Ocean is a troll fishery using tuna jigs. All Canadian vessels must carry logbooks to record daily catch, effort, and location data while fishing for highly migratory species in any waters. Detailed analysis of a combination of sales slips, logbooks, phone-in and transhipment records are undertaken to report fisheries statistics for the Canadian albacore fishery.

In 2007, 196 unique Canadian vessels operated in the North Pacific Ocean and caught 6,112 metric tons (mt) of albacore in 7,135 vessel days (v-d) of fishing for a CPUE of 0.86 mt/v-d. The 2007 estimates are considered preliminary at this time, pending complete logbook submission and validation. Both catch and CPUE have followed an increasing trend over the period 1995-04 and then dropped in 2005. Catch has risen since 2005 and through 2007 as has CPUE, although the 2006 CPUE (0.93 mt/v-d) is the highest CPUE in the time-series (1995-07). Tuna were caught further north in the Canadian EEZ (Queen Charlotte Islands 51-54 °N latitude) than in 2006. Approximately 99.98% of the 2007 catch was taken within 200 miles of the North America coastline, i.e., in the Canadian and USA EEZs. Access by Canadian albacore vessels to waters in the USA EEZ is governed formally through a USA-Canada albacore fishing treaty.

In terms of research activities, a project to document the existing relational database for the Canadian Pacific albacore catch and effort data has been completed. A technical report was published in 2007 and is available at: *http://www.dfo-mpo.gc.ca/Library/327827.pdf*. A pilot project using an electronic logbook system developed by Fisheries and Oceans Canada will be conducted on 10-20 vessels in the Canadian fleet in 2008.

2.1.1. Discussion

Canada reported that no port sampling is currently conducted for purposes of collecting size-related data; however, in the past, a few vessels have voluntarily provided length measurements from particular fishing trips. In general, length-distribution data are collected from Canadian catch landed at ports in the USA and subsequently, pooled with the USA data for inclusion in stock assessment models.

2.2. Japan

Koji Uosaki summarized recent trends in the Japanese fisheries (**ISC/08/ALBWG/04**). Japan has two major fishing operations that catch albacore in the North Pacific Ocean, namely, the pole-and-line and longline fisheries. Other miscellaneous fisheries include purse seine, troll, and drift-net fisheries. Total catches by the Japanese fisheries were 38,600 mt in 2005 and 38,948 mt in 2006 (2006 figures are preliminary estimates). The albacore catch by the two major fisheries have accounted for more than 90% of the total Japanese catch in recent years, with the exception of 2004, in which the purse seine catch was atypically high.

Pole-and-line catches were 16,133 mt and 16,883 mt in 2005 and 2006, respectively, which corresponded to the smallest catches observed over the last decade. Over the last decade, the catch has fluctuated widely, ranging from 17,000 to 50,000 mt. The pole-and-line fishery catches albacore during summer and autumn from off Honshu Island through the Emperor Sea Mountain area; this fishery primarily targets skipjack tuna when not catching albacore. The number of offshore pole-and-line vessels has gradually decreased in recent years, with as many as 10 vessels leaving the fishery in 2006.

The catches by the longline fishery were 20,564 mt and 20,655 mt in 2005 and 2006, respectively. Longline landings have generally declined since 1997, when the catch peaked at 39,000 mt. The longline fishery can be classified into two categories, the 'distant-water/offshore' fishery (20 GRT vessels and larger) and the 'coastal' fishery (smaller than 20 GRT vessels). In recent years, catches from both longline fisheries have generally declined up until 2004, with slight increases observed in the last two years. For distant-water/offshore longline vessels fishing north 10°N, an increasing trend in effort (e.g., number of hooks employed) has been observed, whereas, for coastal vessels, fishing effort has been relatively stable over the recent time frame.

2.2.1. Discussion

Japan researchers highlighted the following from their review of fisheries. The 'preliminary' total catch from all fisheries in 2007 was significantly greater than previous years due to the pole-and-line catch nearly doubling from that landed in 2006. This large increase in catch for the pole-and-line fishery in 2007 is attributed to increased availability of albacore closer to Japan, which allowed mid-sized (20-120 GRT) vessels to target albacore instead of the more typical skipjack. The relatively low estimate for the number of 'offshore' longline vessels in 2006 should be considered strictly preliminary and will likely increase as more data become available. Catches from vessels <20GRT are not available from SID reports after 2002. Longline CPUE in 2006 increased in fishing areas off eastern Japan, while remaining the same as observed in 2005 in other fishing regions; and for longline vessels > 20 GRT, CPUE has declined markedly since 2000. Updates to distant-water longline catches should be more timely in the future due to improvements in logbook reporting procedures.

Finally, the ISC-ALBWG generally discussed the need for further reproductive-related research (i.e., spawning dynamics) associated with albacore, particularly, in the central and eastern Pacific Ocean, i.e., develop a better understanding of the 'boundaries' of spawning each year in the North Pacific Ocean.

2.3. Mexico

Luis Fleisher, the National Coordinator from Mexico, was unable to attend this Meeting. However, he provided a working paper (presented by Alex Aires-da-Silva) that addressed the status of Mexico's albacore fishery in the North Pacific Ocean (**ISC/08/ALBWG/09**). Estimates for 2006-07, as well as updates to earlier estimates of albacore landings, were provided. It was noted that Mexico vessels have landed relatively little albacore over the years, with catches primarily associated with incidental harvests associated with other targeting operations for particularly, yellowfin tuna, bluefin tuna, swordfish, and shark spp.).

2.3.1 Discussion

The lack of information regarding recreational catches of albacore from Mexico waters was generally discussed. The majority of the sport-related catch from Mexico's EEZ is from USA-based vessels (with Mexico-issued licenses) that depart from ports along the southern California coast (particularly, San Diego) and subsequently, land their catch back at USA ports. Ultimately, these recreational landings are reported under USA fisheries (sport), see Table 1.

2.4. Chinese Taipei

Chiee-Young Chen indicated that total catch estimates for 2007 are not yet available, but preliminary statistics from the Overseas Fisheries Development Council (OFDC) are usually presented during the spring each year and thus, 2007 estimates will be available by April 2008. Since 1995, there has been a larger component of albacore catch from longline fishing north (than south) of the equator. Catches have generally declined since 2002. The number of large-scale longline vessels that target albacore in the north Pacific Ocean ranged from 21 to 25 vessels in any given year. Between 2004 and 2006, observers have been placed onboard some longline vessels. Over the years, a general decline in CPUE has been observed, which may be in part due to changes in 'targeting' behavior of the fleet, e.g., increased effort on bigeye tuna. Logbooks now include a field for number of hooks used between floats, which will allow a more objective determination of specific fishing practices than currently possible and ultimately, bolster overall CPUE-related analysis associated with this logbook information.

2.5. United States

John Childers reported on the United States (USA) albacore troll fishery that operated in the North Pacific Ocean in 2006 (**ISC/08/ALBWG/03**). The distribution of effort in the 2007 U.S. troll fishery was similar to previous (recent) years. Total catch by the USA troll fishery increased from 8,413 mt in 2005 to 12,590 mt in 2006. Total fishing 'effort' increased from 541 vessels in 2005 to 604 vessels in 2006. Regarding 'bycatch-related' issues, minor amounts of albacore may be discarded due to being undersized, spoiled, or damaged. Incidental catches of other fish species are typically very low. The most productive fishing areas in 2007 (as in other recent years) were off the coasts of Washington and Oregon between 44°N and 47°N latitude, out to 129°W longitude.

Logbook submissions by troll vessels became mandatory in 2005; however, logbook sampling coverage is computed based on weight, not number of trips, so coverage is not 100%. Catch-per-unit-effort (CPUE) data are typically partitioned according to a 10-day by 1-degree design. Fishing success (nominal CPUE) was observed to increase from 47 to 90 fish per day from 2006 to 2007. Length data are collected by port samplers in the major unloading ports along the USA Pacific coast. Additionally, for some years, length sampling was augmented by measurements taken at-sea by fishermen involved in voluntary biological sampling programs. Fork lengths of sampled albacore ranged from 48 to 99 cm (mean=68 cm).

John Childers reported on the USA longline fleets based in Hawaii and California (**ISC/08/ALBWG/08**). Albacore are an incidental catch in the USA longline fisheries, which typically target both bigeye tuna (‘deep-set’ gear) and swordfish (‘shallow-set’ gear). Fishing effort has remained stable in recent years. There were 129 vessels in the Hawaii-based fishery and a single vessel in the California-based fishery in 2007. Total catch from the USA longline fisheries was 258 mt. The shallow-set sector of the fishery was closed in 2002 and re-opened in 2004, closed again in 2006, and re-opened again in 2007. Albacore catches declined in 2002, but did not increase when the shallow-set part of the fishery re-opened. Observer coverage on ‘swordfish targeted’ trips is 100%, while ‘tuna targeted’ trips have approximately 20% coverage.

In general, smaller albacore are taken in swordfish-related sets (shallow and located north of Hawaii), while larger albacore are caught in tuna-associated sets (deep and in more tropical waters, mostly south of Hawaii). Over the years, some discarding of albacore has been observed (mainly in the swordfish fishery, where smaller albacore are caught) but in general, is considered a minor component of the overall catch in any given year. In this context, the ISC-ALBWG recommended that this issue be generally monitored (via the sampling programs currently in place) to ensure discard-based assumptions are appropriate.

2.5.1. Discussion

USA researchers highlighted the following from their review of fisheries: in recent years, some troll vessels have converted to live bait, due to changes in schooling behavior (tighter, larger schools) and increased availability of fish (closer to the coast); fuel prices and decreased availability of fish in recent years have limited troll vessels from fishing in offshore areas that they had in past years; for the troll fishery, port samplers are being supplied with electronic calipers and computers to enhance length sampling and improve data quality; for the troll fishery, an electronic logbook has been developed and provided to fishermen; various closures associated with the swordfish (shallow-set longline) fishery have influenced the size of albacore landed in this fishery; for observer-based sampling programs associated with the longline fishery, newly implemented sampling protocols will result in fewer albacore length measurements from each sampled boat trip; and finally, regardless of the closure employed, total (annual) catch of albacore from the USA longline fishery has continued to decline since 2002.

3.0. FISHERY STATISTICS

3.1. Database Catalog

John Childers reported on the current status of the Albacore Working Group Database Catalog (**ISC/08/ALBWG/02**), including additions and updates made since the November-December 2006 Albacore Working Group meeting in Shimizu, Japan. The Database Catalog provides information on the availability of fleet-specific data pertaining to annual catches of albacore in the North Pacific Ocean and the number of active vessels in each fishery (Category I), summarized logbook catch and effort (Category II), size composition (Category III), and other forms of 'metadata' for inclusion in ongoing stock assessments and other investigations. The Southwest Fisheries Science Center (SWFSC) in La Jolla, CA maintains the Database Catalog and associated files. It provides a secure FTP server at the Alaska Fisheries Science Center, and oversees the distribution of data to ISC-ALBWG members and other scientists using the FTP site. The FTP site is accessible at ftp.afsc.noaa.gov. Access requires a user account and password. In addition to data and 'metadata,' the site archives reports, working papers from previous meetings, and derived data sets (e.g., estimated catch-by-age matrices) used in albacore stock assessments.

Category I and II data for 2007 and updates to previous years were supplied by Canada, Japan, USA, and Mexico. Several questions remained unresolved including the Working Group's approval of large scale changes to Chinese Taipei longline catches and conflicting information on data submission requirements. Finally, at the present time, it was recommended that each member country's Data Correspondent submit the required data to the ISC-ALBWG Data Manager and not the ISC Data Administrator.

3.2. Sampling Design

Paul Crone presented information regarding monitoring programs that have been in place for at least two decades (and over 50 years in some cases) for USA-based troll and longline fisheries that target albacore in the North Pacific Ocean (**ISC/08/ALBWG/05**). Each year, catch (landings), size (length), and catch-effort (catch-per-unit-effort, CPUE) data are collected via sampling plans designed for each fishery. For the most part, the troll fishery uses ports along the USA Pacific coast, whereas the longline fishery is largely based out of Hawaii.

The purpose of this paper was to document the general sampling procedures and statistics associated with these monitoring programs and in particular, present information (e.g., data collection protocols, sample sizes, potential biases, etc.) that allows consistent parameterization to be conducted within length-based/age-structured models, such as SS2.

4.0. BIOLOGICAL STUDIES

4.1. Reproductive Biology Sampling Design

Maturity schedules are critical time series in stock assessments. Current assessment models for North Pacific albacore are based on maturity-related data from the 1950-60s. To date, no expansive (spatial/temporal) reproductive-related study has been undertaken to address maturity parameters across both the North and South Pacific Oceans. That is, some studies have addressed reproductive issues associated with this species, but these efforts have been largely constrained both spatially and temporally. In this context, the ISC-ALBWG strongly recommends that a collaborative population-wide maturity study be developed in the near future; one that requires involvement (to some degree) by all ISC member nations. Other biological parameters could also be evaluated as part of this expansive sampling design, including fecundity, growth, sex ratio, etc. A general outline (sampling design) for collecting maturity-related material from commercial fishing vessels was presented at a previous ISC-ALBWG Meeting (see Crone and McDaniel 2006).

4.2. Tagging Studies

4.2.1. Archival Tagging Studies

John Childers presented an update of the USA archival tagging project for albacore in the North Pacific Ocean. The project began in 2001. Since then, 504 archival tags have been deployed. Nine tags have been recovered from deployments in the Pacific Northwest (2% return rate). Eleven tags have been recovered from deployments off southern California/Baja California (9% return rate). The overall return rate is 4%. Summarized data from all tags show the general preferences of juvenile albacore tagged in this study. Lengths of tagged fish were representative of those harvested by the USA troll and baitboat fisheries. Five distinct migration patterns were discernable from the tag returns. One fish released from the Pacific Northwest transited the Pacific Ocean to the Kuroshio current area east of Japan in 294 days. Most recovered fish that were released in the Pacific Northwest returned there the next year. Fish released off southern California/Baja California wintered in the central Pacific Ocean (not as far west as those from the Pacific Northwest), then returned to the southern California/Baja California areas. Five fish released in southern California/Baja California overwintered along Baja California, then returned to the southern California/Baja California area. One fish released in southern California/Baja California was recovered in the Pacific Northwest area. Analysis of daily swimming speeds (distance traveled divided by number of days) indicated that during the summer when fish are along the coast, daily swimming speeds were relatively slow. During the fall, swimming speed increased, when the fish move offshore to the central Pacific Ocean. In the spring, when the fish move back toward the coast, their speed increased significantly and the fish did not spend any time in residence areas. Depth/temperature profiles indicated that tagged fish remained in the upper layers, while along the coast in the summer, and had a deeper distribution in warmer waters during the winter in offshore areas. Future plans are to expand the tagging areas to the central Pacific Ocean and target different size (age) animals. Size-specific behaviors need to be examined and environmental data will be incorporated and correlated with the animals' behaviors (depth and movements).

4.2.2. Pacific Tuna Tagging Program – Western and Central Pacific

The Western and Central Pacific Fisheries Commission (WCPFC) is launching a five-year (2008-12) tagging project in the equatorial convention region, using a combination of conventional dart tags, sonic tags, and archival tags, with primary efforts focused on yellowfin, skipjack, and bigeye tunas. The goal is to provide fishery-independent data to help address uncertainties in existing stock assessments, and to investigate movement and mixing patterns of these species within the convention area, as well as between the convention area and other areas.

At present there is no multi-national collaborative tagging program for albacore that inhabit the North Pacific Ocean, although the need for one is recognized. Canada is looking into initiating an albacore tagging program similar to the USA archival tagging project, and the hope is other nations will as well. Archival tagging data can provide valuable information on albacore distribution and movement patterns, which will become increasingly important as spatial stock assessment methods develop further. However, properly designed, large-scale, conventional tagging experiments will are needed for estimation of population-wide parameters, e.g. growth rates, fishing mortality rates (F), etc. New tagging programs are particularly timely, since existing North Pacific albacore life-history data are outdated and recent F estimates are highly dependent upon CPUE trends – two factors that are critically important components in the determination of reliable reference points and current stock status relative to the reference points.

4.3. Japan SHOYO-MARU Survey

Kyuji Watanabe presented plans for investigating the dynamics of North Pacific albacore spawning adults, using the upcoming Japanese Fishery Agency *R/V* SHOYO-MARU cruise. The purpose of the survey is to examine schedules of maturation and relationships between distribution and oceanographic parameters, based on sex, length, and age of the sampled fish. General survey design protocols are: (1) longline sets will be made in both day and night (anticipating roughly 35 sets in total); (2) archival and pop-up tags will be deployed on a subset of the sampled fish (10 individuals); and (3) oceanographic data (e.g. temperature, dissolved oxygen, salinity, and chlorophyll) will be taken using CTDs.

5.0. STOCK ASSESSMENT STUDIES

5.1. Current Stock Assessment Approach

Currently, the ISC-ALBWG employs the VPA-2BOX approach (Porch 2003) for stock assessment. VPA-2BOX provides demographic estimates (e.g. age-specific stock sizes and Fs) for past years (e.g. 1975-2005 in the last stock assessment). These demographics then serve as input for a variety of stock projections that simulate the population dynamics up to and well beyond the current year. Biological reference points (BRPs) are determined as a function of the albacore vital rates (natural mortality, growth, and maturity) and aggregate selectivity (from the VPA-2BOX results). The ALBWG draws upon the above results collectively to develop consensus on the status of the albacore population in the North Pacific Ocean; and this consensus serves as the scientific basis for guiding potential management.

The ALBWG has used variants of the VPA method (ADAPT and VPA-2BOX) for estimating past demographics since 2000. During much of this time, the ALBWG has expended considerable time and effort on issues related to the most appropriate assessment method of albacore. Significant research time was dedicated to the MULTIFAN-CL model as a potential replacement for VPA. This research was fruitful but results were mixed (i.e. while MULTIFAN-CL had greater flexibility than VPA, it was not nearly as robust to minor changes in model structure and inputs); and the ALBWG continued to use VPA for its biennial assessments. Recent research efforts have focused on the SS2 method as a potential replacement for VPA. Stocker (2006) provides further discussion and details regarding this ongoing effort within the ALBWG.

5.2. Alternative Stock Assessment Models

5.2.1. Converting from VPA to Alternative Stock Assessment Model

Mark Maunder made a presentation on “Converting from VPA to a statistical stock assessment: things you need to know.” No working paper was presented. . There are several differences between traditional applications of backward-estimation VPAs and forward-estimation, statistical catch-at-age analyses (SCA, e.g., Stock Synthesis 2 or SS2). It is important to note that both approaches involve statistical estimation; however, SCAs are generally considered more flexible in terms of sensitivity analysis surrounding important areas of uncertainty in an overall stock assessment. Some of the differences have been bridged in modern applications of VPA; however, inherent differences in estimation methods preclude explicitly parameterizing the two approaches in a similar context. The main differences include: (1) VPAs require catch-at-age data for all years, while SCAs only use the years that are available; (2) VPAs allow the relative total fishing mortality-at-age (i.e. partial recruitment) to change over time, while SCAs assume selectivity for any given fishery is constant over time (but can accommodate varying selectivity patterns as well); and (3) VPAs assume catch-at-age is known without error, while SCAs explicitly models the error. The SCA applications can approximate a VPA by combining fishery-specific catch-at-age data into a single fishery and allowing the selectivity to change over time.

When converting from an existing VPA application to a forward-projection catch-at-age analysis, there are several issues that need to be considered. These include: *modeling timeframe*: should the model start before catch-at-age data are available for all fisheries, and should an annual or other (e.g. quarter) time-step be used?; *population dynamics structure*: is a simple age-structured model adequate, or should other structures be used (e.g., partitioned by sex)?; *separating data into multiple fisheries*: should fisheries be defined by gear, season, space, time, and does one fishery have an asymptotic selectivity to improve model stability, and should selectivity change over time?; *treating indices of abundance*: should indices be age-aggregated or age-specific and which ones should be included?; *treating catch-at-age data*: should data be included as age, length, and/or length-age?; *parameterizing initial conditions*: potential parameters to estimate include initial fishing mortality, initial equilibrium recruitment offset, age-specific deviates, and should the model be fit to an initial catch estimate?

5.2.1.1. Discussion

It was generally recognized that many of these issues are well understood and assessment scientists have found ways of dealing with them in practice. Both the SCA and VPA-2BOX methods are statistical models in that they rely upon a well defned objective function and use maximum likelihood for parameter estimation. Model flexibility and robustness are important trade-offs in selecting a model for stock assessment and the concomitant provision of practical management advice. An important structural difference between the methods is that VPAs assume no error in catch-at-age, whereas, SCAs allow such error explicitly. However, it was noted that extensive simulation studies (including ICCAT workshops dedicated to this issue) have not shown important effects of ignoring error in the catch at age.

5.2.2. Stock Synthesis 2 (SS2)

5.2.2.1. SS2 Overview

Rick Methot presented an overview of the Stock Synthesis 2 (SS2) model. The SS2 platform is in the class of assessment models termed integrated analysis. The SS2 model incorporates a population sub-model operating by forward simulation, an observation sub-model to estimate expected values for various types of data, and a statistical sub-model to characterize goodness of fit associated with the input data and finally, to obtain best-fitting parameters with associated variance. The model includes a rich feature set, including age- and size-based population dynamics and the ability to specify observational phenomena, such as ageing imprecision. Model parameters can vary randomly or across time blocks, or can be specified as functions of environmental data. The model includes routines to estimate MSY and exploitation levels that correspond to various standard fishery management targets. A user-selected harvest policy is used to conduct a forecast in the final phase of running the model. The model is coded in AD Model Builder (Otter Research Ltd. 2001). This platform is included in the NOAA Fisheries Assessment Toolbox (http://nft.nefsc.noaa.gov/), which incorporates a graphical user interface developed by Alan Seaver (NEFSC).

The SS2 model was first used for operational assessments in 2005. In 2007, SS2 was updated to version 2.00, which incorporated several enhancements including algorithms to define movement between assessment sub-areas and enhanced controls over processes for growth, selectivity, and recruitment. Its usage has expanded beyond USA Pacific coast groundfish assessments to include several groundfish stocks in Alaska and southeast Australia, west coast sardine and mackerel, and some tuna and billfish assessments conducted in the North Pacific Ocean (including albacore). Finally, enhancements under development in 2008 include the capability to analyze tag-recapture data and weight frequency data.

5.2.2.2. Preliminary SS2 Analysis

Paul Crone presented information regarding development of an alternative stock assessment model for North Pacific albacore (**ISC/08/ALBWG/06**). This paper is based on analyses conducted since the last ISC-ALBWG (Stock Assessment) Meeting, which was held November/December 2006 (see Stocker 2006). The information presented here is intended to:

(1) support an objective of the ISC-ALBWG, i.e., explore population modeling based on an alternative stock assessment model (SS2) to the VPA-2BOX model currently used for ALBWG assessments;
(2) provide preliminary results from a suite of models structured similarly to the ongoing VPA models, i.e., configurations that generally mirror the parameterization of the VPA model; and
(3) present discussion related to more detailed SS2-based models that include alternative time series (both biological and CPUE) that differ, to some degree, from those used in the VPA.

Three Model scenarios (**A-C**) were prepared, distributed, and further refined for purposes of review prior to this Meeting. In general, these 'scenarios' represented a suite of broadly constructed models based on combinations of biological distributions (age and length), fishery-based relative indices of abundance (age-specific and age-aggregated CPUE), and associated time-steps (annual and quarter). Particular attention is given to Model scenario **A** variants, given input data and parameterization in these models are most similar to the ongoing VPA.

Kyuji Watanabe presented (**ISC/08/ALBWG/11**) results from preliminary SS2-related analyses, basic model structures follow: (1) in 'scenarios' 1, 2, and 3, quarterly time steps and length data were used, and $\ln(R_0)$, offset for initial R, σ_r and growth were all estimated; (2) in 'scenario' 4 (structured similar to VPA), annual time steps and age data were used, and $\ln(R_0)$, offset for initial R, σ_r and growth were fixed.

5.2.2.2.1. Discussion

The ISC-ALBWG agreed that in the first phase of SS2 model development that Model **A** and its variants (see **ISC/08/ALBWG/06**) receive the highest priority, given: (1) an age-based model is more straightforward than the corresponding length-based versions (Model scenarios **B** and **C**) and thus, easier to evaluate when attempting to mirror past VPA configurations; and ultimately, (2) data used are most consistent with the ongoing VPA. Further, the ALBWG identified two configurations in particular (under Model **A** scenario) that should serve as the best baseline models to proceed from at this Meeting, as well as future modeling efforts to be conducted in 2008-09, i.e., Models **A1** and **A3** (it is important to note that the final Models **A1** and **A3** presented in this Report were modified during the Meeting and thus, should not be compared strictly with the original Models as presented in paper **ISC/08/ALBWG/06**). The most important difference between Models **A1** and **A3** is the manner in which fisheries were modeled, i.e., in Model **A1**, a 'single' fishery with an aggregated catch-at-age matrix (CAA) was used, whereas in Model **A3**, 'multiple' fisheries (with fishery-specific CAA) were used. For Model **A3**, fisheries were defined in a generally similar fashion as the process used to develop the fishery-specific CAA prepared for the VPA.

Table 2 presents important parameterization-related factors associated with Models **A1** and **A3** (see Appendix 4 for detailed description of the structure of these two baseline models). Model A1, with time varying selectivity, generally followed the stock size trend from VPA with some differences in scale – particularly over the last decade (e.g. see spawning stock biomass, *SSB*, comparison in Figure 3). However, selectivity parameterization in Model **A1** was somewhat problematic in that selectivity (as a function of age) was assumed to be asymptotic, whereas the selectivity associated with the VPA models reflected a bimodal pattern. For NPALB, the bimodal selectivity pattern may be more credible in that it reflects a 'meshing' of the two major fishing operations (surface gears that capture smaller/younger fish and longline fisheries that typically catch bigger/older animals).

Thus, the ISC-ALBWG recommended that emphasis be focused on Model **A3**, given details of fishery-specific selectivity could be better handled than in Model **A1**. It should be noted that early configurations of Model **A**3 provided similar trends in estimated *SSB* as produced in past VPA models (as well as Model **A1**), but the magnitude (or scale) of the estimated SSBs was substantially higher than estimated in VPA models. Subsequently, a profile on 'starting conditions' (i.e., $\ln R_0$) was conducted to evaluate overall model fits and scale of estimated *SSB*, as well as to determine what aspects of the input data (e.g., age compositions vs. CPUE indices) were most influential in the overall model fit (see Appendix Figure 4-1 and 4-2). A review of the diagnostic values revealed relatively poor fits to portions of the age compositions for some fisheries (e.g., ascending limbs of selectivity patterns associated with the Japan pole-and-line fishery and age 9+ for the Japan 'large' (distant water/offshore) longline fishery). Finally, further attention was focused on these selectivity-related issues, which resulted in much improved fits, as well as estimated *SSB* that was more in line with past VPA models and Model **A1** (Figure 4).

The consensus of the ISC-ALBWG regarding transitioning to an SS2 model for the next stock assessment follows:

(1) from <u>preliminary</u> review, Models **A1** and **A3** provide SSB estimates that are generally similar to the VPA (especially with respect to trend but also in scale for most of the time series). Model **A3**, in particular, is biologically reasonable (e.g. the bimodal aggregate selectivity estimates) and fits the fisheries and CPUE data fairly well;

(2) although any model transition process (e.g. VPA to SS2) should address consistency in management-related outcomes that result from employing dissimilar models, it should be recognized that due to differences in assumptions and intrinsic model structure, some differences in outcomes are likely to be found;

(3) further work should be conducted in 2008-2009 to confirm (1), above, and subsequently further improve the SS2 model for NPALB; and

(4) finally, decisions regarding which models (say SS2 and/or VPA) should be used for the next stock assessment (early 2010) should be made at an ISC-ALBWG meeting in 2009 – allowing sufficient time for ALBWG members to prepare data and carry out preliminary modelling well in advance the early 2010 ISC-ALBWG meeting.

5.3. Variability in North Pacific Albacore Length Composition

Koji Uosaki presented information regarding the ratio of relatively large fish (105 cm or larger) in the longline catches from some areas of the North Pacific Ocean, particularly, the area bounded by 10˚N to 25˚N latitude / 130˚E to 160˚E longitude, where the composition of large fish has declined from 70 % to 20% from 1994-01. However, this decline in large fish from catches made in other areas was not observed over the same time frame, e.g., fish caught further east (10˚N to 25˚N latitude / 170˚E to 160˚W longitude), see **ISC/08/ALBWG/13**. In this context, changes in size of fish landed will necessarily influence future development of catch-at-age time series for ongoing assessment efforts. Although it is essential that length compositions within each stratified cell be based on specific time/area combinations, development of overall catch-at-age time series was reasonably homogeneous, with the exception of area 3 (10˚N to 25˚N latitude / 120˚E to 170˚W longitude). In the future, area classification issues will be addressed in the construction of: all catch-at-age time series associated with these longline fisheries; all age-specific CPUE indices; and potentially, it may be necessary to re-examine the catch dynamics associated with the Chinese Taipei longline fishery as well.

5.3.1. Discussion

It was noted that the Chinese Taipei longline fishery generally overlaps (say some spatial/temporal combinations) with the Japanese longline fishery. Also, it was noted that the Chinese Taipei longline fishery typically targets bigeye tuna from 0˚ to 20˚N latitude; however, targeting-related dynamics associated with this fishery are not well understood at this time. Observers have been measuring albacore onboard Chinese Taipei longline vessels since 2002, but coverage rates have been low. Further, it was reported that length compositions previously submitted by Chinese Taipei were reviewed at an earlier workshop and deemed biased (to some degree) and ultimately, were not recommended for inclusion in stock assessments. The National Coordinator for Chinese Taipei communicated that, in the future, these size data will be revisited and in effect, critically compared with size data collected from Japan-based fisheries in the same area/time periods to better ascertain their utility, if any, in future assessments.

Sample sizes for length compositions from Japan longline fisheries were relatively low during the 1990s, but have increased since 2001. Also, the proportion of large fish in samples has declined since the mid 1990s for some fishing areas (see above). The Working Group indicated that since the size structure of albacore in longline areas (e.g., area 3) is not homogeneous, it may be necessary to further stratify spatially when summarizing data for inclusion in ongoing stock assessments. Finally, the use of size data in future SS2 models will need careful consideration, given sample availability related to quarter-based time steps in relation to annual-based length compositions.

5.4. Age-aggregated vs. Age-specific CPUE Indices

Kyuji Watanabe presented a paper on causes of disparity between age-aggregated and age-specific abundance indices for North Pacific albacore from the Japan longline fishery (**ISC/08/ALBWG/12**). The reason for general differences in the two types of CPUE indices is strictly due differing estimation procedures. In particular, for development of age-specific abundance indices, length classes were weighted by spatial-related attributes, whereas, for age-aggregated CPUE, this was not the case.

5.4.1. Discussion

The ISC-ALBWG noted that given abundance is influenced by the size of the area sampled, it was recommended to include a spatial variable in the standardization process for age-aggregated CPUEs and age-specific indices (see above), and potentially, for fisheries other than longline (e.g., pole-and-line). Finally, it was generally communicated that analysts strive to maintain consistency when deriving CPUE trends for different fisheries and time periods (particularly, when used in stock assessments); however, indices should be updated using the most accurate methods available to ensure ongoing stock status determinations are appropriate.

6.0. STOCK STATUS

At the onset, a formal stock assessment was not conducted at this Meeting of the ISC-ALBWG (February 28-March 6, 2008).

The last NPALB stock assessment was carried out in December 2006. At this meeting, the ISC-ALBWG was informed by Dr. Gary Sakagawa (ISC Chairman) that the next NPALB stock assessment will be scheduled for early 2010. The most current information pertaining to stock status determination for this species can be found in Stocker (2006), as well as in ISC (2007), Annex 5. Pertinent conclusions reached from the albacore assessment conducted in 2006 follow:

> "… although current *SSB* reached a historically high level in 2006 (roughly 153,000 mt), projected levels of *SSB* are forecasted to decline to the long-term average (approximately 100,000 mt) observed over the modeled time period (1966-05), i.e., the stock is predicted to decline to the equilibrium level of roughly 92,000 mt by 2015. Further, the ISC-ALBWG strongly recommended that all countries support precautionary-based fishing practices (e.g., limits on current levels of fishing effort) at this time, given the following:

(1) the current level of fishing mortality (i.e., spawning potential ratio of $F_{17\%}$) is high relative to commonly used reference points and often associated with overfishing thresholds in various fisheries world-wide;

(2) a retrospective analysis indicated a noticeable trend of over-estimation of stock biomass over the last two assessment cycles;

(3) the considerable decline in total (North Pacific Ocean) catch over the course of the last two years, particularly in 2005, when the total harvest (roughly, 62,000 mt) was the lowest recorded since the early 1990s; and

(4) a fishing mortality-based reference point ($F_{\text{SSB-Min}}$) designed to ensure that *SSB* in future years remains within the range of the historical 'observed' *SSB* was introduced at an earlier ISC Plenary Meeting conducted in 2005. Even though the ISC forum has not yet determined which reference points are appropriate for North Pacific albacore (or other highly migratory stocks), preliminary discussions within the ISC Plenary forum in 2005 regarding candidate *SSB*-based 'thresholds' to consider, including: minimum 'observed', lower 10th percentile, lower 25th percentile, and median. In this context, at the 95% probability of success, all of the thresholds (lower 10th percentile, lower 25th percentile, and median) would require reductions in future *F* from the current estimated level (*F*=0.75); noting that the future *F*=0.64 associated with the minimum 'observed' SSB target is roughly equal to the current rate. However, this minimum *SSB* value occurred at the beginning of the overall, estimated time series and necessarily reflects additional uncertainty. Thus, the ISC-ALBWG felt that the thresholds based on the lower 10th percentile, lower 25th percentile, and median represented more robust and ultimately, precautionary thresholds that should be considered."

7.0. SPECIAL ASSIGNMENTS

7.1. Action Plan From ISC7 Plenary (July 2007)

7.1.1. IUU Fishing

The action plan from the ISC 7 Plenary dictated that the ISC-ALBWG review potential 'illegal, undocumented, and unregulated' (IUU) fishing in the North Pacific Ocean and ultimately, consider the impact of these operations on future stock assessments for albacore.

Anecdotal evidence suggests that IUU fishing is likely occurring (to some degree) on the albacore stock in the North Pacific Ocean; however, it is important to note that the actual level of removals year-to-year is strictly unknown and thus, precludes accounting for these potential catches in any quantitative manner in formal stock assessments. At present, no country has a formal program for monitoring IUU or obtaining such Category I data (say catch as presented in Table 1 by nation/gear). In this context, the Working Group determined that at this time, IUU estimates could not be adequately defended and thus, should not be incorporated in future assessment efforts. Rather, the ISC-ALBWG suggests that what was needed at this time was a joint, multi-ISC-WG working paper that addresses IUU fishing in the North Pacific Ocean in general and subsequently, individual working groups could then address the relevancy of these fishing operations on species of interest. Finally, the Working Group recommended that enforcement-related committees associated with the WCPFC and IATTC should begin to consider how best to 'monitor' these unregulated fisheries in the future, e.g., to collect even preliminary, quantifiable evidence that such fishing practices are now operating in the North Pacific Ocean.

7.1.2. Rescue of Historical Fishery Data

The action plan from the ISC 7 Plenary charged the ISC-ALBWG with continuing efforts to rescue historical fishery data pertaining to albacore. It should be noted that this issue was examined rigorously in previous workshops, i.e., decisions that culminated in a modeled time period that now begins in 1966 (vice 1975 in earlier assessments). For albacore, the benefits of extending time series further back than 1966 are limited, given: partitioning catch statistics by species becomes problematic the further back in time that is considered; potential biases associated with size/age and CPUE data collected in the 1950s and early 1960s; and given that substantial exploitation has occurred on the albacore stock since even the early 20th Century, coupled with the species' relatively short lifespan (roughly 12-15 years), necessarily precludes obtaining better estimates of virgin biomass levels with further extended time series (i.e., in effect, obtaining better information for 'starting' the model). Thus, at this time, the consensus from the ISC-ALBWG remained unchanged, i.e., for stock assessments, time series should begin no earlier than 1966. Finally, at ISC 7 Plenary, the ISC-ALBWG presented the following statement on historical data rescue: "Albacore data starting in 1966 have been rescued and used in the 2006 assessment. However, problems have been encountered when attempting to rescue data from the 1952-66 period, because these data are mostly limited to annual catch values and are not useful for the kind of fine-scale assessment models being run by the ISC-ALBWG. In addition, these early data are often confounded by problems with species identification. Therefore, in this case, there is a trade-off between the length of the data series and its quality."

7.1.3. Kobe Diagrams

The action plan from the ISC 7 Plenary stipulated that the ISC-ALBWG develop prototype 'Kobe' diagrams, based on the last formal assessment results (2006) and candidate MSY proxy reference points.

Ray Conser presented a paper on an algorithm for Kobe diagrams with application to North Pacific albacore (**ISC/08/NPALB/07**). Kobe diagrams have been recommended for all tuna stocks as a straightforward method of portraying the status of a stock (First Joint Meeting of the Tuna Regional Fishery Management Organizations, Kobe, Japan, January 2007). For each year in the assessment period, a Kobe diagram presents the ratio statistic of 'current' F / F_{MSY} (along the y-axis) against the ratio of 'current' SSB / SSB associated with F_{MSY} (along the x-axis), see Figure 5. However, MSY-based parameters are often not well estimated in fishery models, primarily due to difficulties in estimating steepness associated with stock-recruitment relations and consequently, MSY proxies are frequently used for providing advice for management, e.g., $F_{40\%}$, $F_{0.1}$, etc.

Further, note that at this time, no MSY-proxy reference point has been agreed for North Pacific albacore management. In recent years, stock assessments have provided a suite of potential reference points, namely $F_{40\%}$, $F_{30\%}$, $F_{20\%}$, $F_{0.1}$, and F_{MAX}. More recently, the ISC-ALBWG has also developed minimum *SSB* reference points that in effect, are *F*-based estimators that, for any pre-specified probability, ensure that *SSB* will not decline below historically 'observed' *SSB* levels.

Based on the most recent stock assessment (Stocker 2006), Kobe diagrams indicating stock status over 1968-2004 were developed for $F_{40\%}$, $F_{30\%}$, $F_{20\%}$, $F_{0.1}$, and F_{MAX}. The Kobe diagram using $F_{40\%}$ as the F_{MSY} proxy indicated that all years fell in the upper-left quadrant (Figure 5a), while the corresponding $F_{20\%}$ diagram was characterized by some years in each of the four quadrants (Figure 5b); the latter situation is more common for a long-term time series of assessment results, such as the 37-year time series for albacore.

7.1.3.1. Discussion

The ISC-ALBWG noted that the current Kobe plots present point estimates (more specifically, 3-yr moving averages). An equally important consideration is the uncertainty associated with these point estimates, particularly, for the last or most recent year(s). It was noted that 'error' associated with the most recent point estimate could be included in the future

With the exception of F_{MAX} (as the F_{MSY} proxy), all Kobe plots indicate the albacore stock is currently in the upper-left quadrant, i.e., associated with relatively high fishing mortality and low *SSB* (i.e. overfishing and overfished status). However, it should be noted that consistent with the last stock assessment, 2004 was the last year used in the Kobe analysis. But stock projections indicated large increases in SSB in 2006 and 2007, as the strong 2001 and 2003 year-classes entered the spawning stock. Consequently, Kobe plots associated with the next stock assessment may be more optimistic with respect to the 'current' SSB ratio, but these strong year-classes may have little effect on the 'current' F ratio.

The Kobe plots for $F_{40\%}$, $F_{30\%}$, and $F_{0.1}$ showed all (or nearly all) years in the upper-left quadrant (e.g. see Figure 5a). While this can occur, it is more common with a long time series (37 years for albacore) to have a year-to-year path that moves among the quadrants over time (e.g. as for $F_{20\%}$ in Figure 5b). The causal mechanism for this outcome was discussed at some length. While some managers may favor the $F_{20\%}$ reference point as an F_{MSY} proxy because its Kobe plot demonstrates that the fishery is capable of operating in the 'safe' zone (lower-right quadrant), the ISC-ALBWG suggests that it would not be prudent to establish an F_{MSY} proxy based solely on this criterion. It should be recognized that Kobe plots are highly dependent on life history assumptions (e.g., maturity, growth, longevity, etc.). The albacore life history assumptions are based on outdated studies and may be partly or fully responsible for the unusual nature of the albacore Kobe plot results.

The F_{MAX} Kobe plot indicates that the stock has been in the lower-right quadrant for all years (i.e. neither overfishing nor overfished status). But over the last several stock assessments, the ISC-ALBWG has urged caution in using F_{MAX} as an F_{MSY} proxy for albacore because (i) it was not well estimated and (ii) its magnitude was large and not credible ($F_{MAX} = 2.1$ yr^{-1} in the 2006 assessment).

Finally, it was noted that Kobe analysis was not carried out for the $F_{SSB\text{-}MIN}$ reference points provided in the last albacore assessment (i.e. F levels that ensure the SSB in future years will not decline below 'observed' levels of SSB). The $F_{SSB\text{-}MIN}$ concept is more consistent with a 'limit' reference point, than a 'target,' such as F_{MSY} (also, see section 7.2.2). Analogous Kobe plots can be developed for limit reference points using simulation analysis. In order to make this tractable, however, it will be necessary for fishery managers and scientists to jointly develop a set of feasible projection scenarios.

7.2. Northern Committee Requests

The Northern Committee made several requests with respect to biological reference points for albacore (see *Northern Committee 3 Report - September 2007*).

7.2.1. Additional Projections

Following the Northern Committee 3 Meeting, some ISC-ALBWG members became involved in informal discussions concerning additional projections from the most recent stock assessment conducted in 2006. Some suggestions for handling additional projections follow: assume time-varying *F* and/or recruitment during the projection period; and assume constant catch during the forecasted timeframe. Ultimately, the ISC-ALBWG felt strongly that given the informal (and uncertain) context of these requests, that no further projection analysis be conducted at this time, but rather, for stock status determinations, individuals should refer to results as presented in last formal assessment (see Stocker 2006). In addition, Table 7 in ISC (2007), Annex 5 provides various *F*-related benchmarks needed to achieve a variety of objectives. Should fishery managers desire to have other management scenarios evaluated, requests should be made formally to the ISC-ALBWG – not to individual members of the WG.

7.2.2. Interim Management Objective for North Pacific Albacore

The Northern Committee requested that the ISC comment at the Northern Committee 4 Meeting (September 2008) concerning an interim management measure for North Pacific albacore, which would maintain *SSB* in the range of its historical fluctuations. As is typical in other assessment fora, the ISC-ALBWG provided a suite of potential reference points associated with estimates from the last stock assessment, i.e., evaluations based on projected levels of *SSB* in relation to historical estimates of *SSB* (see Conser et al. (2006) for description of the methodology). Presently, it is important to note that little to no formal direction has been recommended by the ISC on this matter. In general, the ISC-ALBWG felt that this type of (interim) management measure would be reasonable for albacore and further, if adopted, should not be based on forecasted *SSB* being maintained above the absolute minimum *SSB* observed over the historical time series, but rather the 10^{th} percentile or 25^{th} percentile of 'observed' *SSB*. This recommendation is made solely on statistical grounds in that the minimum is not a robust estimator. Finally, the ALBWG emphasized the need to revisit the basic biological parameters associated with this species, such as maturity and growth, given the influence these vital rates have on all stock projections and reference point calculations (see section 4.1).

7.2.3. Fishery Impacts by Gear Type

The Northern Committee requested that the ISC investigate alternative reference points, including management strategies that take into account fishery impacts by gear type and area that might be considered by fishery managers. Ray Conser presented a paper that addressed fishing mortality rates (*F*) associated with the major surface and longline fisheries that target albacore in the North Pacific Ocean (**ISC/08/ALBWG/10**). The most recent stock assessment (Stocker 2006) indicated that due largely to good recruitment pulses (i.e., 2001 and 2003 cohorts), the current *SSB* was estimated to be near the historical high level. However, the assessment also showed that the stock had been subjected to relatively high *F* in recent years. Subsequently, the ISC Plenary recommended that nations strive to maintain (or reduce) current levels of *F* associated with their respective fisheries and further, begin efforts to obtain fishery-specific measures of *F* to better understand how fishing intensity is distributed across the North Pacific Ocean.

The albacore population that inhabits the North Pacific Ocean is targeted by several nations and gears, including the USA (various surface gears and longline), Canada (troll), and Mexico (various surface gears) in the 'eastern' Pacific Ocean, and Japan (various surface and longline gears), Chinese Taipei (longline), and S. Korea (longline) in the 'western' Pacific Ocean. That is, a 'fishery' generally reflects the combination of nation and gear type.

The current stock assessment assumes a single population in the North Pacific Ocean. Stock structure is fairly well established for albacore, and assessments have been carried out under this assumption for many years. While the assessment model is not spatially explicit (within the North Pacific Ocean), the processes of collecting and pre-processing data, on which the assessment will be based, are fishery specific (i.e. nation/gear combination). For example, estimates of catch by age and year, weight-length relationships, indices of abundance, etc. are developed at the fishery level (as practicable). For some fisheries, data are used as independent observations in the assessment modeling (e.g., CPUE indices), while others are aggregated prior to the analysis (e.g., catch by age and year). Reference to the original data by fishery can be helpful in drawing some spatial inferences from the overall assessment results, but such analyses will always be limited in scope. On the other hand, it is fairly straightforward to draw fishery-specific inferences from the overall assessment results (at least in the case of fisheries for which the pre-processing was carried out).

The objective of this working paper was to summarize statistics for the major fisheries, particularly, trends in *F* associated with surface (e.g., troll, gill net, purse seine, recreational, etc.) and 'sub-surface' (namely, longline) fleets for both the USA and Japan, given these fisheries combined represented over 80% of the total harvest for this species in any given year. The analysis relied strictly on the ISC-ALBWG final, consensus-based, assessment results (Stocker 2006), including the fishery-specific data used by the Working Group.

Finally, it is important to note that this analysis: (1) should be considered a relatively simple, preliminary effort to objectively examine the historical patterns of *F* by fishery; and ultimately, (2) will likely be further refined within the ISC-ALBWG forum, in efforts to provide ISC and the Northern Committee with the most accurate information regarding exploitation of this highly migratory fish population that is targeted broadly by fishing fleets across its range.

7.2.3.1. Discussion

The ALBWG noted that this research was essentially a methods paper that provided an initial, broad examination of fishery-specific *F*s. The research showed how to partition *F*-at-age by gear type from results generated from a VPA. The ISC-ALBWG concluded that this method of partitioning *F* appeared sound and could be used to provide gear-specific *F*s from VPA-like models. However, ALBWG involvement in such analyses should await formal requests and clear guidelines from the ISC and/or Northern Committee.

8.0. RESEARCH RECOMMENDATIONS AND UPDATED WORKPLAN

Recommendations are presented under three broad categories: (1) fishery statistics, (2) biological studies; and (3) stock assessment studies.

8.1. Fisheries Statistics

Annual submission of fishery data by Data Correspondents to the Data Manager (John Childers) for inclusion in the Database Catalog is considered a critical requirement of each nation (see below and section 3.1). Correspondents must pay special attention to submitting up-to-date fishery data on a timely basis and well in advance of planned meetings.

8.1.1. Maintain Database Catalog

The Database Catalog is to be maintained by the Data Manager as a record of available data that has been submitted via the Data Correspondent for each member nation. The Catalog also serves as a record of progress, with special data requested of participants, such as detailed information on length-composition samples, including sample sizes (i.e., number of fish measured) by year; notes on measurement units, accuracy, etc. and sampling procedures used, particularly, when procedures differ from the typical protocols; and a full description of steps employed and assumptions made in processing the samples to represent entire catches, particularly, when different from standard procedures. The Catalog is to be made available on an annual basis to all participants (via the respective Data Correspondents).

8.2. Biological Studies

Up-to-date biological information is considered a critical aspect of conducting accurate stock assessments, i.e., biological parameters should be reviewed and updated according to an agreed schedule to ensure assumptions and parameterizations within overall assessment models represent a species' current life history strategies.

8.2.1. Conduct Maturity Studies

The ISC-ALBWG strongly recommends a *collaborative* population-wide maturity study be developed in the near future (see section 4.1).

8.2.2. Conduct Age and Growth Studies

There is a need for a wide range of age/growth-related studies, including weight-length relationships, fish ageing techniques, and growth estimation methods. For all of these studies, emphasis should be on developing parameter estimates that are applicable at the population level, i.e., ultimately, representative of the North Pacific Ocean-wide stock.

8.2.3. Conduct Studies on Behavior and Movement with Archival Tagging

Archival tags are being deployed off the USA Pacific coast by NOAA Fisheries researchers (SWFSC) and in 'western' Pacific Ocean waters by Japan researchers (NRIFSF) in efforts to better understand albacore movement and related dynamics. So far, the results have not shown trans-Pacific movement, but movement solely within the respective eastern and western North Pacific Ocean, where the fish had been initially tagged. Both research institutions have plans for further deployments of archival tags; progress reports will be presented on a regular basis to the ISC-ALBWG. Finally, Canada researchers communicated that they too have begun efforts to develop an archival tagging program, which is currently under consideration.

8.3. Stock Assessment Studies

8.3.1. Conduct Research on Alternative Assessment Models

The ISC-ALBWG noted the importance of developing a tractable work schedule for transitioning from the VPA to the SS model (also, see section 5.2.2.2.1). The forum noted that the following assignments be undertaken and provided preliminary deadlines associated with upcoming meetings of the ALBWG. That is, ideally, researchers should strive to complete the work by the Meeting date; however, the ALBWG also stressed that completion dates must be somewhat flexible, given researchers commitments already in place for 2008-10 (e.g., research that addresses other species that come under ISC purview). The next North Pacific albacore assessment is scheduled for early 2010. A tentative list of ALBWG meetings prior to the stock assessment includes:

(i)	Regular Meeting	(8 days)	February 2008	La Jolla, USA
(ii)	Update Meeting	(2 days)	July 2008	Takamatsu, Japan
(iii)	Regular Meeting	(8 days)	February 2009	Japan
(iv)	Regular Meeting	(8 days)	September 2009	To be determined
(v)	Assessment Meeting	(8 days)	February 2010	To be determined

A brief sketch of the expected progress on alternative assessment models follows. It should be noted that topics other than modelling (e.g. reference points, management strategies, etc.) may also be on the agenda for these meetings and will require time and resources of the ALBWG.

Regular Meeting (i) – February 2008 (this meeting)

(1) Compare/contrast SS2 Model **A** scenarios with the VPA model
This work produced two baseline models to proceed with (Model **A1** and **A3**), with Model **A3** the more likely configuration that meets the objectives of the first stage of this modeling platform transition (see sections 5.2.2.2 and 5.2.2.2.1). More sensitivity analysis on each of these Models should be explored prior to Regular Meeting (iii) – February 2009. Progress should be reported at Update Meeting (ii) – July 2008.

Update Meeting (ii) – July 2008

Model development will not be major agenda item for this brief (2-day) meeting. However, updates of summary statistics will be considered (which will be needed for the modelling) and ALBWG members will have opportunities for informal discussion on modelling progress.

(1) For fishery-specific summary statistics
   (a) Update catch time series, including preliminary 2007 estimates, i.e., see Table 1
   (b) Update length compositions (e.g., USA troll and longline, Japan pole-and-line and longline, and Chinese Taipei longline, i.e., as presented in final Meeting Reports)
   (c) Update CPUE indices, i.e., age-aggregated indices (USA troll and longline, Japan pole-and-line and longline, and Chinese Taipei longline) as presented in final Meeting Reports
   (d) Update catch distribution and fishing effort distribution displays, i.e., as presented in Regular Meeting reports

(2) Provide synopsis of SS2 model transition progress to date

Regular Meeting (iii) – February 2009

(1) For SS2 Model **A** scenarios and VPA
   (a) Update length compositions (annual), i.e., as part of age-composition development
   (b) Update catch-at-age (annual) time series (matrices)
   (c) Update CPUE indices, including age-aggregated indices (USA troll and longline, Japan pole-and-line and longline, and Chinese Taipei longline) and age-specific indices (USA troll; Japan pole-and-line; and Japan longline)

(2) For SS2 Models **B** and **C** (i.e., spatially-explicit '14 fishery' Models)
   (a) Update length compositions, both annual (Model **B**) and quarter (Model **C**) time steps
   (b) Update CPUE indices (annual, age-aggregated), i.e., based on '14 fishery' structure, e.g., USA troll fishery (Fishery 1 index), Japan pole-and-line fisheries (Fishery 4 index and Fishery 5 index), etc.

(3) Reach consensus on the nature of the SS model that will be used for the next assessment (e.g. use of length vs. age-based input data; use of SS3 vs. SS2, etc). Also decide whether VPA will be used along with SS.

Regular Meeting (iv) – September 2009
This meeting will focus on: (a) detailed data preparation for the 2010 assessment and (b) further consideration and refinement of the decisions needed to carry out the assessment modelling.

Assessment Meeting (v) – February 2010
The focus of this meeting is solely to carry out the stock assessment. No additional modelling research will be tabled at this point and no management related agenda items (e.g. reference points) will be undertaken. As has been done for other ISC assessments, it may be beneficial to have a subset of the ALBWG meet for several days in advance of the full WG meeting to ensure that software is performing as expected and to make final data preparations.

8.3.2. Conduct Studies on Biological Reference Points

The ISC-ALBWG recommended that given current workloads, further development of biological reference points (both limit and target thresholds) for North Pacific albacore should not take precedence over development of the SS2 model (see section 8.3.1). It was further noted that guidance and the specification of management objectives (from the Northern Committee and the IATTC) will be needed to facilitate further progress on biological reference points.

8.3.3. Conduct Studies on CPUE Indices

The accuracy of current stock assessments for albacore is largely constrained by the CPUE (relative abundance) indices used in the assessment models and obtained from fishery-related samples (e.g., logbook data). The ISC-ALBWG recommended that a thorough examination of current CPUE indices be conducted prior to the next full assessment (see section 8.3.1).

9.0. ADMINISTRATIVE MATTERS

9.1. Election of Chair

At this Meeting, Max Stocker concluded his term as ISC-ALBWG Chairman The Working Group expressed appreciation to Max for his coordination efforts over the years, particularly, given this work was accomplished during a time when the formulation of the management bodies (WCPFC-Northern Committee) and greater ISC activity had just begun. An election of a new chairman was held following the ISC Rules and Procedures. Ray Conser was unanimously elected as the new ISC-ALBWG Chair and will serve a three-year term.

9.2. National Coordinators and Data Correspondents

The ISC-ALBWG will continue to maintain its data submission, management, and exchange procedures, and research coordination until these responsibilities are transferred to the ISC in a formal manner. Designated National Coordinators and Data Correspondents, therefore, will continue in their roles. Finally, the ISC-ALBWG expressed its gratitude to Al Coan, who had served as the Data Manager for many years. The current Coordinators and Correspondents are as follows:

Sector	National Coordinator	Data Correspondent
Canada	John Holmes	John Holmes
Japan	Koji Uosaki	Kyuji Watanabe
Mexico	Luis Fleischer	Luis Fleisher
Chinese Taipei	Chiee-Young Chen	Shyh-Jiun Wang
United States	Paul Crone	John Childers
IATTC	Alexandre Aires-da-Silva	Michael Hinton
SPC	Simon Hoyle	Peter Williams

9.3. Procedures for Clearing the Report

A first draft report – compiling available authors' paper summaries, rapporteurs' reports, and most figures – was reviewed at the Meeting. A complete draft will be distributed by Ray Conser (newly-elected Chair) for review, comment, and approval by participants. Subsequently, the chairman will evaluate suggested revisions, make final decisions on content and style, and finalize the report.

9.4. Time and Place

The next ISC-ALBWG Update Meeting will be held 15-16 July 2008, in conjunction with the ISC Plenary 8 in Takamatsu, Japan. The objectives of the Meeting will be to: (1) update fishery-specific statistics, such as total catch by nation/gear, length compositions, and CPUE indices; (2) provide a qualitative 'update' on stock status since the last assessment – based on the fishery indicators outlined in (1), above; and (3) discuss the key biological research needs for North Pacific albacore and outline a research program to meet these needs. If time allows, progress on modelling research will be discussed.

The next ISC-ALBWG Regular Meeting will be scheduled (subject to approval by the ISC8 Plenary) for 24 February – 3 March 2009, with Japan offering to host the Meeting.

The primary goal of this meeting will be to further progress on SS2 model development and reach consensus on the modelling platform(s) to be used for the next stock assessment (see details in Section 8.3.1, above).

9.5. Acknowledgments

Meeting participants thanked the host (NOAA Fisheries, Southwest Fisheries Science Center staff) for their hospitality and overall meeting arrangements, which served as the foundation for meaningful scientific discussion and a successful workshop.

9.6. Adjournment

The Meeting was adjourned at 13:00 on 6 March 2008. The chair (Max Stocker) thanked all of the participants for their attendance and contributions and finally, stressed to National Coordinators the need to maintain ongoing communication concerning scientific data exchange and research applicable to North Pacific albacore, as well as scheduling future ISC-ALBWG meetings.

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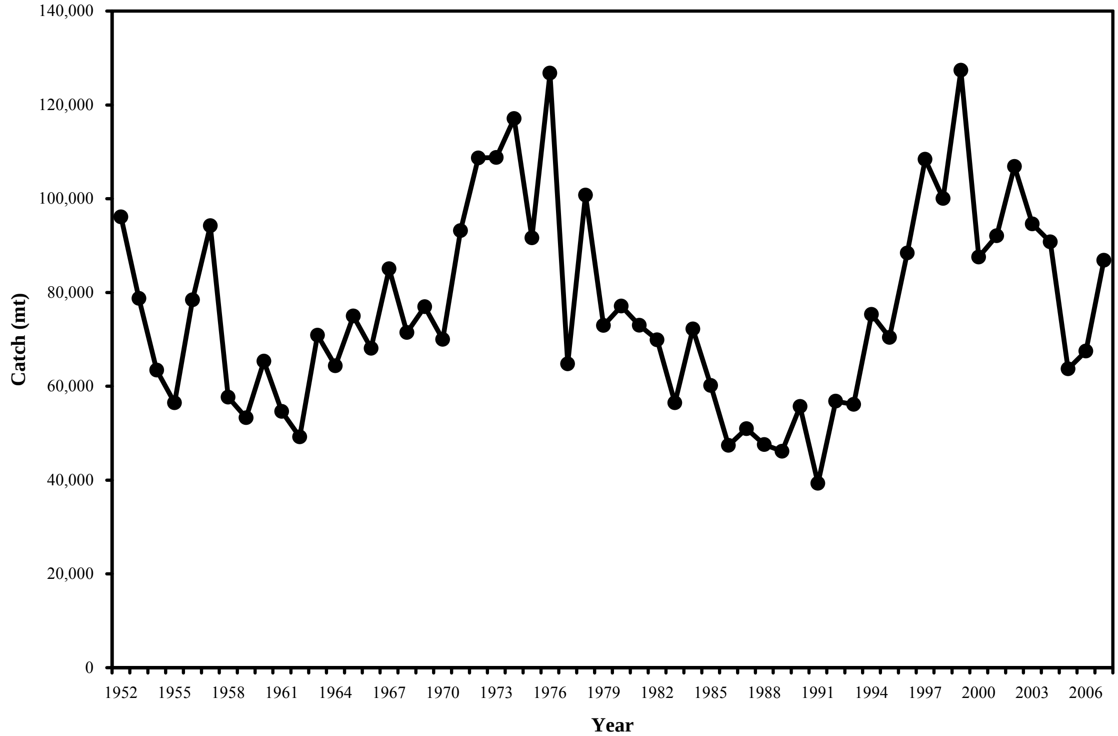

Figure 1. North Pacific albacore landings for all gears and nations combined (1952-07). Landings in 2007 are preliminary.

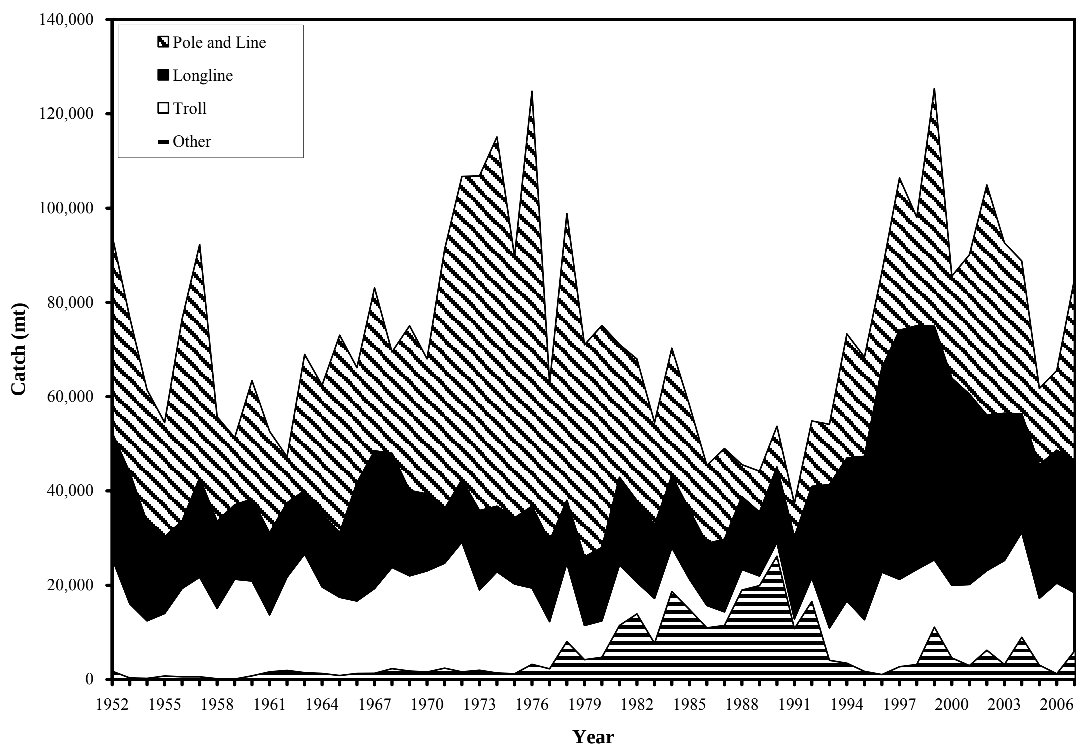

Figure 2. North Pacific albacore landings by gear (1952-07). Landings in 2007 are preliminary.

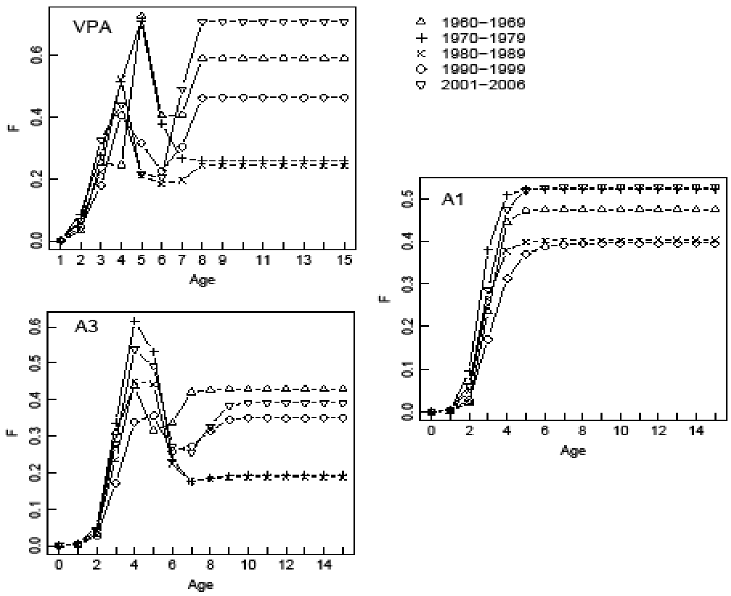

Figure 3. Comparison of 'selectivity' curves estimated from SS2 (**A1** and **A3**) and VPA models.

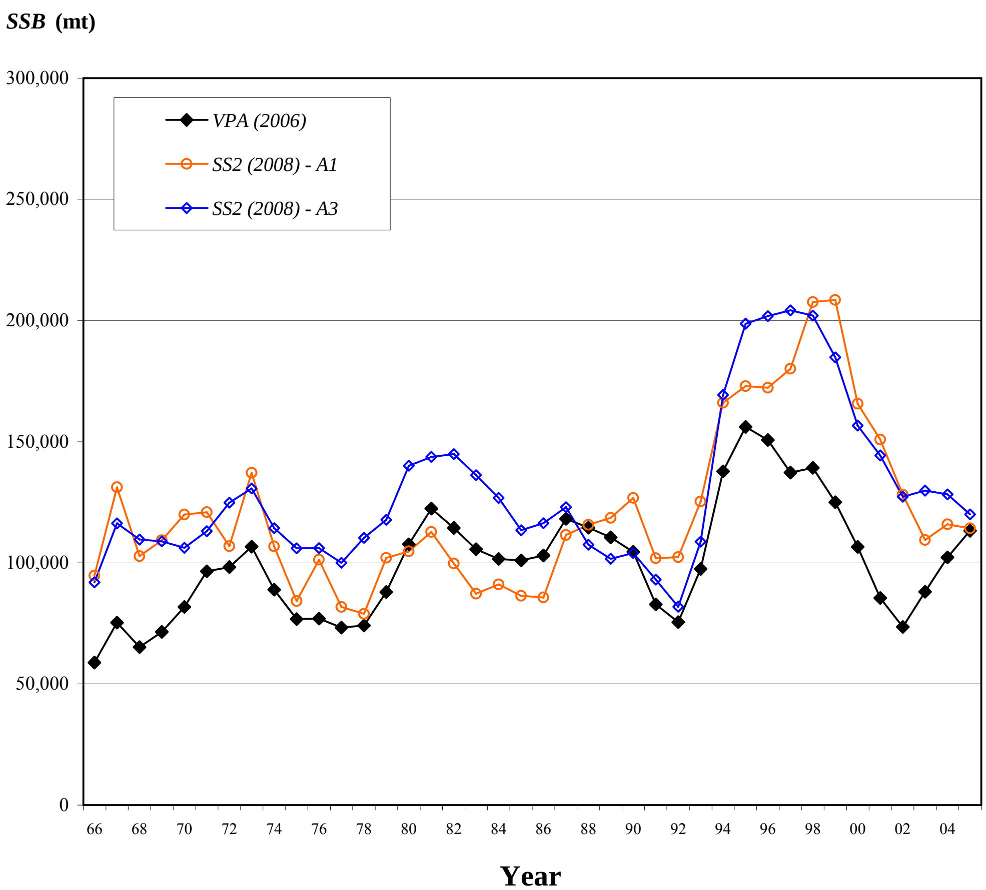

Figure 4. Estimated spawning stock biomass (*SSB*) generated from SS2 Model **A1** (single, 'aggregated' fishery scenario) and **A3** (multiple, 'disaggregated' fishery scenario) and the most recent VPA model (2006).

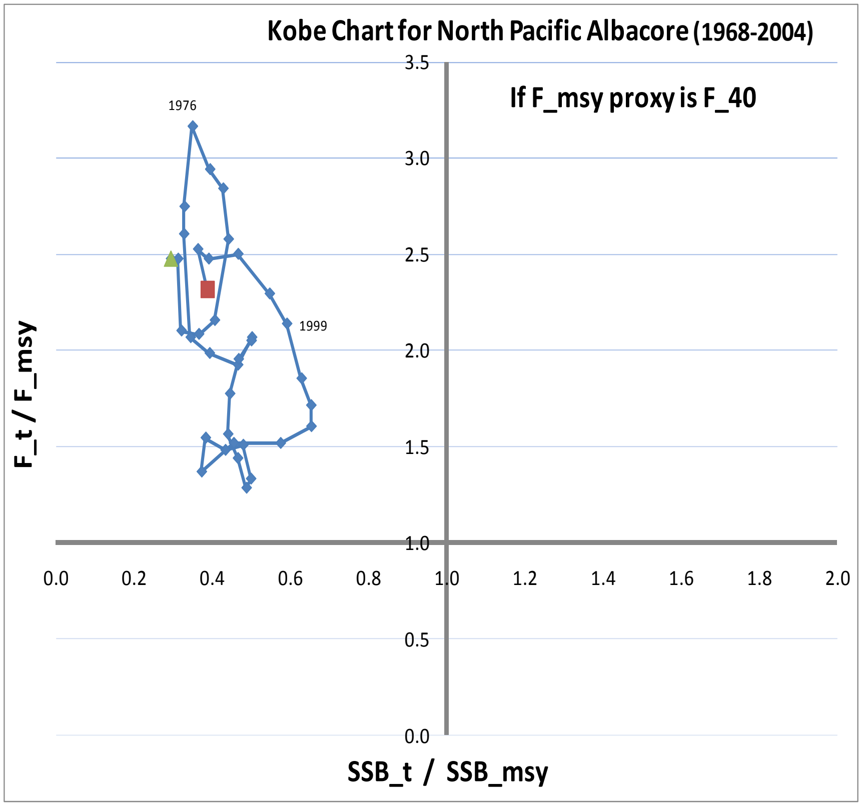

Figure 5a. ‘Kobe’ plot based on $F_{40\%}$ as the F_{MSY} proxy.

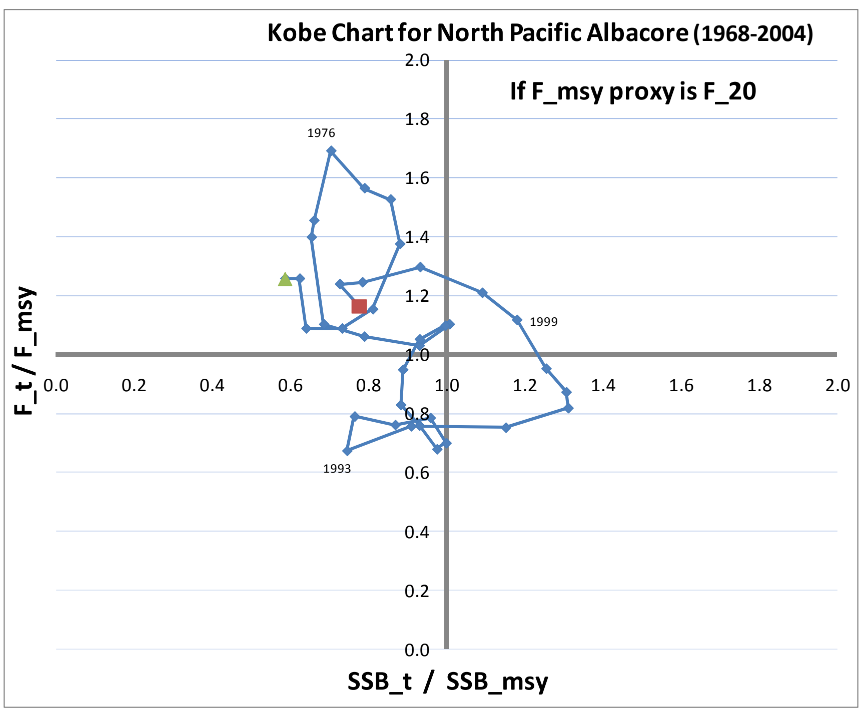

Figure 5b. ‘Kobe’ plot based on $F_{20\%}$ as the F_{MSY} proxy.

Table 1. [1] North Pacific albacore catches (in metric tons) by fisheries, 1952-07. Blank indicates no effort, -- indicates data not available, and 0 indicates less than 1 metric ton. Landings in 2007 are preliminary.

YEAR	CANADA	JAPAN							KOREA		MEXICO		
	TROLL	PURSE SEINE	GILL NET	LONG LINE	POLE & LINE	PURSE SEINE	TROLL	UNSP. GEAR	GILL NET	LONG LINE	PURSE SEINE	LONG LINE	POLE & LINE
1952	71			26,687	41,787	154	--	237					
1953	5			27,777	32,921	38	--	132					
1954				20,958	28,069	23	--	38					
1955				16,277	24,236	8	--	136					
1956	17			14,341	42,810	--	--	57					
1957	8			21,053	49,500	83	--	151					
1958	74			18,432	22,175	8	--	124					
1959	212			15,802	14,252	--	--	67					
1960	5	136		17,369	25,156	--	--	76					
1961	4			17,437	18,639	7	--	268			2	0	39
1962	1			15,764	8,729	53	--	191			0	0	0
1963	5			13,464	26,420	59	--	218			31	0	0
1964	3			15,458	23,858	128	--	319			0		
1965	15			13,701	41,491	11	--	121			0		
1966	44			25,050	22,830	111	--	585			0		
1967	161			28,869	30,481	89	--	520					
1968	1,028			23,961	16,597	267	--	1,109					
1969	1,365			18,030	31,912	521	--	935			0		
1970	390			16,283	24,263	317	--	456			0		
1971	1,746			11,524	52,957	902	--	308			0		
1972	3,921		1	13,043	60,569	277	--	623			100	0	0
1973	1,400		39	16,795	68,767	1,353	--	495			0		
1974	1,331		224	13,409	73,564	161	--	879			1	0	0
1975	111		166	10,318	52,152	159	--	228		2,463	1	0	0
1976	278		1,070	15,825	85,336	1,109	--	272		859	36	0	5
1977	53		688	15,696	31,934	669	--	355		792	3	0	0
1978	23		4,029	13,023	59,877	1,115	--	2,078		228	1	0	0
1979	521		2,856	14,215	44,662	125	--	1,126	0	259	1	0	0
1980	212		2,986	14,689	46,742	329	--	1,179	6	597	31	0	0
1981	200		10,348	17,922	27,426	252	--	663	16	459	8	0	0
1982	104		12,511	16,767	29,614	561	--	440	113	387	0	0	0
1983	225		6,852	15,097	21,098	350	--	118	233	454	0	0	0
1984	50		8,988	15,060	26,013	3,380	--	511	516	136	107	0	6
1985	56		11,204	14,351	20,714	1,533	--	305	576	291	14	0	35
1986	30		7,813	12,928	16,096	1,542	--	626	726	241	3	0	0
1987	104		6,698	14,702	19,082	1,205	--	155	817	549	7	0	0
1988	155		9,074	14,731	6,216	1,208	--	134	1,016	409	15	0	0
1989	140		7,437	13,104	8,629	2,521	--	393	1,023	150	2	0	0
1990	302		6,064	15,789	8,532	1,995	--	249	1,016	6	2	0	0
1991	139		3,401	17,046	7,103	2,652	--	392	852	3	2	0	0
1992	363		2,721	19,049	13,888	4,104	--	1,527	271	15	10	0	0
1993	494		287	29,966	12,797	2,889	--	867		32	11	0	0
1994	1,998		263	29,600	26,389	2,026	--	799		45	6	0	0
1995	1,763		282	29,075	20,981	1,177	856	81		440	5	0	0
1996	3,316		116	32,493	20,272	581	815	117		333	21	0	0
1997	2,168		359	38,951	32,238	1,068	1,585	123		319	53	0	0
1998	4,177		206	35,812	22,926	1,554	1,190	88		288	8	0	0
1999	2,734		289	33,364	50,369	6,872	891	127		107	0	34	23
2000	4,531		67	30,046	21,550	2,408	645	171		414	70	4	29
2001	5,248		117	28,818	29,430	974	416	96		82	5	0	17
2002	5,379		332	23,644	48,454	3,303	787	135		113	28	0	0
2003	6,861	0	126	20,955	36,114	627	922	106	--	144	28	0	0
2004	7,856	0	61	17,360	32,255	7,200	772	65	--	68	104	0	0
2005	4,829		154	20,564	16,133	850	665	316	--	520	0	0	0
2006	5,819		154	20,655	16,847	311	665	316	--	520	109	0	0
2007	6,112		154	20,655	38,289	5,194	665	316	--	520	40	0	0

[1] Data are from the ISC-ALBWG Meeting, February 28 - March 6, 2008, except as noted.

Table 1. Continued.

YEAR	TAIWAN		U.S.								OTHERS		GRAND TOTAL
	GILL NET	LONG LINE[2]	POLE & LINE	GILL NET	LONG LINE	PURSE SEINE	SPORT	TROLL	TROLL/ HANDLINE	UNSP. GEAR	LONG LINE[3]	TROLL [4]	
1952					46		1,373	23,843					96,150
1953					23		171	15,740					78,760
1954					13		147	12,246					63,448
1955					9		577	13,264					56,462
1956					6		482	18,751					78,420
1957					4		304	21,165					94,225
1958					7		48	14,855					57,681
1959					5		0	20,990		0			53,287
1960					4		557	20,100		0			65,363
1961			2,837		5		1,355	12,055		1			54,610
1962			1,085		7		1,681	19,752		1			49,226
1963			2,432		7		1,161	25,140		0			70,900
1964			3,411		4		824	18,388		0			64,357
1965			417		3		731	16,542		0			74,997
1966			1,600		8		588	15,333		1			68,116
1967		330	4,113		12		707	17,814		0			85,063
1968		216	4,906		11		951	20,434		0			71,448
1969		65	2,996		14		358	18,827		0			76,992
1970		34	4,416		9		822	21,032		0			69,992
1971		20	2,071		11		1,175	20,526		0			93,211
1972		187	3,750		8		637	23,600		0			108,689
1973		--	2,236		14		84	15,653		0			108,809
1974		486	4,777		9		94	20,178		0			117,087
1975		1,240	3,243		33		640	18,932		10			91,671
1976		686	2,700		23		713	15,905		4			126,797
1977		572	1,497		37		537	9,969		0			64,779
1978		6	950		54		810	16,613		15			100,800
1979		81	303		--		74	6,781		0			72,983
1980	--	249	382		--		168	7,556		0			77,106
1981	--	143	748		25		195	12,637		0			73,023
1982	--	38	425		105		257	6,609		21			69,935
1983	--	8	607		6		87	9,359		0			56,477
1984	--	--	1,030		2	3,728	1,427	9,304		0			72,242
1985	--	--	1,498	2	0	26	1,176	6,415	7	0			60,188
1986	--	--	432	3		47	196	4,708	5	0			47,382
1987	2,514	--	158	5	150	1	74	2,766	6	0			50,981
1988	7,389	--	598	15	307	17	64	4,212	9	10			47,567
1989	8,350	40	54	4	248	1	160	1,860	36	23			46,165
1990	16,701	4	115	29	177	71	24	2,603	15	4			55,688
1991	3,398	12	0	17	312	0	6	1,845	72	71			39,315
1992	7,866	--	0	0	334	0	2	4,572	54	72			56,839
1993		5	0	0	438		25	6,254	71	0			56,129
1994		83	0	38	544		106	10,978	90	213		158	75,330
1995		4,280	80	52	882		102	8,045	177	1		137	70,411
1996		7,596	24	83	1,185	11	88	16,938	188	0	1,735	505	88,413
1997		9,119	73	60	1,653	2	1,018	14,252	133	1	2,824	404	108,399
1998		8,617	79	80	1,120	33	1,208	14,410	88	2	5,871	286	100,041
1999		8,186	60	149	1,542	48	3,621	10,060	331	1	6,307	261	127,376
2000		8,842	69	55	940	4	1,798	9,645	120	3	3,654	490	87,554
2001		8,684	139	94	1,295	51	1,635	11,210	194	0	1,471	127	92,105
2002		7,965	381	30	525	4	2,357	10,387	235		700	127	106,889
2003		7,166	59	16	524	44	2,214	14,102	85	0	2,400	127	94,624
2004		4,988	126	12	361	1	1,506	13,346	160	0	2,400	127	90,772
2005		4,472	66	20	304		1,719	8,413	170	0	2,400	127	63,727
2006		4,317	22	3	274		291	12,590	86	0	2,400	127	67,514
2007		4,317	19	3	258	4	291	5,408	86	0	2,400	127	86,866

[2] Catches for 2000-04 contain estimates of offshore longline catches from vessels landing at domestic ports

[3] Other longline catches from vessels flying flags of convenience being called back to Taiwan. The catches may be duplicated in Taiwan longline catches (November 2005).

[4] Other troll catches from vessels registered in Belize, Cook Islands, Tonga, and Ecuador

Table 2. Parameter assumptions and estimates used in the SS2 Model with comparison between scenarios Model **A1** and Model **A3**. (See Appendix 4 for explanation.)

Parameterization	**Model A1**	**Model A3**
Est. parameters	135	69
Likelihood (*L*)	1,652.2	1,653.5
Number of fisheries	1	10
Length-at-age	Suda (1966) - Fixed	Suda (1966) - Fixed
Weight-length	Watanabe (2006) - A2/Q2	Watanabe (2006) - A2/Q2
Weight-at-age	Fixed - outside model	Fixed - outside model
$\ln(R_0)$	Estimated (10.72)	Estimated (10.72)
Offset for initial: virgin *R*	Estimated (0.00006)	Estimated (-0.03)
Steepness (*h*)	Fixed (1.0)	Fixed (1.0)
σ-*R*	Fixed (0.6)	Fixed (0.6)
First yr *R* bias adj.	1960	1960
Est. initial *F*	Yes	Some fisheries
Do *R* dev sum to 0	Yes	Yes
Lambda for equil. catch	0	0
S - time block	Annual	Single
S - shape	Asymptotic	Both
Variance adj. factors	Age dist. ss (Fishery 1=500 and CPUE indices=50) CPUE reweighted	None (ss=50)

APPENDIX 1

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APPENDIX 2

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

ALBACORE WORKING GROUP WORKSHOP

La Jolla, California, USA

AGENDA

Work that should be completed prior to the ISC-ALBWG Meeting includes:
- **Develop prototype "Kobe" diagrams using the 2006 assessment results and multiple proxy reference points (*R. Conser*);**
- **Data submission for updating Table 1 to 2006 (2007 preliminary say) (*All*); and**
- **Data preparation work for preliminary SS2 modeling efforts (*All*);**
- **Prepare SS2 baseline models (*Crone et al.*) for next formal assessment (likely 2009ish …) ... time series considered will address 1966-05 data, as modeled in last formal assessment conducted in December 2006;**
- **Sunday is 'off' day; and**
- **Dinner (party) will be on the evening of 3/3/08 (Monday).**

Opening
- Welcome
- Registration and distribution of documents
- Approval of Agenda
- Appointment of rapporteurs

Review of fisheries (each delegation)

Review of fishery statistics
- Status of ISC-ALBWG Database Catalog
- Update of 'catch' table (Table 1)
- Sampling design and statistics applicable to monitored fisheries
- Conclusions and work assignments

Action plan from ISC Plenary
- Review potential IUU fishing in North Pacific Ocean (assessment consideration)
- Continue efforts to rescue historical fishery data
- Develop prototype 'Kobe' diagrams using the 2006 assessment results and candidate MSY proxy reference points

AGENDA (continued)

Review biological reference points

- Review current approach, i.e., maintaining SSB in the range of historical fluctuations (*Northern Committee* request)
- Review F_{SSB} statistics from 2006 assessment
- Additional projections from 2006 assessment

SS2 model development

- Review current time series used in SS2 (and VPA) modeling efforts, (i.e., catch, length compositions, and CPUE). Time series considered will address 1966-05 data, as modeled in last formal assessment conducted in December 2006
- Review the current (SS2) baseline model structures (Models *A*, *B*, and *C*), particularly, Model *A* (SS2) scenarios, given their similarity to ongoing VPA assessment models
- Review similarities/differences between VPA and SS2, particularly, time series and parameterization issues involved in each modeling approach
- Further refine parameterization issues related to the SS2 modeling efforts, including mortality, maturity, longevity, growth, stock-recruitment, starting the model (e.g., equilibrium vs. non-equilibrium assumptions), forecasting, etc.
- Determine best SS2 models to proceed with in 2008-09—in terms of preparation for next formal assessment in 2009
- Follow-up with decisions regarding which model (VPA or SS2) will be used to prepare the next formal stock assessment in 2009—for management-related purposes within the ISC forum

Ongoing and future biological research

- Albacore archival tagging program (NOAA/AFRF)—update
- Pacific tuna tagging program – W&CP
- North Pacific wide fecundity/maturity sampling

Administrative matters

- Clearing of Meeting Report
- Time and place of next meeting, formal assessment, etc.
- Election of chairperson (3-yr term)
- Acknowledgements

Adjournment

APPENDIX 3

List of Documents

ISC/08/ALBWG/01:	The 2007 Canadian North Pacific albacore troll fishery – M. Stocker and J. Holmes
ISC/08/ALBWG/02:	International Scientific Committee Albacore Working Group Database Catalog – J. Childers
ISC/08/ALBWG/03:	Summary of the 2006 U.S. North and South Pacific Albacore Troll Fisheries – J. Childers and A. Betcher
ISC/08/ALBWG/04:	A review of Japanese albacore fisheries in the North Pacific – K. Uosaki
ISC/08/ALBWG/05:	Sampling design and statistics associated with the USA troll and longline fisheries that target albacore in the North Pacific Ocean – P.R. Crone and J.D. McDaniel
ISC/08/ALBWG/06:	Population analysis of North Pacific albacore based on the stock assessment program *Stock Synthesis 2* – NOAA Fisheries South West Fisheries Science Center, National Research Institute of Far Seas Fisheries, and Inter-American Tropical Tuna Commission
ISC/08/ALBWG/07:	Kobe plots for North Pacific albacore – R. Conser
ISC/08/ALBWG/08:	North Pacific albacore catch in the U.S. longline fishery – an update - J. Wetherall and J. Childers
ISC/08/ALBWG/09:	Mexican progress report on the albacore tuna fishery – L.A. Fleischer and M. Dreyfuss
ISC/08/ALBWG/10:	Analysis of the North Pacific albacore fishing mortality rates (*F*) associated with the major surface and longline fisheries during 1966-2004. - R. Conser and P. Crone
ISC/08/ALBWG/11:	Preliminary results of stock assessment of North Pacific albacore using *Stock Synthesis 2* – K. Watanabe
ISC/08/ALBWG/12:	Causes of disparity between age-aggregated abundance index and total of age-specific ones for North Pacific albacore from Japanese longline fishery – K. Watanabe
ISC/08/ALBWG/13:	Variability in North Pacific albacore length composition in their spawning area – K. Uosaki

APPENDIX 4

Description of Principal Parameters for Model A1 and Model A3 Scenarios .

Models **A1** and **A3** described in **ISC/08/ALBWG/06** were modified during the Meeting and thus, should not be compared strictly with the original Models A1 and A3 in **ISC/08/ALBWG/06.**

Detailed specifications for SS2 Models A1 and A3
Model **A1** – single ('aggregated') fishery scenario
Model **A3 -** multiple ('disaggregated') fishery scenario

Models A1 and A3

- Time period modeled is 1966-05
- Number of catch-at-age age bins is 9 (i.e. ages 1 through 8 and a '9+' age group)
- Number of ages modeled is 0-15, with an 'accumulator age' of 15
- Catch is in units of number (in 1,000s)
- Age-based maturity is fixed following Ueyanagi (1957)
- Growth is fixed following Suda (1966) for length-at-age model and Watanabe et al. (2006) for weight-length relationship (*SSB* relationship, i.e., Area 2/Quarter 2 equation)
    - However, although the weight-at-age used in the VPA was configured generally similar to the SS2 models, differences existed and thus, *SSB* estimates were derived 'outside' the SS2 models (as was done in the VPA) using a similar weight-at-age vector as used in the VPA
- Stock-recruitment (S-R) relationship is fixed, based on Beverton-Holt model (steepness=1.0)
    - σ-R is 'fixed' at 0.6
- Model start (initial numbers at age) is based on 'equilibrium' condition
    - Virgin recruitment is estimated
    - Initial fishing mortality (*F*init) is estimated
    - No fitting to equilibrium catch prior to 1966
    - Offset for initial equilibrium recruitment is estimated
    - Recruitment deviates estimated from 1960-05
- First year full-bias adjustment for recruitment is 1960
- Estimates of catchability (*q*) scaled to be median unbiased
- CPUE indices equally 'weighted'
- No prior/penalty parameterization

Model A1

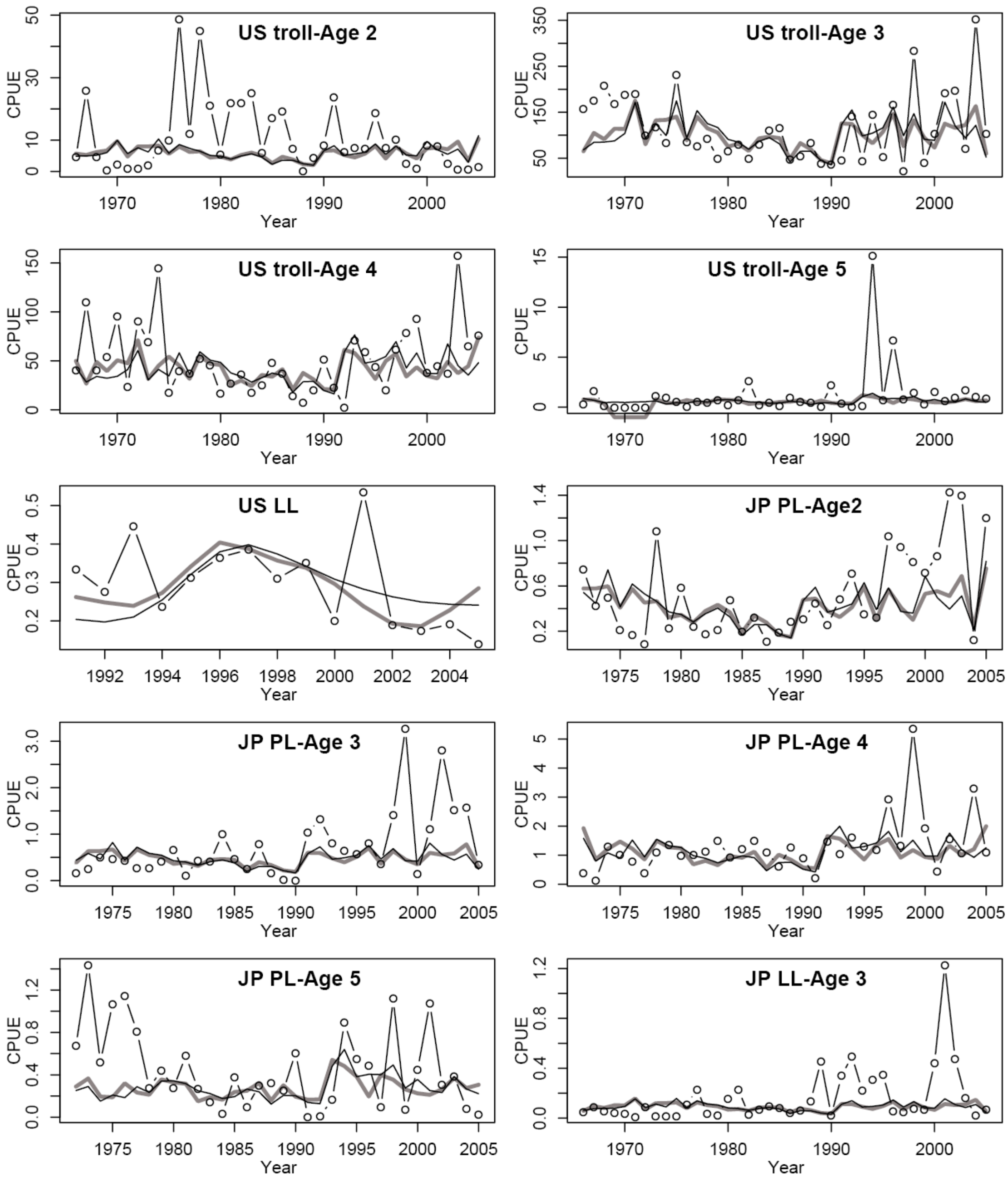
- Includes specifics under **Models A1** and **A3** above, as well as the following
- Age-based selectivity for 'single' fishery (asymptotic, time-varying annually)
- Effective sample sizes for age compositions are fixed and emphasize fits to the fishery age composition data (Fishery ESS=500 and two, age-aggregated CPUE indices=50)
- CPUE indices are 'reweighted' (once)

Model A3

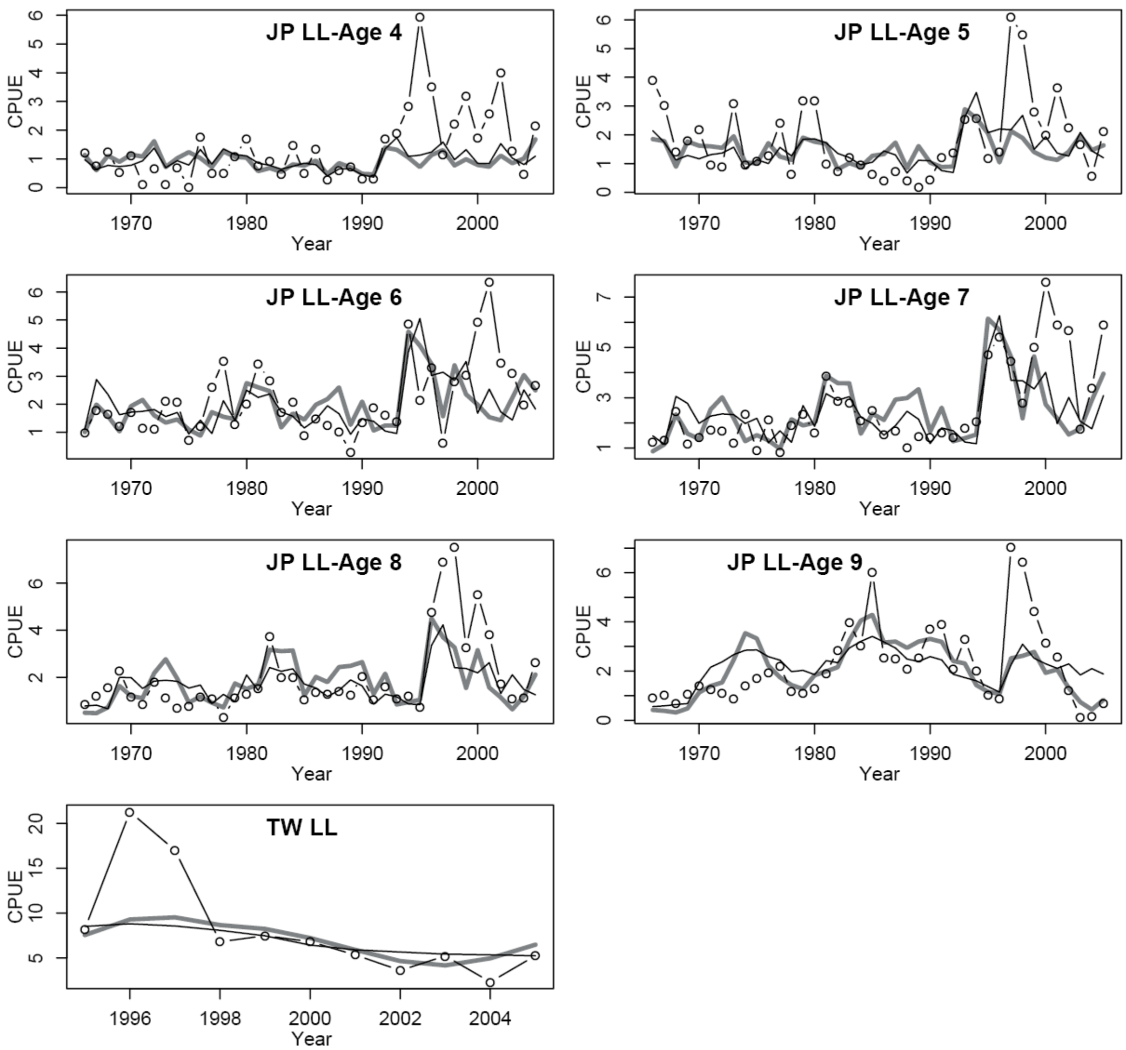
- Includes specifics under **Models A1 and A3**, above, as well as the following
- Single fishery partitioned into multiple (10) fisheries by nation and gear (not spatially), which generally reflected the fishery-specific catch-at-age prepared for the VPA.
- Model start (initial numbers at age) is based on 'equilibrium' condition with the initial F estimated for two fisheries only
  - Initial fishing mortality (*F*init) is estimated for a fishery that harvests 'young' fish (e.g., EPO 'surface' fishery) and a fishery that harvests 'old' fish (e.g., Japan 'large longline' fishery)
- Age-based selectivity for all 10 fisheries (both dome-shaped and asymptotic, constant across a single time block)
  - For USA longline and Japan 'large' and 'small' longline fisheries, selectivity is asymptotic
  - For EPO surface and Japan pole-and-line fisheries, selectivity is dome-shaped
  - Japan gill net, Japan miscellaneous, Chinese Taipei gill net, and Korea gill net fisheries mirror Japan pole-and-line fishery
  - Chinese Taipei/Korea/Others longline fishery mirrors USA longline fishery
  - USA longline age-aggregated CPUE index mirrors USA longline fishery selectivity
  - Chinese Taipei longline age-aggregated CPUE index mirrors Japan 'large' longline fishery selectivity
- Effective sample sizes for age compositions are fixed for both fisheries and CPUE indices (ESS=50)
- CPUE indices equally 'weighted,' i.e., not reweighted
  - Catchability (q) for Japan 'large' longline age-specific (age 9+) CPUE index mirrors the age-specific (age 8) CPUE index

Model A3 Development During the Meeting

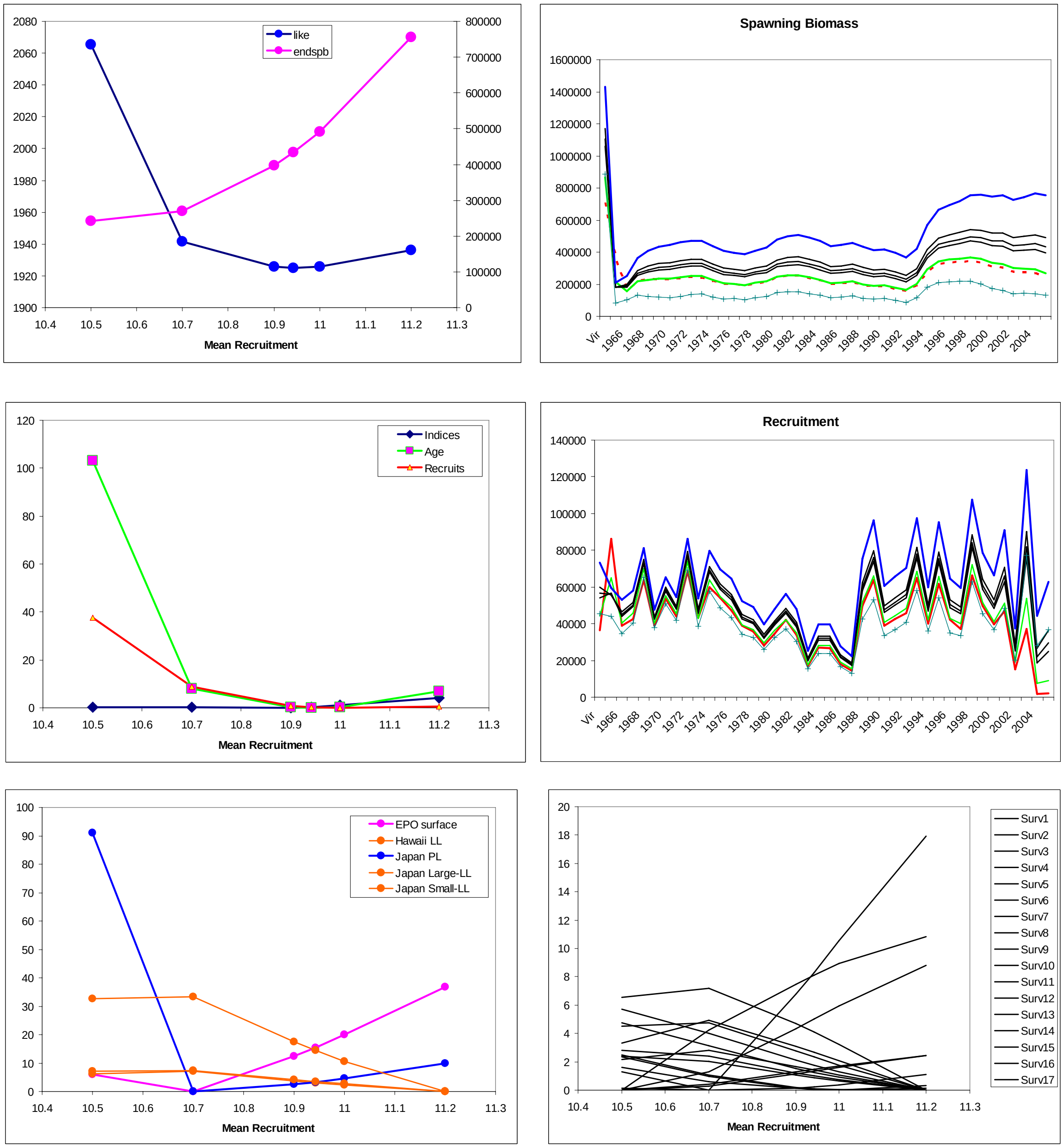
- Although Model **A3** estimated *SSB* trend was generally similar to Model **A1** (and other Model **A** variants as well …), the scaling of the time series was much elevated from that estimated in the VPA and Model **A1**
  - Profiling was conducted on parameterization related to the start of the model, i.e., estimates of virgin recruitment ($\ln R_0$) were fixed at various levels to better understand overall fit statistics associated with respective runs. Results indicated better overall fits were associated with SSB trajectories that were more 'in line' with those from VPA and Model **A1** (i.e. trajectories that matched in both trend and scale)
  - Following this profiling, sensitivity analysis was conducted that addressed selectivity parameterization associated with the fisheries, particularly, those parameters associated with the ascending limb for both asymptotic and dome-shaped fisheries. Results indicated that this aspect of selectivity parameterization is very influential to both model fits and stock size estimation. Ultimately with some reasonable tuning of these parameters, the Model **A3** fits improved and the estimated *SSB* generally mirrored the VPA and Model **A1** in both trend and scale.



Appendix Figure 4-1. Model fits to CPUE indices included in SS2 Model **A3**. Fits to CPUE indices included in last VPA assessment (2006) are also presented (shaded line).



Appendix Figure 4-1. Continued.



Appendix Figure 4-2. Likelihood profiles based on initial equilibrium recruitment, say $\ln(R_0)$, i.e., used in diagnostic review associated with refining SS2 Model **A3**.