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

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

PLENARY SESSION

13-18 July 2016
Sapporo, Hokkaido
Japan

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ACRONYMS AND ABBERVIATIONS

Names and FAO Codes of ISC Species of Interest in the North Pacific Ocean

FAO Code	Common English Name	Scientific Name
	TUNAS	
ALB	Albacore	*Thunnus alalunga*
BET	Bigeye tuna	*Thunnus obesus*
PBF	Pacific bluefin tuna	*Thunnus orientalis*
SKJ	Skipjack tuna	*Katsuwonus pelamis*
YFT	Yellowfin tuna	*Thunnus albacares*
	BILLFISHES	
BIL	Other billfish	Family *Istiophoridae*
BLM	Black marlin	*Makaira indica*
BUM	Blue marlin	*Makaira nigricans*
MLS	Striped marlin	*Kajikia audax*
SFA	Sailfish	*Istiophorus platypterus*
SSP	Shortbill spearfish	*Tetrapturus angustirostris*
SWO	Swordfish	*Xiphias gladius*
	SHARKS	
ALV	Common thresher shark	*Alopias vulpinus*
BSH	Blue shark	*Prionace glauca*
BTH	Bigeye thresher shark	*Alopias superciliosus*
FAL	Silky shark	*Carcharhinus falciformis*
LMA	Longfin mako	*Isurus paucus*
LMD	Salmon shark	*Lamna ditropis*
OCS	Oceanic whitetip shark	*Carcharhinus longimanus*
PSK	Crocodile shark	*Pseudocarcharias kamonharai*
PTH	Pelagic thresher shark	*Alopias pelagicus*
SMA	Shortfin mako shark	*Isurus oxyrinchus*
SPN	Hammerhead spp.	*Sphyrna* spp.

ISC Working Groups

Acronym	Name	Chair
ALBWG	Albacore Working Group	John Holmes (Canada)
BILLWG	Billfish Working Group	Jon Brodziak (U.S.A.)
PBFWG	Pacific Bluefin Working Group	Hideki Nakano (Japan)
SHARKWG	Shark Working Group	Suzanne Kohin (U.S.A.)
STATWG	Statistics Working Group	Ren-Fen Wu (Chinese Taipei)

Other Abbreviations and Acronyms Used in the Report

CDS	Catch documentation scheme
CIE	Center for Independent Experts
CKMR	Close-kin mark-recapture
CMM	Conservation and Management Measure
CPFV	Charter passenger fishing vessel
CPUE	Catch-per-unit-of-effort
CSIRO	Commonwealth Scientific and Industrial Research Organization
DWLL	Distant-water longline
DWPS	Distant-water purse seine
EEZ	Exclusive economic zone
EPO	Eastern Pacific Ocean
F	Fishing mortality rate
FAD	Fish aggregation device
FAO	Fisheries and Agriculture Organization of the United Nations
FL	Fork length
HCR	Harvest control rule
HMS	Highly migratory species
H_{MSY}	Harvest rate at MSY
IATTC	Inter-American Tropical Tuna Commission
ISC	International Scientific Committee for Tuna and Tuna-Like Species in the North Pacific Ocean
ISSF	International Seafood Sustainability Foundation
LFSR	Low fecundity spawner recruitment relationship
LTLL	Large-scale tuna longline
LRP	Limit reference point
MSE	Management strategy evaluation
MSY	Maximum sustainable yield
NC	Northern Committee (WCPFC)
NRIFSF	National Research Institute of Far Seas Fisheries (Japan)
NPALB	North Pacific albacore
OFDC	Overseas Fisheries Development Council (Chinese Taipei)
PICES	North Pacific Marine Science Organization
PIFSC	Pacific Islands Fisheries Science Center (U.S.A.)
SAC	Scientific Advisory Committee (IATTC)
SC	Scientific Committee (WCPFC)
SG-SCISC	Study Group on Scientific Cooperation of ISC and PICES
SPC-OFP	Oceanic Fisheries Programme, Secretariat of the Pacific Community
SPR	Spawning potential ratio, spawner per recruit
SSB	Spawning stock biomass
$SSB_{F=0}$	Spawning stock biomass at a hypothetical unfished level
$SSB_{CURRENT}$	Current spawning stock biomass
SSB_{MSY}	Spawning stock biomass at maximum sustainable yield
STLL	Small-scale tuna longline
SWFSC	Southwest Fisheries Science Center

t, mt	Metric tons, tonnes
WCNPO	Western Central and North Pacific Ocean
WCPFC	Western and Central Pacific Fisheries Commission
WPO	Western Pacific Ocean
WWF	World Wide Fund for Nature - Japan
GRT	Gross registered tons

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Highlights of the ISC16 Plenary Meeting

The 16th ISC Plenary, held in Sapporo, Hokkaido, Japan from 13-18 July 2016 was attended by members from Canada, Chinese Taipei, Japan, Republic of Korea, and the United States as well as the Western and Central Pacific Fisheries Management Commission. The Plenary reviewed results, conclusions, new data, and updated analyses of the Billfish, Albacore, Shark and Pacific Bluefin tuna working groups.

1 INTRODUCTION AND OPENING OF THE MEETING

1.1 Introduction

The ISC was established in 1995 through an intergovernmental agreement between Japan and the United States (U.S.A.). Since its establishment and first meeting in 1996, the ISC has undergone a number of changes to its charter and name (from the Interim Scientific Committee to the International Scientific Committee) and has adopted a number of guidelines for its operations. The two main goals of the ISC are (1) to enhance scientific research and cooperation for conservation and rational utilization of the species of tuna and tuna-like fishes that inhabit the North Pacific Ocean during a part or all of their life cycle; and (2) to establish the scientific groundwork for the conservation and rational utilization of these species in this region. The ISC is made up of voting Members from coastal states and fishing entities of the region as well as coastal states and fishing entities with vessels fishing for highly migratory species in the region, and non-voting Members from relevant intergovernmental fishery and marine science organizations, recognized by all voting Members.

The ISC provides scientific advice on the stocks and fisheries of tuna and tuna-like species in the North Pacific Ocean to the Member governments and regional fisheries management organizations. Fishery data tabulated by ISC Members and peer-reviewed by the species and statistics Working Groups (WGs) form the basis for research conducted by the ISC. Although some data for the most recent years are incomplete and provisional, the total catch of highly migratory species (HMS) by ISC Members estimated from available information is in excess of 500,000 metric tons (t) annually and dominated by the tropical tuna species. In 2015 the catch of priority species monitored by ISC member countries was 60,094 t of North Pacific albacore tuna (NPALB, *Thunnus alalunga*), 11,020 t of Pacific bluefin tuna (PBF, *T. Orientalis*), 11,100 t of North Pacific swordfish (SWO, *Xiphias gladius*), 2,348 t of North Pacific striped marlin (MLS, *Kajikia audax*), 7,228 t of Pacific blue marlin (BUM, *Makaira nigicans*), 334 t of shortfin mako shark (SMA, *Isurus oxyrinchus*) and 25,409 t of North Pacific blue shark (BSH, *Prionace glauca*). [1] The total estimated catch of these seven species is 117,533 t, or approximately 83% of the 2014 total estimated catch of 142,286 t. Annual catches of priority stocks throughout their ranges are shown in Table 15-1 through **Table 15-7**.

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1.2 Opening of the Meeting

The Sixteenth Plenary session of the ISC (ISC16) was convened in Sapporo, Hokkaido, Japan, at 0900 on 13 July 2016 by the ISC Chairman, G. DiNardo. A roll call confirmed the presence of delegates from Canada, Chinese Taipei, Japan, Republic of Korea, and U.S.A. (*Annex 1*). Representatives from the Western and Central Pacific Fisheries Commission (WCPFC) and the North Pacific Marine Science Organization (PICES) were also present. Pew Charitable Trusts, World Wildlife Fund for Nature - Japan (WWF), Duke University, Monterey Bay Aquarium, and Wild Oceans were present as observers.

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[1] FAO three-letter species codes are used throughout this report interchangeably with common names.

ISC Members China, Mexico, the Secretariat of the Pacific Community (SPC), the Fisheries and Agriculture Organization of the United Nations (FAO), along with the Inter-American Tropical Tuna Commission (IATTC), did not attend the Plenary.

G. DiNardo introduced Dr. Hideki Nakano, Director General, National Research Institute of Far Seas Fisheries, who gave the welcome address for the meeting:

> Good morning.
>
> We welcome all of you and thank you very much for your participation at the 16th ISC Plenary Session here in Sapporo. Now is the best season; you are so lucky. On behalf of the Japan Fisheries Research and Education Agency, I am so glad to meet you here in this beautiful city of Sapporo. As you know, the first ISC meeting was held in Tokyo in May 1996 and since then we have two decades of history in ISC.
>
> Japan is a country surrounded by the ocean, and the life of its people is associated with fisheries very much. Also Japan is the greatest consumer of tunas and is in a position to take responsibility for the management of tuna resources. For this reason, the ISC is an important scientific organization for us.
>
> Our institution, Japan Fisheries Research and Education Agency, is the largest organization for fishery science in Japan, and we continue to cooperate with scientists of member countries at the ISC.
>
> During this 16th ISC plenary session, we will review and discuss several aspects relating fisheries for tunas and tuna-like species living in the North Pacific, such as biology, resources, fisheries, and so on. So far the ISC has made a great contribution to the conservation and management of tuna resources in the North Pacific Ocean. I am expecting a similar contribution for this meeting and hope that we could take the next steps to the future ideal relations between human being and natural resources. Thank you very much.

2 ADOPTION OF AGENDA

The proposed agenda for the session (*Annex 2*) was considered and adopted noting that Mexico would not present its national report. It was noted that observers would be given the opportunity at the end of each day to offer comments and seek clarification on topics discussed. C. Dahl was assigned lead rapporteur duties. A list of meeting documents is contained in *Annex 3*.

3 DELEGATION REPORTS ON FISHERY MONITORING, DATA COLLECTION AND RESEARCH

3.1 Canada

J. Holmes presented a summary of Category I, II, and III data from Canadian fisheries for highly migratory species in 2015 (**ISC/16/PLENARY/04**). The Canadian fleet of 164 vessels targets juvenile north Pacific albacore and operated primarily in the coastal waters of Canada and the United States, with little effort or catch outside of these areas in 2015. Preliminary estimates of catch and effort in 2015 are 4,334 t and 5,197 vessel days (v-d) and are 9% lower and 9.5% higher, respectively, relative to 2014. The effort and catch in Canadian waters (73% of effort and 67% of catch) were about twice the levels occurring in US waters (27% of effort and 33% of the catch) in 2015 while a minimal amount of effort and catch were recorded in high seas waters as far west as 140°W. The Canadian fleet began fishing in mid-June and stopped fishing in early October. This is a compressed fishing season relative to the historical pattern of fishing and has been accompanied by a shift in the seasonal pattern of nominal CPUE, which peaked in July and was below average through August and September. The size composition data sampled from the catch (N=13,228) in 2015 exhibit a distinct change relative to 2014 and are dominated by fish less than 69 cm FL (2-year olds). In addition, releases of albacore too small to be marketable (< 3 kg) increased from 7.2 t in 2014 to 14.6 t in 2015 and approximately half of the releases occurred in Canadian waters. It appears that the distribution of juvenile albacore in the eastern Pacific Ocean shifted northward in 2015.

Discussion

It was agreed that catch of a “silky shark” by a Canadian albacore troll vessel was likely a soupfin shark, given the morphological similarities of the two species. Canada noted that it is seeking further information from the vessel captain to confirm the identification.

Canada was asked if the smaller average length of albacore in Canadian fisheries than in previous years could be a function of increased recruitment. Canada responded that either increased recruitment or a northward shift in the range of juveniles is a plausible explanation. However, Canada believes the decrease in length coupled with increased releases of small (<3 kg) fish in Canadian waters seem to point to a northern shift in distribution. It would be useful to age these fish but so far samples suitable for this purpose have not been obtained.

3.2 Chinese-Taipei

W. Wang presented the Chinese-Taipei national report (**ISC/16/PLENARY/5**). There are two principal tuna fisheries of Chinese-Taipei operating in the North Pacific Ocean, namely the tuna longline fishery and the distant-water purse seine fishery; other offshore and coastal fisheries include the harpoon, setnet and gillnet fisheries, and account for a small proportion of overall tuna and tuna-like species catch. The catches of longline and purse seine fisheries account for 99% of the total tuna and tuna-like species catches in the North Pacific Ocean by Chinese-Taipei. Longline fisheries comprise the large-scale tuna longline (LTLL, vessels larger than 100 gross registered tons, GRT) and small-scale tuna longline (STLL, vessels less than 100 GRT) fleets. The total catch of tunas and billfish (including swordfish, striped marlin, blue marlin, black marlin, and sailfish) for the longline fishery (including the catch of LTLL and STLL) in the North Pacific Ocean was 25,046 t in 2015. There were 76 active LTLL vessels operating in the Pacific Ocean in 2015 and 1,306 STLL vessels. Total catch in the purse seine fishery in the Pacific Ocean in 2015 was 194,249 mt, caught by 34 vessels.

For the LTLL fishery, Category I data sources include weekly catch reports and commercial data from individual fishing vessels. Categories II and III data are all compiled from logbook data.

Fishers are required to measure the length of the first 30 fish caught in each set. For the STLL fishery, Category I data sources include landings and auction records of local fish markets, reports of market sales, and monthly catch reports from individual fishing vessels. For the purse seine fishery, Category I and Category II data are obtained from logbooks.

A catch documentation scheme (CDS) was established and implemented in 2010 for collecting data from vessels fishing for PBF. When PBF are caught, fishers are required to attach a tag and to measure length and weight of each PBF. Regarding the close-kin mark recapture project, Chinese Taipei has already collected 1,389 PBF tissue samples, about twice of the number in the ISC sample design.

An observer program on the LTLL fleet was implemented in the Pacific Ocean in 2002. The program was gradually expanded in later years and hence the number of observers increased. The program was further expanded to the STLL fleet in 2012. In total, 23 observers were deployed on longline vessels in 2015, including 12 observers for LTLL vessels and 11 observers for STLL vessels.

Discussion

An explanation for the decrease in the number of samples for size distributions between 2013 and 2014-2015 was sought. The length records are not recovered completely for 2014 and 2015. It was noted that observer coverage rates were believed to be greater than 5% for large-scale tuna longline vessels (the minimum level identified in CMM 2012-03) but remain below 5% for small-scale tuna longliners. It was also noted that PBF catch in the setnet fishery occurs every year in small amounts. Most of the fish weigh more than 100 kg. Setnet catches are also reported to the Taiwan Fisheries Agency and sent to market to be tagged in accordance with domestic regulation.

The 1,389 PBF tissue samples for close-kin analysis represent a more than 60% sampling rate of total catch in the fishery.

3.3 Japan

H. Shimada presented the Japan National Report **(ISC/16/PLENARY/6)**. Japanese tuna fisheries consist of the three major fisheries (longline, purse seine, and pole-and-line) and other miscellaneous fisheries like troll, driftnet, and setnet fisheries. The national report describes the recent trend of the Japanese tuna fisheries in the North Pacific Ocean and updates the statistics given in the previous national report for ISC15 **(ISC/15/PLENARY/6)**. The total catch of tunas (excluding skipjack) caught by Japanese fisheries in the north Pacific Ocean was 108,745 t in 2014 and 101,807 t in 2015. The total catch of tunas (including skipjack) caught by Japanese fisheries in the north Pacific Ocean was 289,446 t in 2014 and 289,358 t in 2015. The total catch of SWO and MLS was 6,312 t in 2014 and 7,026 t in 2015. In addition to the fisheries description, a brief description was given of Japanese research activities on tuna and tuna-like species in the Pacific Ocean in 2015.

Discussion

None.

3.4 Republic of Korea

Y. Kwon presented the Republic of Korea National Report **(ISC/16/PLENARY/7)**. Republic of Korea has two types of fishing gears, purse seine and longlines, that engage in fishing for tuna and tuna-like species in the North Pacific. The total number of longline vessels showed a steady trend from 122 vessels in 2010 to 125 in 2013. Recently, it decreased to 113 in 2014 to 84 in 2015. The total number of purse seine vessels was constant during 2010-2014 and slightly decreased to 25 in 2015. Total catch of tuna and tuna-like species caught by Republic of Korea distant-water fisheries in the North Pacific Ocean was 64,324 t in 2015. Total catch by longline vessels was 9,531 t, which is 48.1 % of the historical highest catch in 2004. That of purse seine was 54,793 t, which corresponds to 54.4% of the historical highest catch in 2003. As for the catch composition of the longline fishery, dominant species were BET, over 64% of total catch, YFT and, SWO comprising 16% and 8%, respectively. As for that of the purse seine fishery, SKJ, YFT, and BET were 73%, 25%, and 1% of the catch, respectively. The offshore large purse seine fishery in the Republic of Korean EEZ caught 676 mt of PBF in 2015. It was distributed in the South Sea around Jeju Island throughout the year with the highest catch in March to July and less than 10 t caught in August to November. In 2015, 583 PBF tissue samples were collected for close-kin analysis.

Discussion

Japan said that it is also conducting research on tuna larvae and would like to exchange information on these research projects with Republic of Korea. It was noted that the goal of the larval survey is to determine if these are PBF spawning grounds in Republic of Korea waters. In providing more information about the electronic logbook system introduced in 2015, Republic of Korea noted that thus far it has only been implemented in the distant-water fishery, although it plans to extend implementation to the offshore fisheries.

One catch reporting issue was identified. The 2015 BLM catch of 82 t reported in Table 2 of the National Report appears anomalously high. Is it possible that fishermen are misidentifying BUM as BLM? Republic of Korea responded that it will continue to investigate this species identification issue. Republic of Korea

It was confirmed that some PBF have been caught with troll gear around Jeju Island.

It was noted that in 2015 ISC agreed that member countries would be responsible for tissue processing for the PBF close-kin analysis. Republic of Korea said it has not yet started processing the samples it collected but plans to do so.

Republic of Korea clarified that the reported observer coverage is in its distant-water fisheries.

In discussion Republic of Korea further noted that there was no catch of large PBF documented prior to 2008. That is because PBF was considered as bycatch before then, so collecting accurate data on PBF catch was very difficult. However, adult PBF have been continuously caught in the coastal waters of Republic of Korea in recent years; it even accounted for about 50% of total PBF catch, or 469 t in 2016. Under paragraph 4 of WCPFC CMM 2015-04, the catch limit of PBF, 30 kg or larger, was set at the 2002-2004 annual average catch level, so Republic of Korea has no allowable catch limit, because of the lack of catch documentation prior to 2008. But this year, the Republic of Korea offshore purse seine fishery caught an exceptional amount of large PBF. In response the government implemented an emergency measure to halt catching large PBF, consistent with the aforementioned WCPFC CMM. On this matter, all interested parties in the relevant fisheries were strongly requested to find a solution that would allow them to keep their livelihood. Republic of Korea requested consideration of reasonable scientific advice about the change in the catch trend due to oceanographic conditions.

3.5 U.S.A.

M. Seki presented the United States National Report to the Plenary (**ISC/16/PLENARY/9**) covering fishery data submissions and relevant research by National Oceanic and Atmospheric Administration's Pacific Islands and Southwest Fisheries Science Centers related to its purse seine, albacore troll, and longline fisheries in the North Pacific in 2015. For the U.S. albacore troll fishery, the number of vessels fishing has been highly variable since 2008 and 587 vessels participated in 2015. US NPALB catch by troll and pole-and-line in 2015 was 11,571 t. U.S. purse-seine fishery catch in the North Pacific was 53,807 t for 2015, most of which was in the WCPO. The U.S. longline fishery targets mostly BET and SWO. There were 143 longline vessels participating and 13,093 t landed in 2015. Of that, the majority (67%) was BET. The U.S. is approaching its WCPFC BET quota and fishery might close as early as late-July. The early closures of the Hawaii-based BET longline fishery in recent years were noted, as were increased catches of BET, opah (*Lampris guttatus*), and other bycatch species encountered in that fishery.

Research highlights were provided on biological sampling and cooperative research, PBF close-kin mark recapture sampling, PBF recreational size sampling, post-release survival of silky sharks, marine mammal interactions with longline fisheries, bycatch mitigation studies, ecosystem and foodweb research, ocean dynamics, and stock assessment modeling and improvements. Capacity building efforts by CAPAM (the Center for the Advancement of Population Assessment Methodology) were mentioned, including a workshop on data weighting in October 2015.

Discussion

It was noted that increases in opah catch described for the Hawaii longline fishery are also being documented in west coast highly migratory species fisheries. It was observed that increased catch of both opah and BET could be a result of a shift in fishing conditions by the Hawaii longline fishery. BET catch rates and effort have increased, partially explaining the catch increase. Ecosystem scientists at the Pacific Islands Fisheries Science Center are investigating environmental factors that may explain the increase in catch rates for these species.

An explanation for the dramatic decline in fishing effort in the shallow-set longline (swordfish target) fishery was sought. It is believed that this decline is primarily due to preferability for the deep-set fishery for BET; e.g., greater profitability. Vessels have shifted into that fishery as a result.

It was clarified that purse seine catch was reported for only the North Pacific, based on the understanding of the area of responsibility for the ISC. However, Pacific-wide purse seine catch did not change significantly in 2015 compared to 2014.

4 REPORTS OF CHAIRMAN

4.1 Chairman's Annual Report

G. DiNardo, ISC Chair presented the following report to the Plenary.

> The ISC had another busy year since the ISC Plenary met in Kona, Hawaii in July 2015. The year was spent completing a stock assessment update for Pacific blue marlin, a benchmark assessment for Pacific bluefin tuna, renewing the Memorandum of Cooperation with IATTC, formalizing research collaborations with PICES, and collection of biological samples to facilitate close-kin research, as well as preparing for a benchmark assessment on North Pacific albacore tuna in 2017, a review of the ISC function in 2017, and a process to formalize the structure/existence of the ISC. While numerous accomplishments and successes advanced the scientific integrity of ISC, we cannot afford to waiver from our scientific mission. The failure of ISC to complete assignments on time has far-reaching implications. While we still struggle with established report submission deadlines, the process has improved greatly.
>
> Progress was made by improving best practices and scientific reporting procedures, compiling a catalogue and inventory of the ISC database, and advancing development of the website and data enterprise system. Six intersessional workshops were held to facilitate collaboration among Member scientists in implementing ISC work plans and coordinating research on the stocks. In addition, the ISC conducted an international workshop on *Management Strategy Evaluations* in Yokohama, Japan and, under the auspices of PICES, formalized a joint ISC-PICES Working Group (WG34) to assess the impacts of climate change on highly migratory species. We continue to address recommendations stemming from the 2013 peer review of the ISC function, and John Holmes (Canada) was reelected as Chair of the ISC Albacore Working Group.
>
> Managing ISC activities continued to be a challenge during the past year. As before, the challenge is an inherent consequence of the ISC framework adopted by the members. That is, ISC relies on in-kind contributions from its members rather than monetary contributions to support a "Secretariat" to oversee day-to-day operations of the organization. Given this framework, the Office of the Chairman takes on the role of a Secretariat, but not a full-service one at that, owing to uncertain support from the Chairman's funding source. Likewise, the working groups depend on in-kind contributions from Members who elect to participate in specific working groups. This support is uneven among the Members, and Members with insufficient support cannot participate actively and hence, can delay progress of a working group in completing

assignments. To date, the support for administration of ISC activities has been provided by the U.S. for day-to-day operations of the Office of the Chairman, and by Japan for operating the ISC website and database. Member countries with scientists serving as chairpersons of the working groups have contributed to supporting administrative services of the working groups. All of the support is appreciated and acknowledged. Efforts to formalize the ISC through a Memorandum of Understanding (MOU) are moving forward and should provide the necessary framework to address many of these concerns including support for a fulltime secretariat.

I close this report by thanking all my colleagues who have worked on ISC tasks and who have provided the support to ISC and the Office of the Chair in advancing the objectives and purpose of the organization. The service of Chi-lu Sun, Vice-Chairman, for support and insightful advice is acknowledged, as well as the services of Jeannette Miller. A special thanks and appreciation is owed to the Chairs of the working groups, namely Ren-Fen Wu, Jon Brodziak, John Holmes, Hideki Nakano, and Suzanne Kohin, who provided unselfish leadership in guiding the work of the Working Groups. In addition, the leadership role of Hideki Nakano with respect to the Data Administrator, Izumi Yamasaki, and Webmasters, Yumi Okochi and Kirara Nishikawa, is appreciated. Finally, I acknowledge the professional assistance and dedicated service of Sarah Shoffler to the ISC in completing tasks assigned to the Chairman. In that capacity, she served as point of contact for the Office of the Chairman, led in organizing the facilities for annual meetings, led in writing and assembling technical information required for agenda items of meetings and for responding to inquiries, and served as advisor to me on aspects of ISC operations. Thanks to all of you for contributing to another successful year for ISC and for the support and service provided.

4.2 ISC Science Activities

The Chair reviewed several science topics that are not discussed in detail elsewhere:

- The ISC has started exploring stock assessment methods for data-poor species. An example is the 2015 SMA indicator analysis. Other RFMOs are beginning to conduct assessments for data-poor species but they may be using different methods for some species. There is a need to assess the utility of data-poor methods and identify potential candidate indicators for species groups. In 2015 the Chair was tasked with contacting other RFMOs about having a workshop to develop “standardized” techniques. The Chair has so far contacted the WCPFC about the possibility of a workshop and will continue to work on the specifics of organizing a workshop with participation from all relevant RFMOs.

- As noted in discussion above, each member country was tasked with collecting samples for close-kin analysis of PBF with a goal of achieving the sample size spelled out at ISC15 by this year. That is unlikely to be achieved in 2016 so sample collection will need to continue into next year. Second, members – rather than the ISC Secretariat – are responsible for genotyping but it is recognized that the cost for this processing varies considerably in different countries. The Chair will consult with members on the cost issue so as to move sample processing forward. In addition, the ISC will organize a workshop for geneticists to develop a standard tissue processing procedure across participating members.

- Establishing a tagging program for PBF would be beneficial to better understand trans-Pacific movement and other stock structure issues. However, tagging programs are expensive and need to be conducted over a long time to yield useful data. Ideally, an integrated program featuring international collaboration can be developed. This is a potential seminar topic for ISC17.

Discussion

None.

5 INTERACTIONS WITH REGIONAL ORGANIZATIONS

5.1 WCPFC

A. Beeching presented on interactions between the WCPFC and ISC. There were no stock assessments for northern stocks in 2015; ISC presented to WCPFC Scientific Committee (SC) meeting an indicator-based evaluation of North Pacific SMA and a stock assessment for North Pacific MLS. Key SC responses were presented, i.e., that changes in fishing practices of all fleets fishing in the WCPO be documented through time; the SC noted that this information would be important for assessing fishery impacts on all species including SMA. The SC also recommended that the Commission develop a rebuilding plan for North Pacific SMA with subsequent revision of CMM 2010-01 in order to improve stock status. There was an update regarding ongoing deliberation to designate North Pacific BSH as a northern stock. The Plenary was also informed about the recently established WCPFC tissue bank and relevant outcomes from WCPFC11.

Discussion

In response to a question, the presenter opined that it is unlikely that the WCPFC will reach a decision this year on whether North Pacific BSH should be considered a northern stock under Northern Committee (NC) auspices. He also noted that to facilitate this process, clearer criteria for determining northern stocks need to be articulated. It was pointed out that criteria for determining the northern stock has already been defined by the WCPFC.

It was noted that the WCPFC has established an inventory of tissue bank holdings of WCPFC members. Information on tissue bank holdings can be accessed through the WCPFC website. The WCPFC welcomes applications to use those samples. It was also noted that progress could be made to ensure samples are stored in a way suitable for their use in genetic analyses. Samples will be stored and provided without charge for WCPFC members.

5.2 PICES

G. DiNardo reported on the activities to establish a joint ISC-PICES Working Group to assess the impacts of climate variability on highly migratory species under the auspices of PICES **(ISC/16/PLENARY/10)**. Understanding the impacts of climate variability on pelagic fish dynamics and spatial structure, and incorporating these processes into stock assessments to support effective fisheries management decision-making, represents the next generation of stock assessment models. With that goal in mind, a joint Study Group on Scientific Cooperation of ISC and PICES (SG-SCISC) was established in April 2015 to review each organization's scientific needs and identify where similar key questions or scientific issues might be explored jointly by both organizations. The study group met at ISC15 and shortly afterwards finalized a framework for implementing the joint activities and mechanisms to periodically review and update the activities. The framework was submitted to PICES for consideration at the 2015 PICES Annual Meeting in October 2015 and in January 2016 a joint ISC-PICES Working Group (PICES WG-34) on Ocean Conditions and the Distribution and Productivity of Highly Migratory Fish was established. Three overarching research themes were identified by the working group including:

1. Understanding the influence of oceanographic conditions on the distribution and production of commercial pelagic fish species in the North Pacific Ocean;
2. Linking oceanographic conditions to fleet and fisher behavior (ecosystem stressors) to improve understanding of fishery indices used in assessing stock status; and
3. Understanding climate change effects on North Pacific marine ecosystems and impacts on pelagic fish dynamics.

Working group activities span three years with the possibility of additional years based on interest. Working group membership is comprised of scientists from both ISC and PICES.

As a first order of business the Working Group will convene a one-day workshop (November 3) at the PICES 2016 Annual Meeting in San Diego, CA, followed by a half-day business meeting with all WG-34 members on November 4. The workshop, *FIS Workshop (W4): Methods relating oceanographic conditions to the distribution of highly migratory species*, provides an opportunity to discuss direction and specific research topics during the business meeting.

PICES invited the ISC to participate in the PICES 2016 Annual Meeting in San Diego, California, USA 1-13 November. It was agreed that Hidetada Kiyofuji (Japan) and the ISC Chair would present an ISC poster on ISC structure and recent activities at the PICES 2016 Annual Meeting.

Discussion

It was noted that ISC-PICES ecosystem/climate change research will complement ISC-sponsored management strategy evaluation (MSE) work.

6 REPORT OF SPECIES WORKING GROUPS AND REVIEW OF ASSIGNMENTS

6.1 North Pacific Albacore Tuna

J. Holmes reported on the activities of the ALBWG over the past year (*Annex 8*). The Second ISC MSE workshop was attended by approximately 24 managers, scientists, and stakeholders and a set of six management objectives was proposed for the initial MSE evaluations (Attachment 5 in Annex 8). Performance indicators and example output from MSE evaluations were proposed for each objective by the ALBWG. Further work is needed with managers and stakeholders on the concept of acceptable risk so that the objectives can be operationalized for use in the MSE simulations.

Planning for the next stock assessment in 2017 focused on preliminary specification of model structural assumptions and parameterization, and identifying appropriate diagnostic analyses and sensitivity runs. Work assignments for ALBWG members were developed and work plans for the assessment period were also developed. The ALBWG intends to use data through at least 2014, and will assess the achievability of using data through 2015 at the data preparation workshop in the fall 2016.

Accomplishments of the ALBWG over the past year include:

1. Maintained progress on the MSE process for north Pacific albacore tuna;
2. Planning for the stock assessment in 2017, including the development of work assignments for WG members and work plans for the WG;
3. Recommendations on stock status and conservation advice for 2016;
4. Identified a Vice-Chair (H. Kiyofuji, Japan); and
5. Re-elected the current Chair (J. Holmes) to a one-year term that will conclude at the end of the ISC17 meeting.

The ALBWG proposes the following work plans and schedule for 2016/17:

Meeting	Dates	Location	Goals
NC12	29 Aug-02 Sept 2016	Fukuoka, Japan	ALBWG Chair to discuss proposed management objectives for approval
Data Preparation Workshop	08-15 Nov 2016	Nanaimo, Canada	Define fisheries & review input data series for consistency & conflicts
	31 Jan 2017		Data submission deadline
Stock Assessment Workshop	4-13 Apr 2017	Shimizu, Japan	Recommendations on stock status and conservation advice

1SC17	July 2017	1-day preparation meeting; elect new Chair

The ALBWG noted the following ongoing issues affecting its work:

1. Clarification of North Pacific ALB catches reported by China and Vanuatu to the IATTC and WCPFC (see ISC15 Plenary report for a fuller description and
2. Clarification of engagement with managers/stakeholders from the IATTC and WCPFC on MSE.

Discussion

Clarification of the location of albacore catches in the EPO reported by Vanuatu is needed. This could be resolved at NC12, because Vanuatu has confirmed it will be attending that meeting and has already submitted a catch report to the WCPFC Science Manager. Furthermore, Vanuatu will be hosting the 2017 annual IATTC meeting, which offers a second opportunity to confer on this issue.

In response to a comment from the ALBWG Chair about engaging the IATTC in the MSE process, it was noted that this year the IATTC directed its staff to assist with the MSE.

It was pointed out that providing the PBF stock assessment executive summary to IATTC in advance of the 2016 SAC meeting was very helpful to decision-makers. It was agreed that the 2017 NPALB stock assessment executive summary should be provided to IATTC in advance of the SAC8 meeting.

The ISC Chair confirmed that independent stock assessment scientists, provided that ISC procedures for clearing him/her were followed, with appropriate credentials can participate in the next NPALB stock assessment.

The length of proposed ALBWG stock assessment meetings was discussed and the ALBWG Chair was encouraged to shorten those meetings, if at all possible.

The process for identifying candidate management procedures or harvest control rules for the MSE was raised, because work to date has not focused on those components. For the next year the ALBWG will be focusing on completing the stock assessment and will not have time to devote to MSE development. The USA National Marine Fisheries Service is in the process of hiring a scientist who will be tasked with leading MSE development. This person will work closely with the ALBWG and take on the identification of management procedures for evaluation.

6.2 Pacific Bluefin Tuna

H. Nakano, PBFWG Chair, summarized the activities of the PBFWG (*Annexes 4, 6, and 9*). The PBFWG met three times after ISC15, on 18-25 November 2015 in Kaohsiung, Taiwan, to discussing model and data improvements, 29 February – 11 March 2016 in La Jolla, USA, for the benchmark assessment and 10 July 2016 in Sapporo, Japan, prior to the ISC16 Plenary. The

November 2015 PBFWG meeting was the second opportunity to discuss model and data improvements towards the benchmark assessment; the discussions covered data preparation and model structure improvement for the benchmark assessment and the setting of the future projection model (see *Annex 4* for the report of the PBFWG meeting). The PBFWG then conducted the benchmark assessment in the February-March meeting; it completed the benchmark assessment and future projections and prepared the draft stock status and conservation advice (see *Annex 6* for the report of PBFWG meeting and *Annex 9* for the assessment report). Lastly, the 10 July PBFWG meeting focused on updating PBF catch statistics, definition of an interim rebuilding target and a work plan. In addition, the PBFWG elected S. Nakatsuka as the PBFWG Vice-Chair.

PBF catch statistics from 1952 to 2015 by calendar year were updated (Table 15-2). The preliminary PBF catch estimate for 2015 is 11,020 t, lower than the 2014 catch of 17,115 t. Each member country also provided information on their fisheries and research activities including catch and effort trends and operational changes.

With regard to the PBFWG work plan, the PBFWG considered that updating the assessment annually would limit the time and capacity of the WG to address other issues such as improvement of the assessment model and consideration of reference points. In addition, annual updates could end up chasing the noise rather than the actual trend of the stock. Therefore, the PBFWG considered it would be more sensible and constructive to conduct update assessments, including projection and revision of conservation advice, in two years (in 2018) and conduct a benchmark assessment after an additional two years (in 2020). In addition, it was agreed that the ISC should present the trend of adult CPUE indices and recruitment to managers to check if anything unexpected is happening in the intermediate years. With this basic scheduling in mind, the PBFWG agreed to hold the next PBFWG meeting in early February 2017 to review the indices and to discuss possible improvement of the assessment model. The venue was tentatively agreed to be Shimizu, Japan.

<u>Discussion</u>

The proposed assessment schedule was clarified. Every four years a benchmark assessment will be conducted. Update assessments are planned in the second intervening year using all available new catch, effort, and size data. This schedule can be changed if an extraordinary event is observed.

6.3 Billfish

J. Brodziak provided the BILLWG Report (*Annexes 5, 7, 10*).

The BILLWG held three meetings during the work cycle for providing assessment information and conservation advice for ISC16.

The BILLWG held a Data Preparation Workshop in Honolulu, USA, for the 2016 Pacific BUM stock assessment in January 2016. Participants came from Japan, USA, and the IATTC. The goal of this workshop was to prepare fishery data for the stock assessment of Pacific BUM in 2016 including catch by quarter data, standardized catch-per-unit effort, size composition data by quarter, tagging data, and life history parameters.

The BILLWG work assignments addressed at the January 2016 workshop were:

1. Submit all outstanding catch, CPUE, and size composition data for the Pacific BUM stock assessment to the BILLWG Chair.
2. Provide 10 draft working papers and review and finalize these research documents.
3. Prepare information to make any corrections to the Pacific BUM catch, CPUE, and size composition data tables for the stock assessment.

The BILLWG conducted a stock assessment modeling workshop for the 2016 Pacific BUM stock assessment in Busan, Republic of Republic of Korea in March 2016. Participants came from Chinese Taipei, Japan, Republic of Korea, USA, and the ISC Secretariat. Two working papers were provided, reviewed, and finalized. The goal of this workshop was to conduct modeling analyses for an update of the stock assessment for the BUM stock. These analyses included fitting the base case Stock Synthesis model, running sensitivity analyses and developing stock projections.

The BILLWG work assignments addressed at the March 2016 workshop also included:

1. Conduct and agree upon a base case model for the 2016 Pacific BUM stock assessment update. At the January 2016 workshop, it was agreed to use the same base case model structure and assumptions as the 2013 benchmark assessment, modifying the model structure only if it is necessary, for example, based on a lack of convergence or a severely degraded model fit to the observed data.
2. Conduct sensitivity analyses, focusing on the same sensitivity analyses conducted in the last Pacific BUM stock assessment in 2013.
3. Conduct the stock projections using the same projection methodology as was used in the 2013 assessment.

The BILLWG held a preparation workshop for the ISC16 Plenary in Sapporo, Japan in July 2016. Participants came from Chinese Taipei, Japan, Republic of Korea, and the USA

The BILLWG work assignments addressed at the July 2016 workshop included:

1. Review stock assessment results for the Pacific BUM stock and prepare presentation information for the ISC 16 Plenary meeting.
2. Review and revise the draft ISC 16 conservation advice for WCNPO MLS, North Pacific swordfish stocks, and Pacific BUM, as needed.
3. Develop BILLWG work plan for 2016-2017.

BILLWG Work Plan for 2016-2017

- Review Japanese longline CPUE and stock structure for the EPO SWO stock and revise as needed
- Develop MSE goals and algorithms for application to ISC BILLWG stocks, starting with a tabulation of primary uncertainties related to ecosystem-based fisheries management for billfish species that could be addressed through MSE work

- Improve information to characterize the seasonal spatiotemporal patterns of billfish stocks and fisheries
- Update BILLWG webpage information
- Conduct assessment methods research, e.g., develop standardized software packages for steepness estimation and Bayesian production modeling

Dates and Locations of BILLWG Intercessional Meetings 2016-2017

- Hold December 2016 webinars to review and discuss research on Japanese longline SWO CPUE, SWO stock structure, billfish biological parameters, MLS spatial population structure, and other topics, including uncertainty tables for billfish stocks that could be addressed through MSE
- Hold spring 2017 BILLWG intercessional meeting to complete planned research
- BILLWG Meeting location and dates are: NTOU in Taiwan during March-May 2017, depending on member availability, with exact dates to be determined, for a five to seven day meeting

Dr. Mikihiko Kai was elected vice chair of the BILLWG.

Discussion

There was a query concerning the ability of the BILLWG to complete the proposed work plan with the current WG capacity. The BILLWG has lost its Data Manager and more analysts would be helpful. Currently, the WG does not have the capacity to perform a full benchmark assessment, but next year no assessments are planned. Instead, the BILLWG will devote its time to improving research capacity. The BILLWG Chair emphasized that the Data Manager has played a crucial role in the BILLWG. In response, the ISC Chair said he will reach out to the delegation heads to encourage participation in the BILLWG, as well as other working groups that are short-staffed. Such requests will be more effective if working group meetings can be shortened to no more than five days. Greater use of webinars in advance of a face-to-face meetings is one method that should be considered. The ISC Chair pointed out that advance preparation contributed to an efficient BILLWG workshop in March 2016. The meeting lasted only five days, and resulted in the completion of an update assessment for Pacific blue marlin. Much of the modeling work was conducted by the multinational assessment team prior to the March workshop via internet. Other WGs should take note.

The ISC Chair also complemented the BILLWG for proposing to work with the Webmaster on website updates. He then asked for more detail on the BILLWG work program. The BILLWG Chair noted that 2017 will be devoted to understanding the changes in CPUE for EPO SWO in the Japanese longline fishery. This is the basis for an index that is used for tuning the stock assessment. The BILLWG will also examine new information on swordfish population heterogeneity, although this work may not lead to a change in stock definitions. A swordfish benchmark stock assessment is scheduled for 2018, a MLS update assessment in 2019, and a Pacific BUM benchmark assessment in 2020.

The differences between a benchmark and update assessments were discussed, because the BILLWG has the most experience in defining and conducting these two assessment types. An update assessment can be less work, because it only involves running the same assessment model with additional data. However, there is still considerable work involved in reviewing and preparing data series for the update. Benchmark assessments are harder to characterize, because they imply that all aspects of the assessment are open to revision. Benchmarks take more time in intersessional meetings, but most of the work happens outside the WG meetings. An important aspect of benchmark assessments is the identification of a lead analyst who considers the entirety of required information and modeling. A five-year benchmark schedule is reasonable, but since billfish are high-turnover species, update assessments and projections during the intervening periods may be necessary.

6.4 Shark

S. Kohin, SHARKWG Chair, provided a summary of SHARKWG activities over the past year. The SHARKWG did not take on a shark assessment between ISC15 and ISC16 with the plan to advance research on fisheries data improvements, modeling, and biology of BSH and SMA. The SHARKWG is planning to conduct a benchmark assessment of BSH in 2017 and the first full stock assessment of north Pacific SMA in 2018.

Over the past year, the SMA indicator analysis was presented to the WCPFC at SC11. Given the indeterminate status of the stock, SC11 did not make conservation recommendations., Because the quality of fisheries data varied across fleets, in order to determine impacts of individual fleets on all species, SC11 recommended that changes in fishing practices of all fleets fishing in the WCPO be documented through time. Regarding BSH, the WCPFC tasked their scientific services provider (Secretariat of the Pacific Community Oceanic Fisheries Program) with providing analyses to determine if North Pacific BSH should be considered a northern stock, coordinating with ISC if further information is necessary

The SHARKWG held a webinar in April 2016 to advance the interim work and plan for the 2017 North Pacific BSH assessment. Sixteen scientists from Canada, China, Chinese Taipei, Japan, Republic of Korea, Mexico, and USA participated. The main objectives of the webinar were to:

1) discuss progress on BSH data preparation, potential modeling approaches and biological studies on BSH and SMA,
2) plan for preliminary data submission and review before the fall 2016 BSH data preparation meeting,
3) establish a schedule for a webinar and fall data prep meeting, and
4) elect a vice-chair.

The working group held preliminary discussions about the models to use for the BSH assessment and decided tentatively to run two Bayesian Surplus Production (BSP) models, BSP2 as was used in the 2013 and 2014 assessments, and a state-space BSP that was developed and used for the South Atlantic BSH assessment. The group agreed to submit detailed size and sex data by 1 August 2016, in order to look at spatial patterns to help inform fishery definitions and determine if the information is adequate for a more complex model; for example, a hybrid production model that integrates size data, or a fully integrated size structured model such as Stock

Synthesis. Key uncertainties that need to be addressed in the upcoming assessment include catch estimates, CPUE indices, and productivity parameters. Mexico will provide a new CPUE index for the 2017 assessment while other nations will work to improve their indices, and there is the potential for improved catch estimates for China and Republic of Korea given their increased involvement in the working group.

Research on BSH and SMA is progressing on many fronts. Preliminary results of ongoing BSH reproductive biology, BSH ageing, BSH and SMA tagging, BSH and SMA stable isotope analyses for stock structure studies, and SMA temporal-spatial distribution were reviewed. A webinar was scheduled for 6-7 September (7-8 September for Western Pacific nations) and the fall data preparatory meeting scheduled for 14-21 November in Republic of Republic of Korea. Finally, Jackie King of Canada was elected vice-chair of the SHARKWG. The webinar was productive in that it provided an opportunity for workgroup members to provide updates on ongoing work and to review assignments, but it was not without challenges due to the difference of 11 hour difference between members in Mexico City and Taipei.

Research is also progressing on a number of other topics that were not reviewed during the webinar. These include meta-analyses and simulations on BSH and SMA productivity and population growth rates, SMA genetics, SMA reproductive biology, and a review of background information on low fecundity stock recruitment relationships. Two scientists outside the working group have also begun efforts to conduct a BSH management strategy evaluation that may be of interest to the SHARKWG.

The SHARKWG established the following schedule in order to complete the North Pacific BSH assessment before the 2017 ISC Plenary.

- **August 1, 2016:** Detailed BSH size/sex data submission deadline; preliminary catch and CPUE data submission deadline
- **September 6-7, 2016 (PDT) Webinar:** Review size data summarizations and decide on modeling approach for BSH assessment
- **November 14-21, 2016, Republic of Korea:** BSH final data prep meeting
- **March 2017 (time and location TBD):** BSH assessment meeting

<u>Discussion</u>

The capacity of the SHARKWG was discussed in a similar vein to the discussion of the BILLWG report. As with the BILLWG Chair, the SHARKWG Chair stated that completing planned assignments will be challenging given current capacity but the WG should be able to complete the BSH stock assessment.

It was suggested that a mean length mortality estimator could be used for data-poor shark assessments. There is considerable information available on the application of this technique. The SHARKWG Chair said she will review this information in advance of the BSH data preparation meeting but noted that BSH is a relatively data-rich species.

The ISC Chair suggested that the proposed workshop on data poor methods could take up some of the points discussed here.

SPC was a valuable partner during the last BSH assessment. However, it is unclear at this point whether SPC will participate in the upcoming BSH assessment.

It is unclear how the request made by SC11 for members to document changes in fishing practices will be collated so the information can be used by the SHARKWG. It was noted that the SHARKWG does request members to document their data collection and analysis procedures.

6.5 Management Strategy Evaluation

J. Holmes and G. DiNardo provided a brief update on the management strategy evaluation (MSE) for NPALB. The second ISC sponsored workshop was held 24-25 May 2016, in Yokohama, Japan. The goal of the workshop was to develop management objectives for the stock that can be used for initial evaluations. The ALBWG Chair led the workshop and drafted a short Chairman's report for consideration by NC12 (*Annex 8, Attachment 8*). The USA is in the process of hiring an analyst to work on this project full time and take over the task of leading the MSE process in collaboration with the ALBWG. It is recognized that the development of objectives and management procedures is iterative and that additional stakeholder input will be needed throughout the development of the MSE.

Discussion

An MSE lead analyst is being hired at the NMFS Southwest Fisheries Science Center and will be responsible for developing a work plan beyond NC12. The analyst will work closely with the ALBWG. There will be a need for substantial ongoing consultations with stakeholders and managers to elaborate management objectives and evaluation metrics.

The linkages between MSE and ecosystem-based fisheries management were noted. It was emphasized that the process for developing the MSE should be transparent and well documented.

It was agreed that the ALBWG Chair's report on the Second MSE Workshop will be presented to SC12 and NC12 as the MSE Workshop Chair's Report.

7 STOCK STATUS AND CONSERVATION ADVICE

7.1 North Pacific Albacore Tuna

J. Holmes, ALBWG Chair, summarized recommendations on stock status and conservation advice for NPALB. He noted that the latest assessment was in 2014 and that a new benchmark assessment would be conducted in 2017. Stock status of NPALB may be related to recruitment, but the ALBWG has not developed a method to monitor recruitment between assessments. The recommendations on stock status and conservation advice shown here are based on a brief review of 2015 catch data. The preliminary estimate of total catch in 2015 is 69,842 t (ISC and nonmember countries combined), which is below the long-term average (1981-2010; 72,128 t) and is below catch in the terminal year (2012) of the last stock assessment. This estimate includes partial catch information from China and non-ISC member countries. The ALBWG noted that the NPALB stock has not been fished heavily over the 1966-2012 time frame used in the 2014 assessment. It was noted that WCPFC CMM 2005-03 and IATTC Resolution C-05-02 for NPALB specify that the level of fishing effort by member countries and cooperating non-member countries for NPALB in the Convention Areas north of the Equator shall not be increased beyond current levels. NC6 clarified that current levels of effort was the average of the 2002-2004 period. Since the ALBWG has no new information on stock status or conservation concerns, it recommends no changes to the stock status and conservation advice provided by ISC15.

Discussion

The possibility of constructing a recruitment index based on CPUE of age 2-3 fish in the US/Canada surface fishery was raised. Discussions of this topic will begin at the data preparation meeting in November 2016 but there are a number of impediments to creating such an index. The troll fishery occurs mainly inshore and may not be a good candidate for such an index. Also, the fishery has gone through some significant operational changes including fishing area extent.

Chinese catch in the most recent three years is estimated to be about 5% of the total and has declined since a peak in 2011. All nations' catch declined in 2015 from previous levels. It was noted that China is operating in the area between the Equator and 15° N, which is thought to be the spawning area for NPALB. For this reason, this fleet may be harvesting the largest fish. So far obtaining more information from Vanuatu has been unsuccessful but members should raise this issue at NC12, because Vanuatu is an NC member and will be at the meeting. China may also attend NC12, and if so, there will also be an opportunity to get more information on their catches. The conservation advice notes the need for these countries to provide catch information.

Stock Status and Conservation Advice

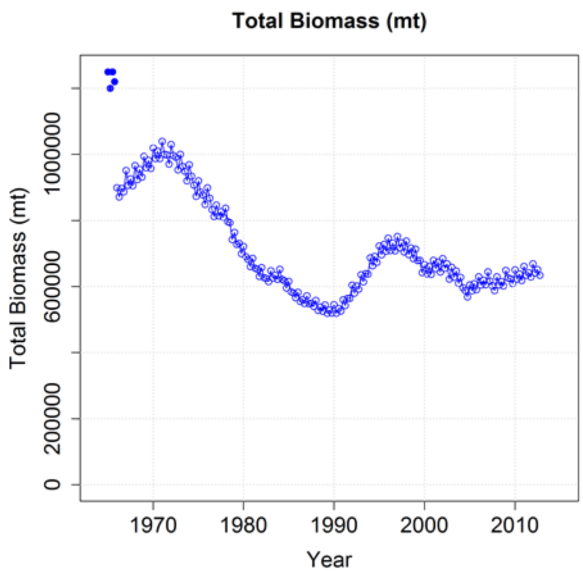
Stock Status

Because the calculated Fs for 2010-2012 relative to most candidate reference points, except F_{MED} and $F_{50\%}$ (which the ALBWG considers to be poor choices as reference points for this stock), are below 1.0, NPALB is not experiencing overfishing. The 2014 assessment estimated that spawning biomass in 2012 (110,101 t) was more than two times greater than the $20\%SSB_{CURRENT\ F=0}$ limit reference point established by the WCPFC, which means that the stock is not in an overfished state. Thus, the ISC concludes that overfishing is not occurring and that the stock is not in an overfished state (Figure 7-1, Figure 7-2, and Figure 7-3).

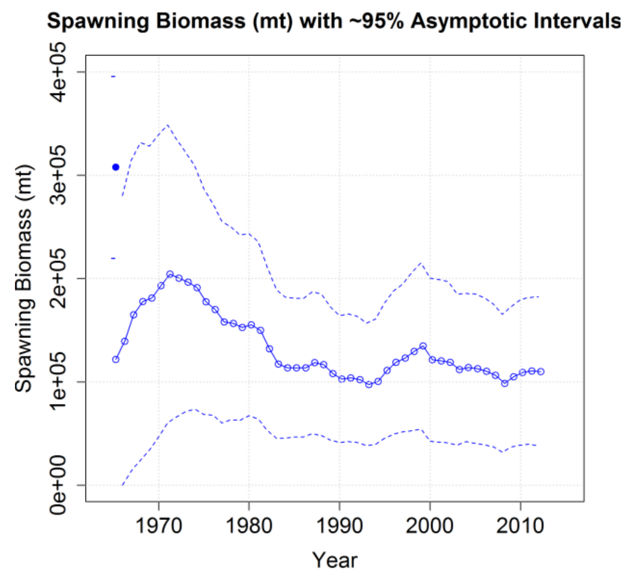
Conservation Advice

The ISC concludes that the north Pacific albacore stock is healthy ($SSB_{2012} > 20\%SSB_{current\ F=0}$) and that current productivity (SSB_{2012}) is sufficient to sustain recent exploitation ($F_{2010\text{-}2012}$), assuming average historical recruitment (about 42.8 million fish annually) continues.

A.



B.



C.

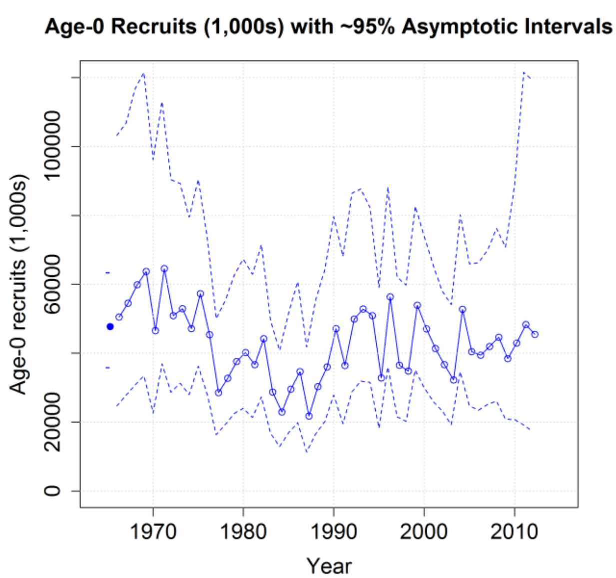


Figure 7-1. Estimated total age-1+ biomass (A), female spawning biomass (B), and age-0 recruitment (C) of NPALB. The open circles represent the maximum likelihood estimates of each quantity and the dashed lines in the SSB (B) and recruitment (C) plots are the 95% asymptotic intervals of the estimates (± 2 standard deviations) in lognormal (SSB – B) and arithmetic (recruitment – C) space. Since the assessment model represents time on a quarterly basis, there are four estimates of total biomass (A) for each year, but only one annual estimate of spawning biomass (B) and recruitment (C).

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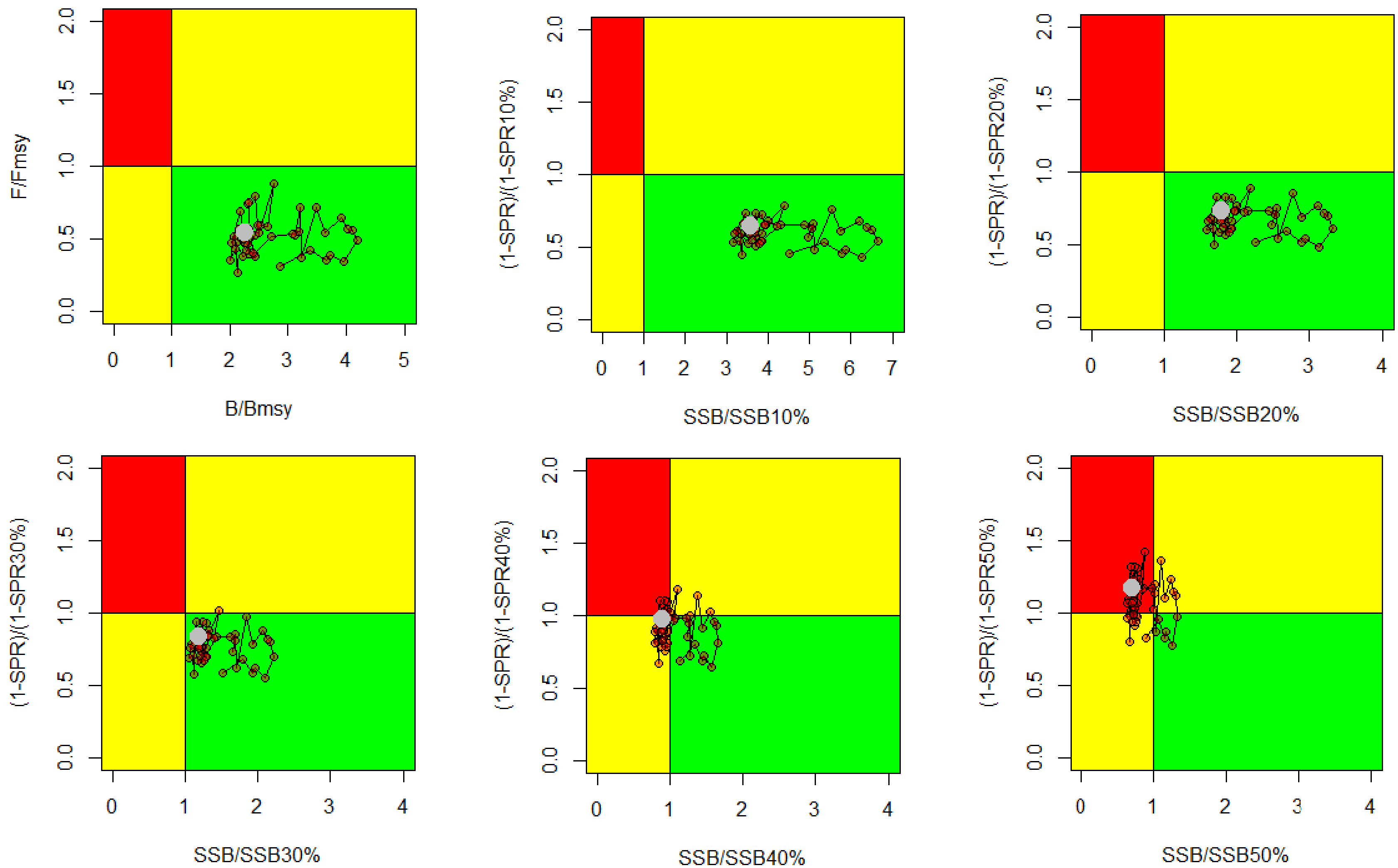

Figure 7-2. Alternative Kobe plots showing NPALB stock status based on Fcurrent (F2010-2012) relative to MSY-based reference points (top left) and MSY proxies consisting of SPR-based fishing intensity reference points($F_{10\%-50\%}$) for the 2014 base case model. Grey dots are the terminal year (2012) of the assessment. NC10 chose SB20% as the limit reference point. These plots are presented for illustrative purposes, because a target reference point has not been chosen. .

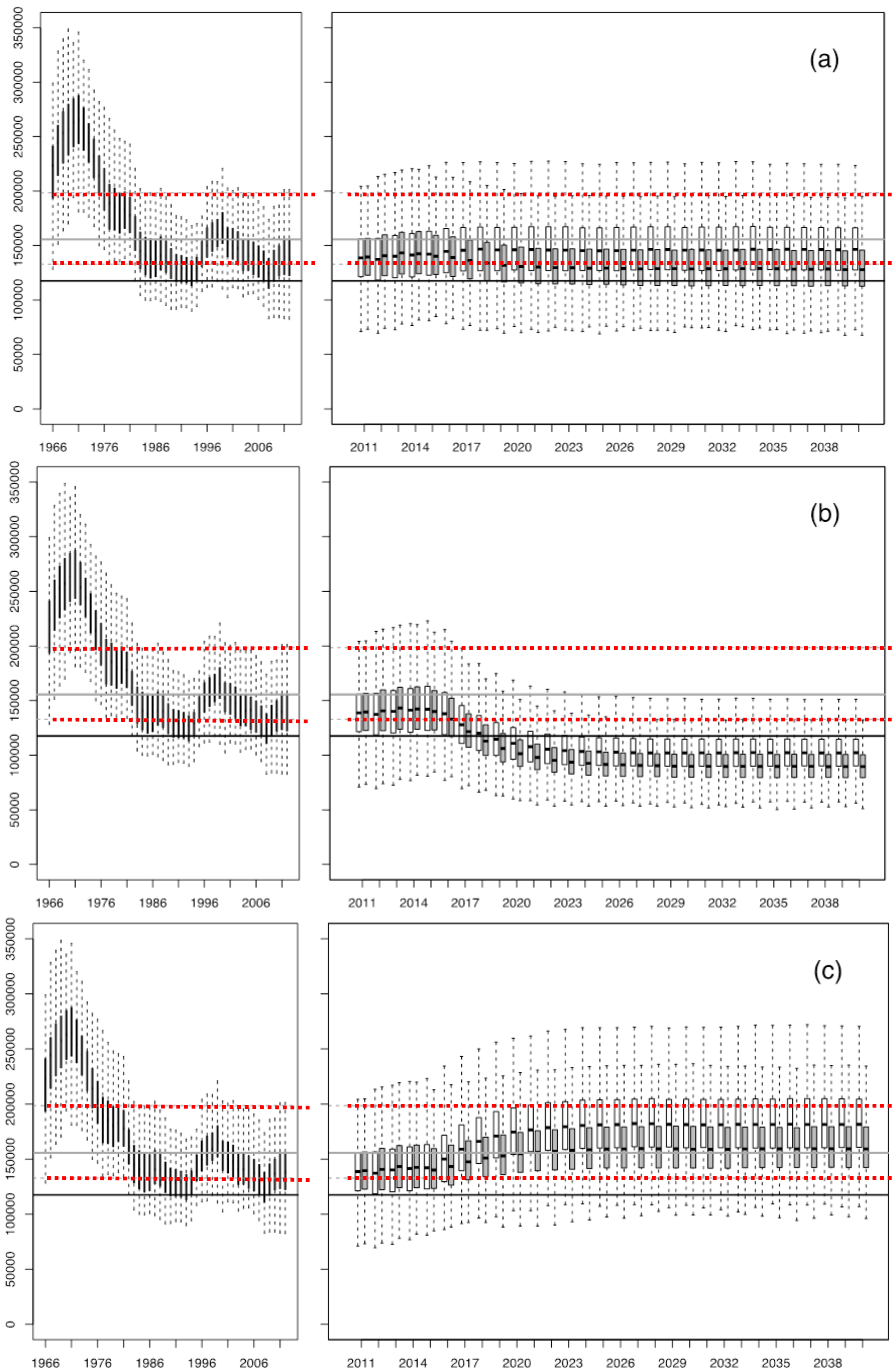

Figure 7-3. Historical (left) and future trajectories of NPALB female spawning biomass (SSB) based on to two constant harvest scenarios (F2002-2004 - gray boxplot; F2010-2012 - white boxplot) for average historical recruitment (a), low historical recruitment (b) and high historical recruitment (c) scenarios. The solid gray and red dashed lines represent median, 25% and 75% quartiles of past SSB, respectively. The solid black line is the average of 10 lowest estimated historical female SSB values, i.e., the SSB-ATHL threshold. Outlier values are not shown in these figures.

7.2 Pacific Bluefin

H. Nakano, the Chair of PBFWG reported the results of the benchmark assessment of PBF (Annex A) conducted in February-March in 2016, which used the best available fisheries and biological information. The base-case model fits the data well, and is internally consistent among most of the sources of data. The model is substantially improved compared to the 2014 assessment, indicating: (1) SSB fluctuated throughout the assessment period (fishing years 1952-2014), (2) SSB steadily declined from 1996 to 2010, and (3) the decline appears to have ceased since 2010, although the stock remains near the historic low.

SSB_{MED} is defined as the historical median spawning stock biomass and is used by the WCPFC as the rebuilding target. However, the SSB_{MED} used in the projections and to evaluate the rebuilding strategy was different from that used for the potential biological reference point. The projection SSB_{MED} of 38,000 t is less than the base-case model SSB_{MED} (41,000 t), which is used as a potential biological reference point, and less than that used in WCPFC CMM 2015-04 (43,000 t). Probabilities of rebuilding to 38,000, 41,000 t, and 43,000 t are reported (Table 7-3). The PBFWG also notes that currently the calculation of SSB_{MED} is not based on a fixed set of years. The calculation of SSB_{MED} included the addition of SSB estimated for the most recent years, which were not available in prior assessments. Without a fixed range of years, the calculated value of SSB_{MED} will be influenced by the long-term trend in SSB. The PBFWG therefore recommends unifying the definition of SSB_{MED} to the median of point estimates for future use. In this method, SSB_{MED} would be 41,069 t for the period of 1952-2012 and 40,994 t for 1952-2014. The period should be fixed to either one. The probability of achieving 41,000 t by 2024 is 62% under Scenario 2, which gives the most pessimistic perspective.

Discussion

The Plenary agreed that this current assessment represents the best available science for management decision-making.

As has been highlighted in previous ISC advice, using depletion-based biological reference points of 20% (which the WCPFC has adopted for other tuna stocks), the stock has been overfished and subject to overfishing for almost all of the assessment time series, which begins in 1952. Based on the assumption that fishing intensity was low in the years following World War II, it is hard to explain this stock status at the beginning of the assessment time series, although there are some historical data to suggest that catches were relatively high in the 1930s.

It was agreed that the conservation advice should present two calculations of SSB_{MED} based on the median point estimate over a fixed period of either 1952-2012 or 1952-2014 and call on managers to decide on which of these two periods to use to define SSB_{MED} going forward. It will be important for managers to choose a single definition to be consistent with management advice based on a set time period and to understand that the absolute value of SSB_{MED} will change with each assessment.

The Plenary discussed the weight threshold identified in CMM 2015-04. It is recognized that the threshold of 30 kg (in CMM 2015-04) is less than the size/age at which 50% of the fish are sexually mature based on the maturity ogive used in the assessment. It is also evident that increasing the threshold weight would hasten stock recovery regardless of the maturity schedule since a larger portion of the stock would be subject to the more stringent management measures for small fish in the current CMM 2015-04.[2] The conservation advice was amended to more clearly communicate to managers these issues around the choice of a threshold weight in the management measure. It was emphasized that the effectiveness of measures that employ size limits depends on the ability of fisheries to control size selectivity and/or the post-release survival of size classes subject to a catch limit.

It was noted that age-specific average fishing mortality increased across an intermediate range of age classes from 2011-2013, ages 2-5 and 7-10 (see Table 7-1)compared to the 2002-2004 benchmark (see Table 7-1) although total fishing mortality has declined relative to the benchmark.

The best way to explain the origin of the 38,000 t estimate of SSB_{MED} was discussed. This value was calculated using the method used in the previous assessment.

The characterization of the risk of falling below SSB_{LOSS} was discussed. It was noted that the probability value is less than 0.01.

<u>Stock Status and Conservation Advice</u>

Stock Status

The PBFWG conducted a benchmark assessment (base-case model) using the best available fisheries and biological information. The base-case model fits well the data that were considered to be more reliable and is internally consistent among most of the sources of data. The 2016 base-case model is a substantial improvement compared to the 2014 assessment and fits all reliable data well. The base-case model indicates: (1) spawning stock biomass (SSB) fluctuated throughout the assessment period (fishing years 1952-2014) and (2) the SSB steadily declined from 1996 to 2010; and (3) the decline appears to have ceased since 2010, although the stock remains near the historic low. The model diagnostics suggest that the estimated biomass trend for the last 30 years is considered robust although SSB prior to the 1980s is uncertain due to data limitations.

Using the base-case model, the 2014 (terminal year) SSB was estimated to be around 17,000 t (Figure 7-4), which is about 9,000 t below the terminal year estimated in the 2014 assessment (26,000 in 2012). This is because of improvements to the input data and refinements to the assessment model scaled down the estimated value of SSB and not because the SSB declined from 2012 to 2014.

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[2] It was noted that the term small fish is not used in CMM 2015-04; however, the measure states “Further substantial reductions in fishing mortality and juvenile catch over the whole range of juvenile ages should be considered…”

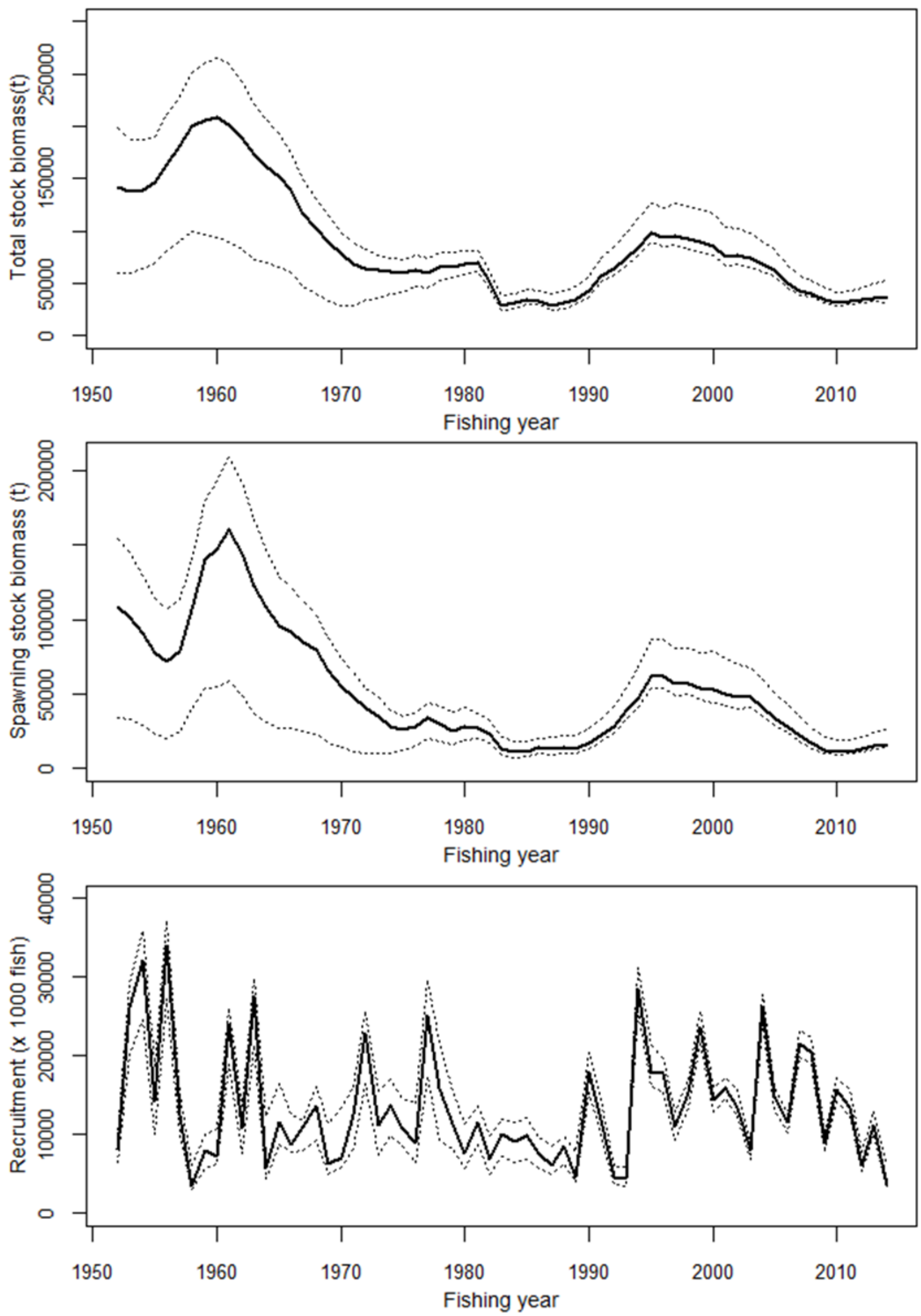


Figure 7-4 Total stock biomass (top), spawning stock biomass (middle) and recruitment (bottom) of PBF from the base-case model. The solid line indicates point estimate and dashed lines indicate the 90% confidence interval.

Recruitment estimates fluctuate widely without an apparent trend. The 2014 recruitment was relatively low, and the average recruitment for the last five years may have been below the historical average level (Figure 7-4). Note that recruitments in terminal years in an assessment are highly uncertain due to limited information on the cohorts. However, two of the last three data points from the Japanese troll CPUE-based index of recruitment, which was consistent with other data in the model, are at their lowest level since the start of the index (1980). Estimated age-specific fishing mortalities on the stock during 2011-2013 and 2002-2004 (the base period for WCPFC CMM 2015-04) are presented in Figure 7-5. Most age-specific fishing mortalities (*F*) for intermediate ages (2-10 years) are substantially above $F_{2002-2004}$ while those for age 0 as well as ages 11 and above are lower (Table 7-1).

Table 7-1. Percent change of estimated age-specific fishing mortalities of PBF from 2002-2004 to 2011-2013.

Age	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
change from F2002-2004 to F2011-2013	-28%	-1%	+96%	+4%	+86%	+43%	-9%	+81%	+21%	+23%	+5%	-5%	-7%	-8%	-9%	-10%	-10%	-10%	-11%	-11%	-11%

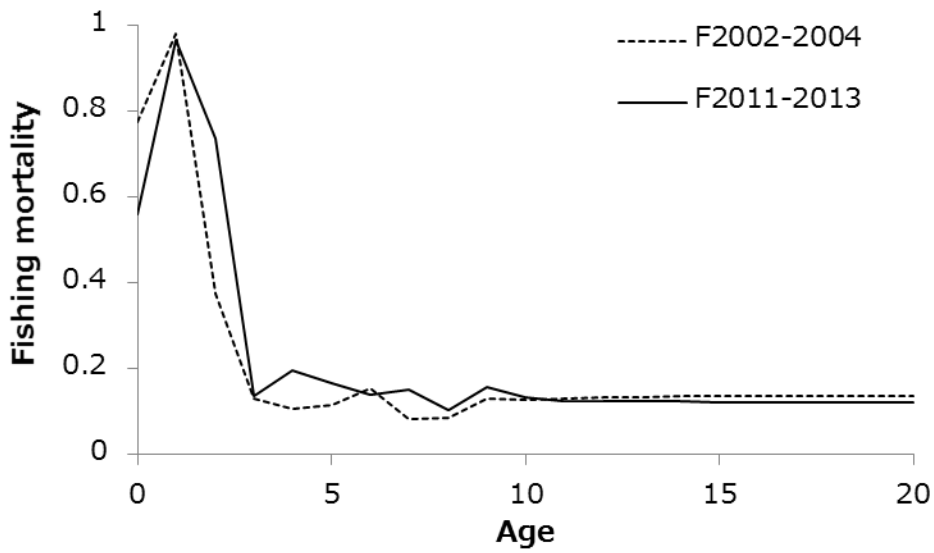


Figure 7-5.. Geometric means of annual age-specific (years) fishing mortalities of PBF for 2002-2004 (dashed line) and 2011-2013 (solid line).

Although no limit reference points have been established for the PBF stock under the auspices of the WCPFC and IATTC, the $F_{2011-2013}$ exceeds all calculated biological reference points except for F_{MED} and F_{LOSS} despite slight reductions to F in recent years (Table 7-2). **The ratio of SSB in 2014 relative to the theoretical unfished[3] SSB ($SSB_{2014}/SSB_{F=0}$, the depletion ratio) is 2.6%[4] and $SSB_{2012}/SSB_{F=0}$ is 2.1% indicating a slight increase from 2012 to 2014.** Although the $SSB_{2014}/SSB_{F=0}$ for this assessment (2.6%) is lower than $SSB_{2012}/SSB_{F=0}$ from the 2014 assessment (4.2%), this difference is due to improvements to the input data and model structure (Figure 7-4) rather than a decline in SSB from 2012 to 2014. Note that potential

[3] "Unfished" refers to what SSB would be had there been no fishing.

[4] The unfished SSB is estimated based upon equilibrium assumptions of no environmental or density-dependent effects.

effects on Fs as a result of the measures of the WCPFC and IATTC starting in 2015 or by other voluntary measures are not yet reflected in the data used in this assessment.

Since reference points for PBF have yet to be identified, two examples of Kobe plots (Figure 7-6: plot A based on SSB_{MED} and F_{MED}, plot B based on $SSB_{20\%}$ and $SPR_{20\%}$) are presented. These versions of the Kobe plot represent two interpretations of stock status in an effort to prompt further discussion. In summary, if these were the reference points, overfishing would be occurring or just at the threshold in the case of F_{MED}; and the stock would be considered overfished. Plot B shows that the stock has remained in an overfished and -overfishing status for the vast majority of the assessment period if $F_{20\%}$ and $SSB_{20\%}$ are the reference points. The ISC notes that the SSB estimates before 1980 are more uncertain and that the reason why the fishing mortality is estimated to be so high right after the WWII is not well understood. The low biomass level at the beginning of the assessment period (1952) could potentially be the result of relatively high catches prior to the assessment period.

Table 7-2. Ratios of the estimated fishing mortalities $F_{2002-2004}$, $F_{2009-2011}$ and $F_{2011-2013}$ relative to computed F-based biological reference points and SSB (t) and depletion ratio for the terminal year of the reference period for PBF.

	F_{max}	$F_{0.1}$	F_{med}	F_{loss}	$F_{10\%}$	$F_{20\%}$	$F_{30\%}$	$F_{40\%}$	Estiamted SSB for terminal year of each reference period	Depletion ratio for terminal year of each reference period
2002-2004	1.86	2.59	1.09	0.80	1.31	1.89	2.54	3.34	41,069	0.064
2009-2011	1.99	2.78	1.17	0.85	1.41	2.03	2.72	3.58	11,860	0.018
2011-2013	1.63	2.28	0.96	0.70	1.15	1.66	2.23	2.94	15,703	0.024

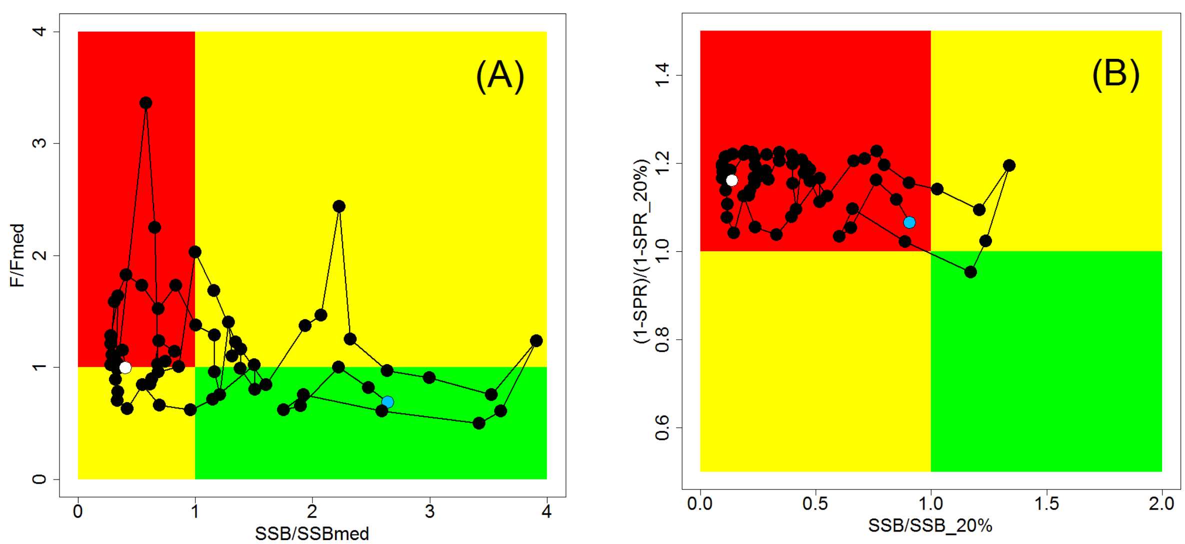
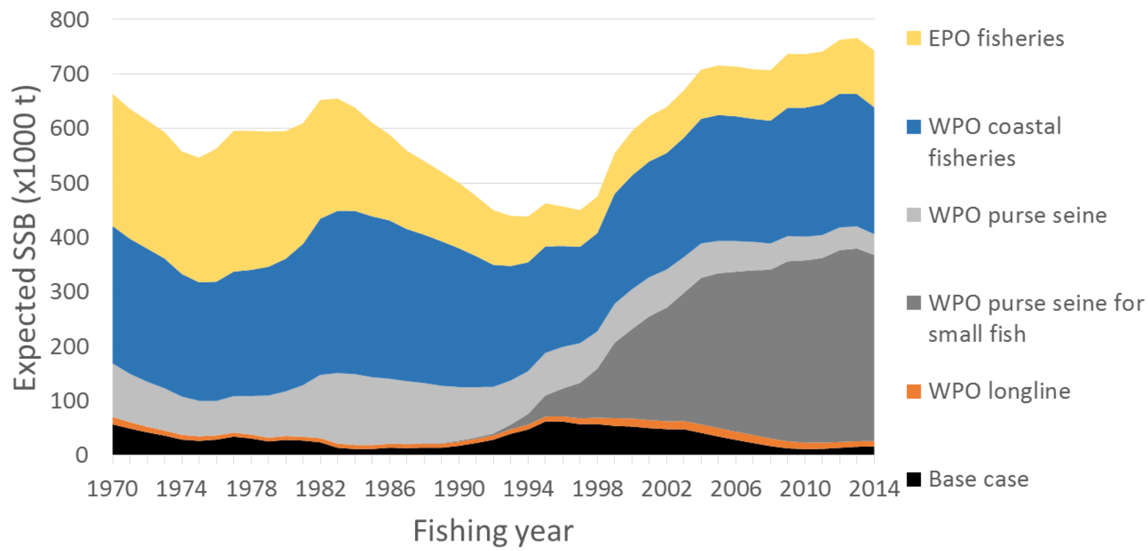


Figure 7-6. Kobe plots for PBF. (A) SSB_{MED} and F_{MED}; (B) $SSB_{20\%}$ and $SPR_{20\%}$ based. Note that SSB_{MED} is estimated as the median of estimated SSB over whole assessment period (40,944 t) and F_{MED} is calculated as an F to provide SSB_{MED} in long-term, while the plots are points of estimates. The blue and white points on the plot show the start (1952) and end (2014) year of the period modeled in the stock assessment, respectively.

Historically, the WPO coastal fisheries group has had the greatest impact on the PBF stock, but since about the early 1990s the WPO purse seine fleets, in particular those targeting small fish (age 0-1), have had a greater impact, and the effect of these fleets in 2014 was greater than any of the other fishery groups. The impact of the EPO fishery was large before the mid-1980s, decreasing significantly thereafter. The WPO longline fleet has had a limited effect on the stock throughout the analysis period (Figure 7-7). This is because the impact of a fishery on a stock depends on both the number and size of the fish caught by each fleet; i.e., catching a high number of smaller juvenile fish can have a greater impact on future spawning stock biomass than catching the same weight of larger mature fish.



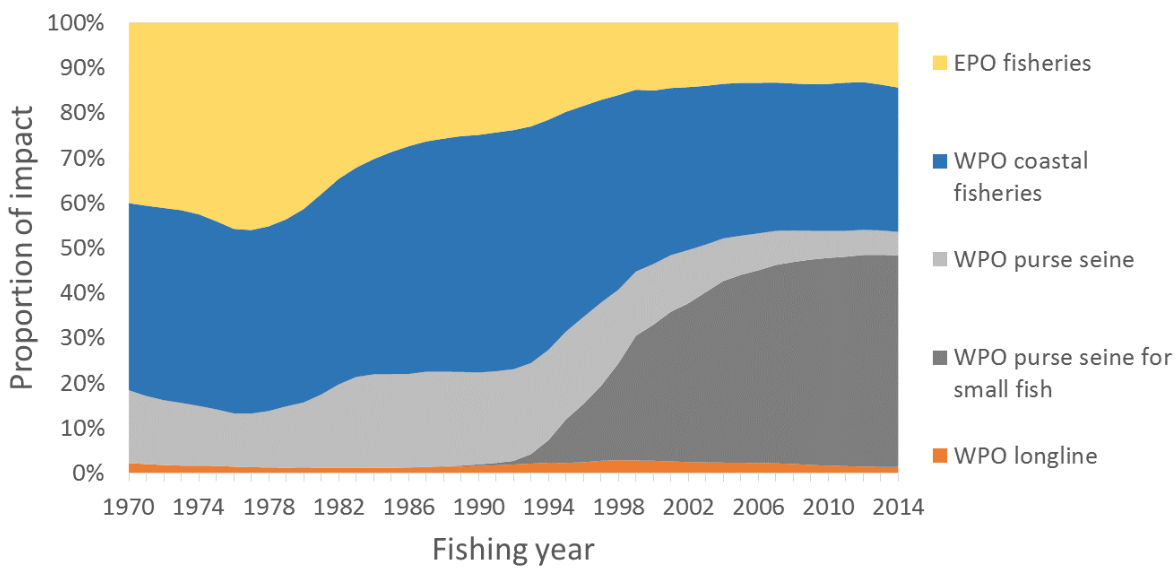


Figure 7-7. Trajectory of the spawning stock biomass of a simulated population of PBF when zero fishing mortality (F=0) is assumed and the STET at F=0 is the same as estimated in the base-case assessment model, estimated by the base-case model. (top: absolute impact, bottom: relative impact). Fleet definition; WPO longline: F1, F12, F17. WPO purse seine for small fish: F2, F3, F18. WPO purse seine: F4, F5. WPO coastal fisheries: F6-11, F16, F19. EPO fisheries: F13, F14, F15.

Conservation Advice

The steady decline in SSB from 1996 to 2010 appears to have ceased, although SSB_{2014} is near the historic low and the stock is experiencing exploitation rates above all calculated biological reference points except for F_{MED} and F_{LOSS}.

The projection results based on the base-case model under several harvest and recruitment scenarios and time schedules are shown in Table 7-3 and Figure 7-8. Under all examined scenarios the initial goal of WCPFC, rebuilding to SSB_{MED} by 2024 with at least 60% probability, is reached and the risk of SSB falling below SSB_{LOSS} at least once in 10 years was low.

The projection results indicate that the probability of SSB recovering to the initial WCPFC target (SSB_{MED} by 2024, 38,000 t, calculated in the same manner as the previous assessment) is 69% or above the level prescribed in the WCPFC CMM if low recruitment scenario is assumed and WCPFC CMM 2015-04 and IATTC Resolution C-14-06 continue in force and are fully implemented (Table 4: Scenario 2 with low recruitment).

The ISC notes there are technical inconsistencies in the calculation of SSB_{MED} in the assessment and projection. The ISC also notes the current calculation of SSB_{MED} in the projection includes the most recent estimates of SSB and unless a fixed period of years is specified to calculate SSB_{MED}, the calculation of SSB_{MED} could be influenced by future trends in spawning biomass. The ISC therefore recommends defining SSB_{MED} as the median point estimate for a fixed period of time, either, 1952-2012 or 1952-2014. If 1952-2012 is chosen, then SSB_{MED} is estimated to be 41,069 t, and if 1952-2014 is chosen, SSB_{MED} is 40,994 t. The probabilities of achieving 41,000 t under various scenarios are provided in Table 7-3. The probabilities of achieving 43,000 t, where WCPFC CMM 2015-04's initial rebuilding target is specified as 42,592 t, are also provided in Table 7-3, although this value is derived from the previous assessment and is higher than the SSB_{MED} calculated in the current assessment. The ISC recommends that in the future absolute values should not be used for the initial rebuilding target, as the calculated values of reference points would change from assessment to assessment.

Scenario 2 with low recruitment has the lowest prospect of recovery among the examined harvest scenarios. The probability of achieving the WCPFC's initial target (SSB_{MED} by 2024) would increase if more conservative management measures were implemented as shown in Table 7-3 and Figure 7-8. The projection results indicate that a 10% reduction in the catch limit for fish smaller than the weight threshold in CMM 2015-04 would have a larger effect on recovery than a 10% reduction in the catch limit for fish larger than the weight threshold. (Figure 7-8 (D)). The ISC notes that the current assessment model uses a maturity ogive that assumes 20%, 50% and 100% maturity in age 3 (weight on July 1: 34kg), 4 (weight on July 1: 58kg) and 5 (weight on July 1: 85kg), respectively, while the WCPFC CMM 2015-04 specifies that catches of fish smaller than 30kg should be reduced. The weight threshold in the CMM needs to be increased to 85kg (weight of age 5) if the intent is to reduce catches on all juveniles according to the maturity ogive in the assessment.

The projections results assuming a stronger stock-recruitment relationship (where h=0.9) than in the assessment model are not necessarily more pessimistic than the low recruitment scenario.

The projection results assume that the CMMs are fully implemented and are based on certain biological or other assumptions. In particular, the ISC noted the implementation of size based management measures need to be monitored carefully. If conditions change, the projection results would be more uncertain. Given the low SSB, the uncertainty in future recruitment, and the influence of recruitment has on stock biomass, monitoring recruitment and SSB should be strengthened so that the recruitment trends can be understood in a timely manner.

Harvesting Scenario #	Fishing mortality	Catch limit *		Threshold of Small/Large	Recruitment scenario **	Probability that SSB exceeds 38,000 tons (SSB median of Bootstrap analysis runs)			Probability that SSB exceeds 41,000 tons (SSB median of Basecase model) ***			Probability that SSB is more than 43,000 tons (SSBmed@last assessment)			Probability that SSB is more than 10%SSB0			Probability that SSB is more than 20%SSB0			Average Catch	
		Small	Large			2024	2029	2034	2024	2029	2034	2024	2029	2034	2024	2029	2034	2024	2029	2034	2019	2024
Scenario1	F2002-2004	scenario 6 in 2014 assessment		30 kg	Low recruitment	77.0%	88.8%	89.9%	69.7%	83.3%	85.2%	64.3%	79.3%	81.9%	14.7%	28.0%	31.8%	0.0%	0.0%	0.1%	11619.2	13574.9
Scenario2		50% of 2002-2004 average catch for WPO fisheries 3,300 tons for EPO commercial fisheries	2002-2004 average catch for WPO fisheries		Low recruitment	69.3%	83.7%	86.6%	61.5%	77.8%	82.3%	56.1%	73.9%	79.0%	13.6%	29.3%	35.4%	0.1%	0.4%	0.6%	11749.7	12994.2
					Average recruitment	99.6%	100%	100%	99.3%	100%	100%	99.3%	100%	100%	96.3%	99.8%	100%	73.8%	95.0%	98.0%	12958.4	14750.8
					Stock Recruit Relationship w/ h=0.9	98.2%	99.8%	99.9%	97.7%	99.8%	99.9%	97.5%	99.7%	99.9%	93.5%	99.4%	99.9%	72.0%	97.3%	99.6%	13087.3	15020.1
Scenario3		50% of 2002-2004 average catch		50 kg	Low recruitment	80.5%	91.5%	94.0%	73.8%	87.9%	90.7%	69.1%	85.1%	88.5%	22.2%	43.6%	51.7%	0.2%	0.9%	1.3%	11404.4	12672.3
Scenario4				80 kg	Low recruitment	86.4%	94.6%	96.5%	80.6%	91.9%	94.7%	76.6%	90.0%	93.0%	27.8%	51.8%	61.3%	0.2%	1.1%	1.6%	11292.6	12542.7
Scenario5		90% of scenario 2	same as Scenario 2	30 kg	Low recruitment	90.0%	96.5%	98.1%	85.3%	94.8%	97.0%	81.5%	93.4%	95.9%	35.0%	61.7%	70.4%	0.3%	2.5%	3.7%	11306.4	12881.3
					Average recruitment	99.9%	100%	100%	99.9%	100%	100%	99.9%	100%	100%	98.4%	100%	100%	82.2%	97.8%	99.3%	12442.0	14126.3
					Stock Recruit Relationship w/ h=0.9	99.4%	100%	100%	99.2%	100%	100%	99.1%	100%	100%	97.0%	99.8%	100%	81.8%	99.0%	99.9%	12576.4	14448.2
Scenario6		same as Scenario 2	90% of scenario 2		Low recruitment	75.3%	88.2%	90.2%	67.2%	82.9%	86.5%	61.7%	78.6%	83.4%	15.7%	32.5%	38.7%	0.1%	0.5%	0.7%	11496.2	12632.4
					Average recruitment	99.7%	100%	100%	99.6%	100%	100%	99.5%	100%	100%	96.8%	99.9%	100%	75.1%	95.2%	98.1%	12686.3	14071.5
					Stock Recruit Relationship w/ h=0.9	98.9%	99.9%	100%	98.6%	99.9%	100%	98.4%	99.9%	100%	95.0%	99.7%	100%	75.5%	98.0%	99.9%	12761.0	14379.7
Scenario7		90% of scenario 2			Low recruitment	90.3%	96.8%	98.3%	86.2%	95.4%	97.6%	82.7%	94.2%	96.8%	39.4%	68.0%	77.4%	0.5%	3.5%	5.6%	11231.0	12607.1
					Average recruitment	99.9%	100%	100%	99.9%	100%	100%	99.9%	100%	100%	98.5%	100%	100%	83.5%	98.1%	99.6%	12139.4	13461.7
					Stock Recruit Relationship w/ h=0.9	99.2%	100%	100%	99.1%	100%	100%	99.0%	99.9%	100%	96.9%	99.8%	100%	81.6%	99.0%	99.9%	11227.3	12461.8
Scenario8		80% of scenario 2	same as Scenario 2		Low recruitment	97.5%	99.6%	99.9%	96.1%	99.3%	99.7%	94.8%	98.9%	99.5%	65.4%	89.2%	94.0%	1.9%	14.5%	22.8%	10922.8	12688.4
Scenario9		same as Scenario 2	80% of scenario 2		Low recruitment	78.1%	89.9%	92.5%	70.4%	85.6%	88.8%	65.0%	81.9%	86.3%	18.4%	37.1%	44.7%	0.2%	0.6%	0.9%	11327.0	12329.9
Scenario10		80% of scenario 2			Low recruitment	98.3%	99.8%	99.9%	97.4%	99.6%	99.9%	96.3%	99.5%	99.8%	73.2%	93.8%	97.5%	3.1%	22.4%	34.1%	10585.9	11586.4
					Average recruitment	100%	100%	100%	100%	100%	100%	100%	100%	100%	99.7%	100%	100%	91.0%	99.5%	100%	11194.1	12104.9
					Stock Recruit Relationship w/ h=0.9	99.8%	100%	100%	99.7%	100%	100%	99.7%	100%	100%	98.7%	100%	100%	90.0%	99.7%	100%	11227.3	12461.8
Scenario11	F2011-2013	same as Scenario 2	same as Scenario 2		Low recruitment	82.6%	93.0%	95.0%	75.9%	89.9%	92.1%	71.3%	86.4%	89.9%	23.6%	46.2%	56.0%	0.1%	1.2%	1.6%	12266.8	13587.4

Table 7-3. Future projection scenarios for PBF and their probability of achieving various target levels by various time schedules based on the base-case model.

*** Catch limits for EPO commercial fisheries is applied for all the catch (small and large fish) made by the Fleets.**

**** Average recruitment refers to the recruitment for the whole assessment period while low recruitment refers to that of 1980-1989.**

***** Probability that SSB exceeds 41,000 tons (SSB median of Basecase model) developed by PBFWG at ISC16 Plenary.**

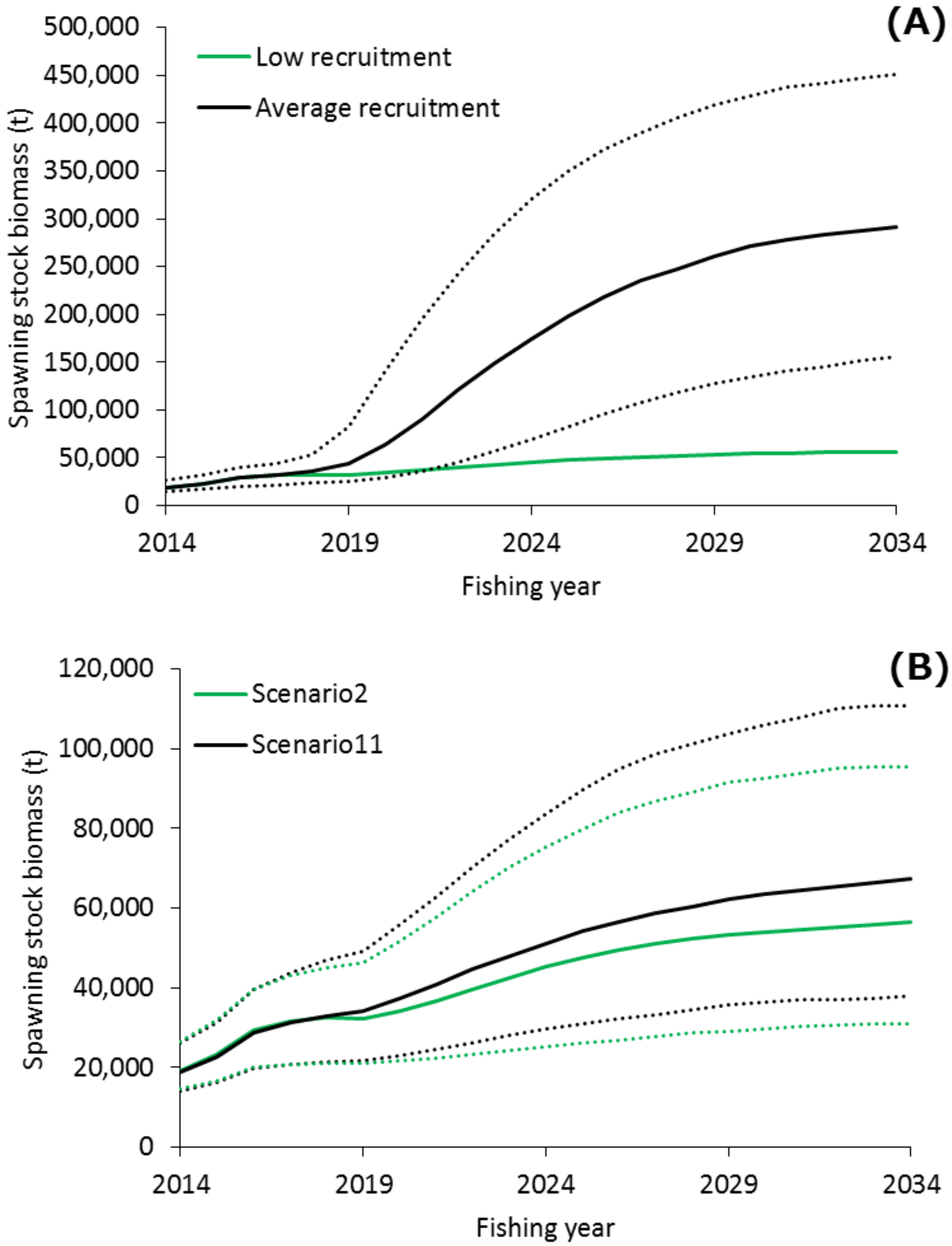
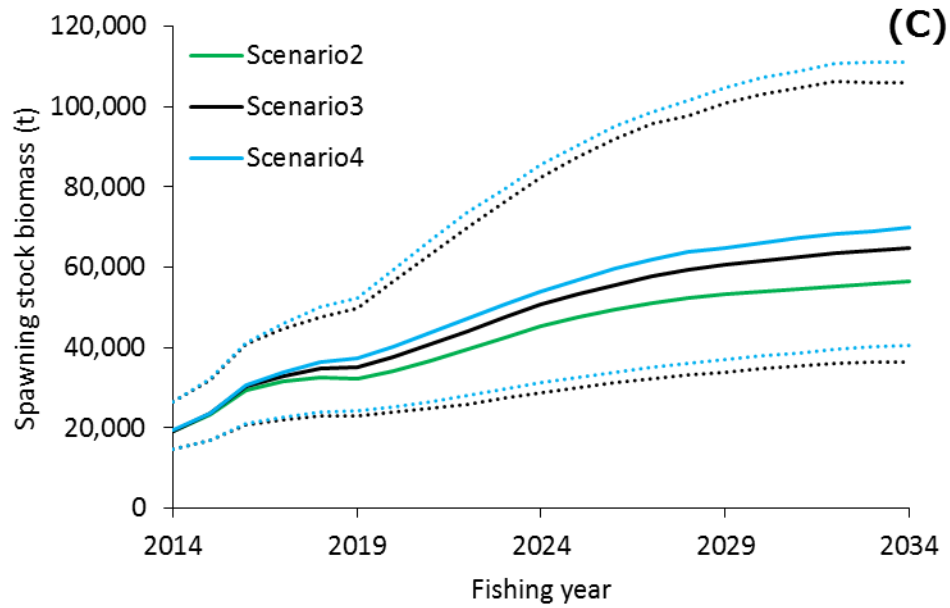


Figure 7-8. Comparisons of various projection results for PBF. (A) low recruitment vs. historical average recruitment (Scenario 2). (B) current CMMs (Scenario 2) vs. current F (Scenario 11) (low recruitment). The solid lines indicate median of bootstrapped projection results and dotted lines indicate 90% confidence interval.



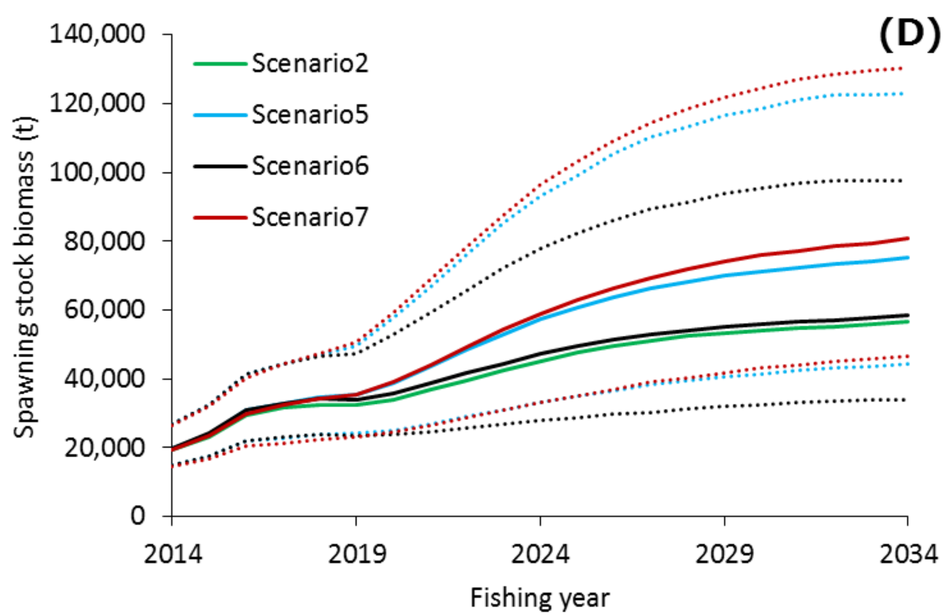


Figure 7-8 (cont.) Comparisons of various projection results for PBF. (C) different definition of small fish (30kg (Scenario 2) vs. 50kg (Scenario 3) vs. 80kg (Scenario 4)) (low recruitment). (D) current CMMs (Scenario 2) vs. additional 10% catch limit reduction for small fish (Scenario 5), for large fish (Scenario 6) and for all fish (Scenario 7) (low recruitment). The solid lines indicate median of bootstrapped projection results and dotted lines indicate 90% confidence interval.

7.3 Blue marlin

J. Brodziak presented the BILLWG's current stock assessment for blue marlin (*Annexes 05, 07, and 10).*

Catches: Pacific BUM catches exhibited an increasing trend from the 1950s to the 1980s and thereafter fluctuated without trend. In the 1990s the catch by Japanese fleets decreased while the catch by Taiwanese, WCPFC, and some IATTC member countries increased (Figure 7-9). Overall, longline gear has accounted for the vast majority of Pacific BUM catches since the 1950's (Figure 7-10).

Data and Assessment: Catch and size composition data were collected from ISC members (Japan, Chinese Taipei, and USA), IATTC member countries, and the WCPFC (Table 7-3). Standardized catch-per-unit effort data used to measure trends in relative abundance were provided by Japan, USA, and Chinese Taipei. The Pacific BUM stock was assessed using an age-, length-, and sex-structured assessment Stock Synthesis model fit to time series of standardized CPUE and size composition data. Sex-specific growth curves and natural mortality rates were used to account for the sexual dimorphism of adult BUM. The value for stock-recruitment steepness used for the base case model was $h = 0.87$. The assessment model was fit to relative abundance indices and size composition data in a likelihood-based statistical framework. Maximum likelihood estimates of model parameters, derived outputs, and their variances were used to characterize stock status and to develop stock projections. Several sensitivity analyses were conducted to evaluate the effects of changes in model parameters, including the data series used in the analyses, the natural mortality rate, the stock-recruitment steepness, the growth curve parameters, and the female age at 50% maturity.

Biological Reference Points: Biological reference points were computed for the base case model with Stock Synthesis (Table 7-4). The point estimate of maximum sustainable yield was MSY = 19,901 t. The point estimate of the spawning biomass to produce MSY (adult female biomass) was SSB_{MSY} = 19,853 t. The point estimate of F_{MSY}, the fishing mortality rate to produce MSY (average fishing mortality on ages 2 and older) was F_{MSY} = 0.32 and the corresponding equilibrium value of spawning potential ratio at MSY was SPR_{MSY} = 18%. The point estimate of $F_{20\%}$ was 0.30 and the corresponding estimate of $SSB_{20\%}$ was 22,727 t.

Projections: Deterministic stock projections were conducted with Stock Synthesis to evaluate the impact of alternative future levels of harvest intensity on female spawning stock biomass and yield for Pacific blue marlin. Future recruitment was predicted based on the stock-recruitment curve. These projections used all the multi-fleet, multi-season, size- and age-selectivity, and complexity in the assessment model to produce consistent results. The stock projections started in 2015 and continued through 2024 under 4 levels of constant fishing mortality: (1) constant fishing mortality equal to the 2003-2005 average ($F_{2003-2005} = F_{16\%}$); (2) constant fishing mortality equal to $F_{MSY} = F_{18\%}$; (3) constant fishing mortality equal to the 2012-2014 average defined as current ($F_{21\%}$); and (4) constant fishing mortality equal to $F_{30\%}$ ($F_{30\%}$ corresponds to the fishing mortality that produces 30% of the spawning potential ratio). Results show the projected female spawning stock biomasses and the catch biomasses under each of the four harvest scenarios (Table 7-5 and Figure 7-13).

Special Comments: The lack of sex-specific size data and the simplified treatment of the spatial structure of Pacific blue marlin population dynamics were important sources of uncertainty in the 2016 stock assessment update.

Discussion

The Plenary agreed that this current assessment represents the best available science for management decision-making.

The methods for developing standardized fishery CPUE indices was explained in relation to the discontinuity in the S4 and S5 fishery indices. Although the same fishery, reporting changed so the indices were separated for the two time periods. Catchability (Q) was separately calculated for each CPUE time series.

The model fits the data well but the estimate of sigma R, at ~0.28, seems quite low for a teleost. Blue marlin characteristics may be unusual given its fast growth and large size. Also, it may be cannibalistic in the larval phase. Aside from these factors, the low sigma R value cannot be explained.

The change in the estimate of SSB from the previous assessment is explained by the fact that new data show higher historical catch, which, all other things being equal, implies higher SSB.

The Plenary discussed the stock status and conservation advice and agreed to the following:

Stock Status and Conservation Advice

Stock Status

Estimates of total BUM stock biomass show a long term decline. Population biomass (age-1 and older) averaged roughly 130,965 t in 1971-1975, the first 5 years of the assessment time frame, and has declined by approximately 40% to 78,082 t in 2014 (Figure 7-11). Female spawning biomass was estimated to be 24,809 t in 2014, or about 25% above SSB_{MSY} (Table 7-3 and Table 7-4). Fishing mortality on the stock (average F, ages 2 and older) averaged roughly F = 0.28 during 2012-2014, or about 12% below F_{MSY}. The estimated spawning potential ratio of the stock (SPR, the predicted spawning output at the current F as a fraction of unfished spawning output) is currently $SPR_{2012-2014}$ = 21%. Annual recruitment averaged about 897,000 recruits during 2008-2014, and no long-term trend in recruitment was apparent. Overall, the time series of spawning stock biomass and recruitment estimates indicate a long-term decline in spawning stock biomass and suggest a fluctuating pattern without trend for recruitment (Figure 7-11). The Kobe plot depicts the stock status relative to MSY-based reference points for the base case model (Figure 7-12) and shows that spawning stock biomass decreased to roughly the MSY level in the mid-2000s, and has increased slightly in recent years (Table 7-4 and Figure 7-3).

Based on the results of this 2016 stock assessment update, the Pacific blue marlin stock is not currently overfished and is not experiencing overfishing. Because Pacific blue marlin is mainly caught as bycatch, direct control of the annual catch amount through the setting of a total allowable catch may be difficult.

Conservation Advice

Since the stock is nearly full exploited, the ISC recommends that fishing mortality remain at or below current levels (2012-2014).

Table 7-3. Reported catch (t) used in the stock assessment along with annual estimates of population biomass (age-1 and older, t), female spawning biomass (t), relative female spawning biomass (SSB/SSB_{MSY}), recruitment (thousands of age-0 fish), fishing mortality (average F, ages-2 and older), relative fishing mortality (F/F_{MSY}), and spawning potential ratio of Pacific BUM.

Year	2008	2009	2010	2011	2012	2013	2014	Mean[1]	Min[1]	Max[1]
Reported Catch	17,828	18,282	20,086	18,165	19,407	20,727	20,356	18,232	9,160	25,589
Population Biomass	71,768	69,720	72,696	72,995	76,697	78,761	78,082	101,149	69,720	135,623
Spawning Biomass	22,706	23,065	22,392	23,182	23,432	24,771	24,809	41,717	20,972	71,807
Relative Spawning Biomass	1.14	1.16	1.13	1.17	1.18	1.25	1.25	2.10	1.06	3.62
Recruitment (age 0)	687	1031	702	1061	763	909	839	897	589	1181
Fishing Mortality	0.27	0.29	0.30	0.26	0.27	0.28	0.28	0.22	0.09	0.38
Relative Fishing Mortality	0.82	0.88	0.92	0.82	0.83	0.87	0.87	0.67	0.26	1.17
Spawning Potential Ratio	22%	21%	20%	22%	22%	21%	21%	31%	15%	57%

[1] During 1971-2014

Table 7-4 Estimates of biological reference points along with estimates of fishing mortality (F), female spawning stock biomass (SSB), recent average yield (C), and spawning potential ratio (SPR) of BUM, derived from the base case model assessment model, where "MSY" and "20%" indicate reference points based on maximum sustainable yield and a spawning potential ratio of 20%, respectively.

Reference Point	Estimate
F_{MSY} (age 2+)	0.32
$F_{20\%}$ (age 2+)	0.30
$F_{2012-2014}$ (age 2+)	0.28
SSB_{MSY}	19,853 mt
$SSB_{20\%}$	22,727 mt
SSB_{2014}	24,809 mt
MSY	19,901 mt
$C_{2012-2014}$	20,163 mt
SPR_{MSY}	0.18
$SPR_{2012-2014}$	0.21

Note: SSB values represent female spawning biomass only.

Table 7-5 Projected values of BUM spawning stock biomass (SSB, t) and catch (t) under four constant fishing mortality rate (F) scenarios during 2015-2024.

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Scenario 1: F = $F_{2003-2005}$										
SSB	24,545	22,683	21,163	20,014	19,167	18,546	18,086	17,741	17,481	17,283
Catch	25,688	24,044	22,890	22,089	21,522	21,111	20,806	20,576	20,402	20,268
Scenario 2: F = F_{MSY}										
SSB	24,810	23,850	22,972	22,260	21,710	21,295	20,982	20,745	20,564	20,426
Catch	23,194	22,336	21,693	21,234	20,905	20,667	20,491	20,359	20,259	20,182
Scenario 3: F = $F_{2012-2014}$										
SSB	25,114	25,242	25,217	25,144	25,063	24,995	24,942	24,901	24,869	24,845
Catch	20,267	20,162	20,047	19,958	19,895	19,852	19,822	19,800	19,785	19,774
Scenario 4: F = $F_{30\%}$										
SSB	25,638	27,797	29,585	31,042	32,212	33,151	33,903	34,506	34,985	35,367
Catch	15,015	15,802	16,386	16,833	17,177	17,442	17,648	17,808	17,932	18,028

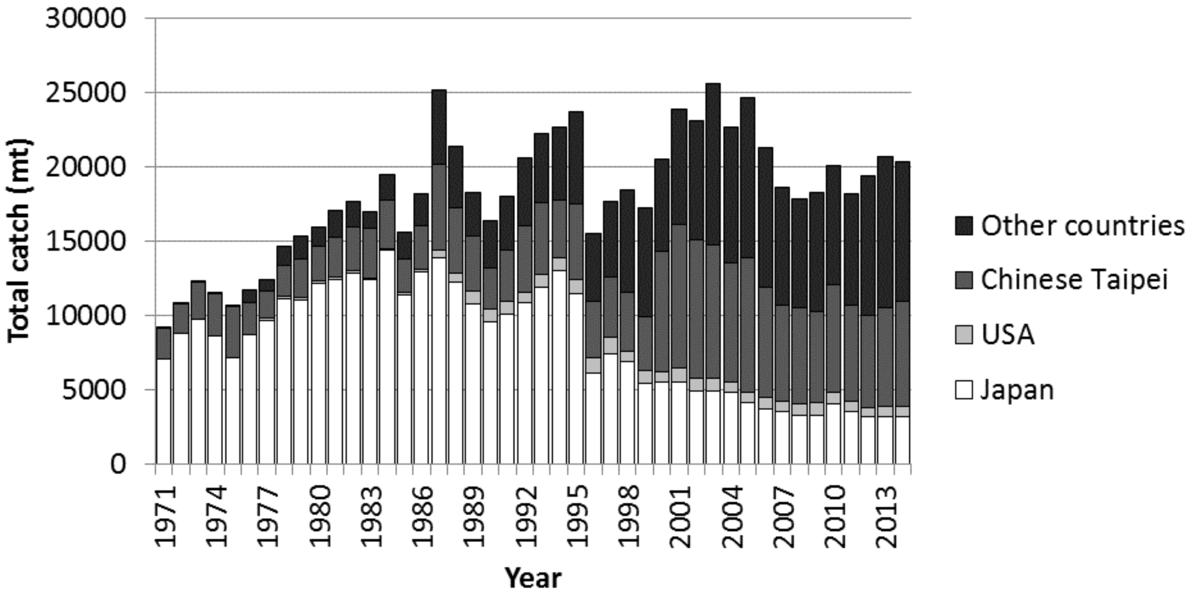


Figure 7-9. Annual catch biomass (mt) of BUM by country for Japan, Chinese Taipei, the U.S.A., and all other countries during 1971-2014.

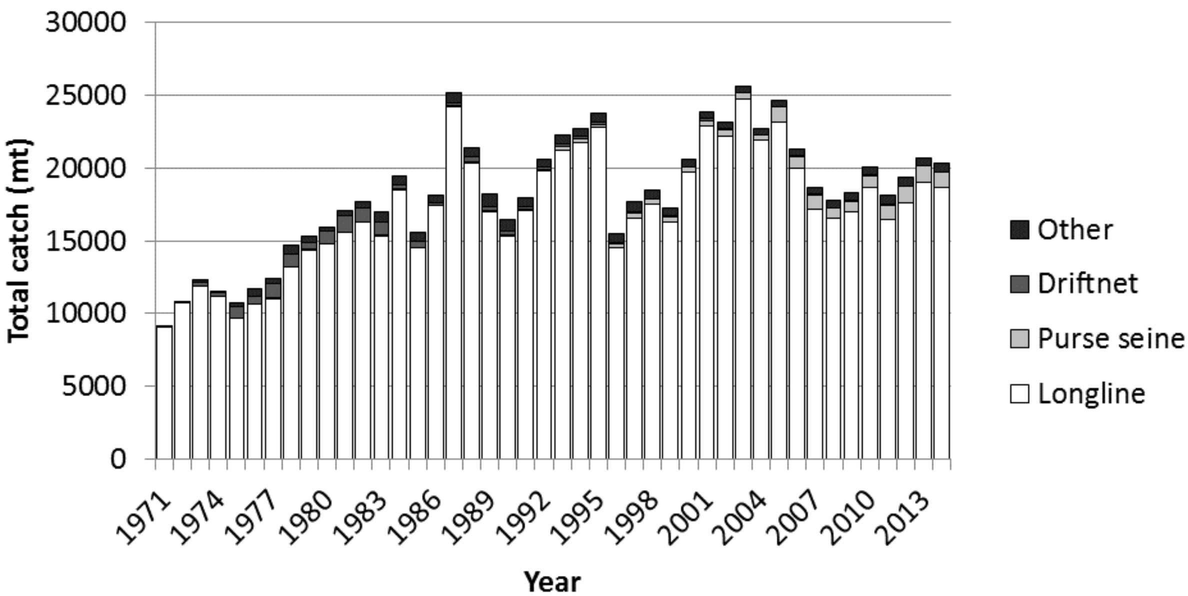


Figure 7-10. BUM annual catch biomass (t) by fishing gear from 1952-2014.

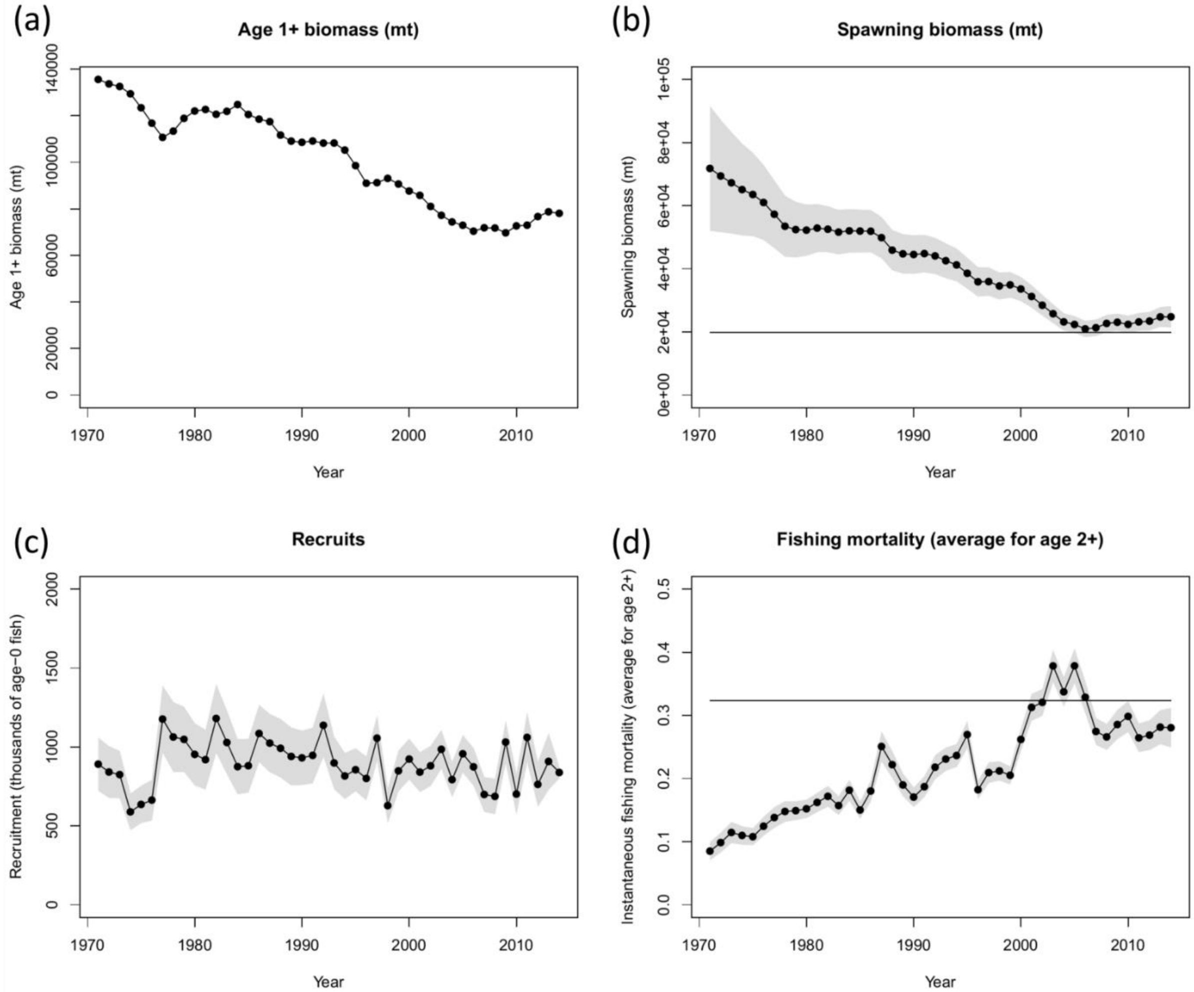


Figure 7-11. Time series of estimates of (a) population biomass (age 1+), (b) female spawning biomass, (c) recruitment (age-0 fish), and (d) instantaneous fishing mortality (average for age 2+, year-1) for BUM derived from the 2016 stock assessment update. The solid circles represents the maximum likelihood estimates by year for each quantity and the shadowed area represents the uncertainty of the estimates (± 1 standard deviation), except for the total biomass time series. The solid horizontal lines indicate the MSY-based reference points for spawning biomass and fishing mortality.

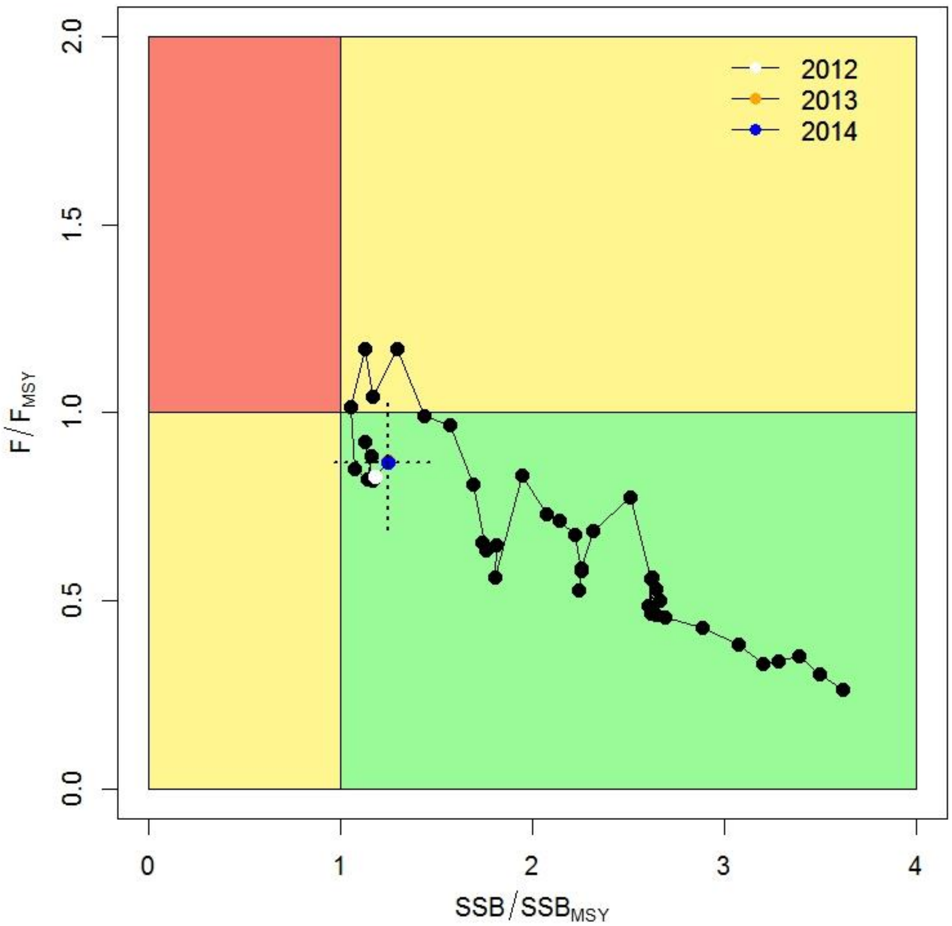


Figure 7-12. Kobe plot of the time series of estimates of relative fishing mortality (average of age 2+) and relative spawning stock biomass of BUM during 1971-2014. The dashed lines denote the 95% confidence intervals for the estimates in the year 2014.

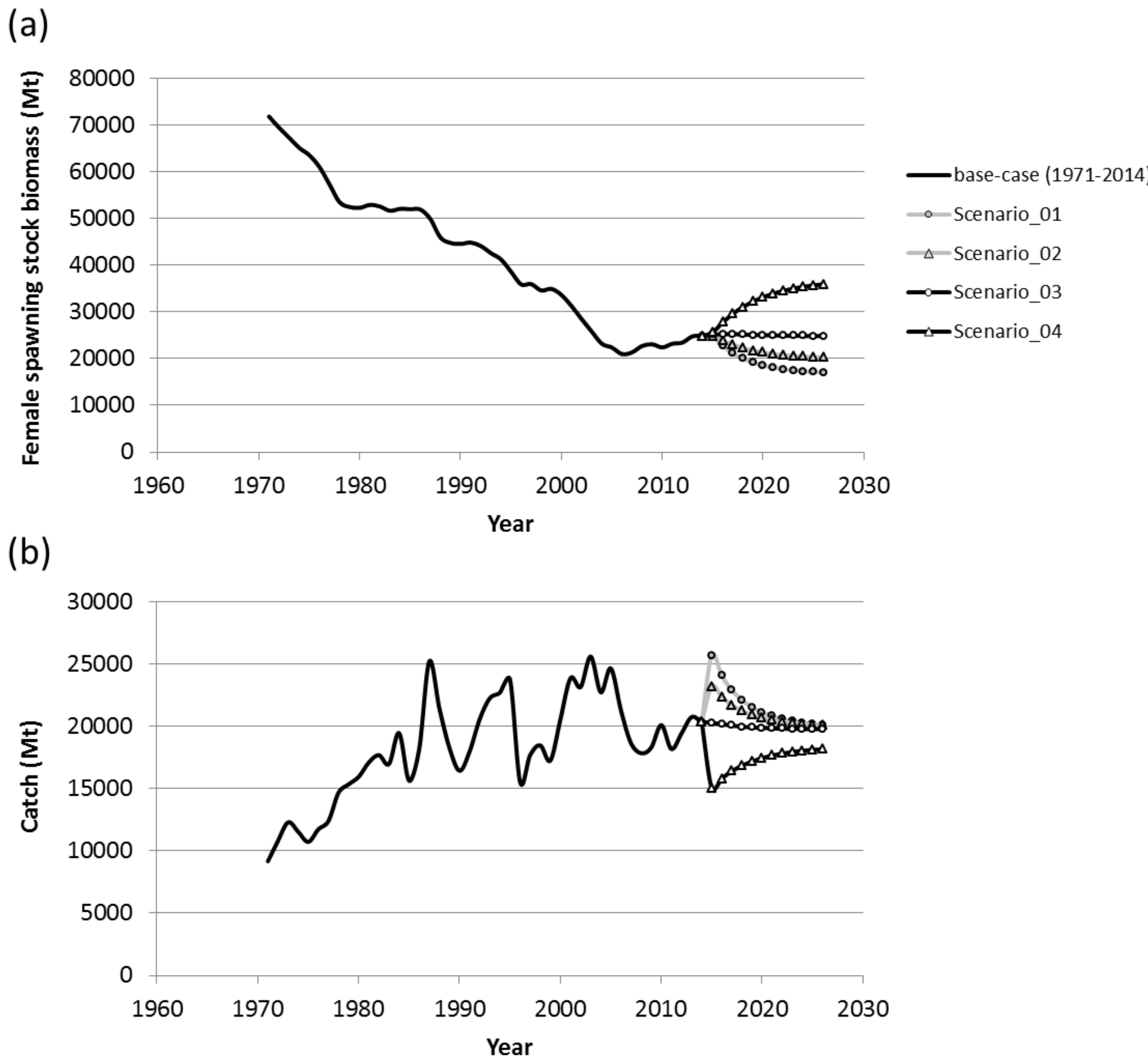


Figure 7-13. Historical and projected trajectories of (a) female spawning biomass and (b) total catch from the BUM base case model. Stock projection results are shown for four constant fishing mortality rate scenarios during 2015-2024: Scenario 1, F equal to the average fishing mortality during 2003-2005 ($F_{2003-2005}= F_{16\%}$); Scenario 2, F equal to FMSY ($F_{18\%}$); Scenario 3, F equal to the average fishing mortality during 2012-2014 ($F_{2012-2014}= F_{21\%}$); Scenario 4, F equal to F30%.

7.4 Striped Marlin

J. Brodziak, BILLWG Chair, reported that no new stock assessment for striped marlin was conducted in 2016. The most recent stock assessment was completed in 2015. The next assessment is schedule for 2018 and will be a benchmark assessment.

<u>Discussion</u>

The Plenary reviewed the conservation advice from ISC15 and reiterated that advice with some clarifying modifications.

Stock Status and Conservation Advice

Stock Status

Estimates of population biomass of the WCNPO MLS exhibit a long-term decline (Figure 7-14 and Figure 7-15). Population biomass (age-1 and older) averaged roughly 20,513 t, or 46% of unfished biomass during 1975-1979, the first 5 years of the assessment time frame, and declined to 6,819 t, or 15% of unfished biomass in 2013. Spawning stock biomass is estimated to be 1,094 t in 2013 (39% of SSB_{MSY}, the spawning stock biomass to produce MSY, Figure 7-15). Fishing mortality on the stock (average F on ages 3 and older) is currently high (Figure 7-16) and averaged roughly $F = 0.94$ during 2010-2012, or 49% above F_{MSY}. The predicted value of the spawning potential ratio (SPR, the predicted spawning output at current F as a fraction of unfished spawning output) is currently $SPR_{2010\text{-}2012} = 12\%$,which is 33% below the level of SPR required to produce MSY. Recruitment averaged about 308,000 recruits during 1994-2011, which was 25% below the 1975-2013 average. No target or limit reference points have been established for the WCNPO striped marlin stock under the auspices of the WCPFC.

The WCNPO MLS stock is expected to be highly productive due to its rapid growth and high resilience to reductions in spawning potential. The status of the stock is highly dependent on the magnitude of recruitment, which has been below its long-term average since 2007, with the exception of 2010. Changes in recent size composition data in comparison to the previous assessment resulted in changes in fishery selectivity estimates and also affected recruitment estimates. This, in turn, affected the scaling of biomass and fishing mortality to reference levels.

When the status of MLS is evaluated relative to MSY-based reference points, the 2013 spawning stock biomass is 61% below SSB_{MSY} (2819 t) and the 2010-2012 fishing mortality exceeds F_{MSY} by 49% (Figure 7-17**). Therefore, overfishing is occurring relative to MSY-based reference points and the WCNPO MLS stock is overfished.**

Conservation Advice

The stock has been experiencing overfishing since 1977, with the exception of 1982 and 1983, and fishing appears to be impeding rebuilding especially if recent (2007-2011) low recruitment levels persist. Projection results show that fishing at F_{MSY} could lead to median spawning biomass increases of 25%, 55%, and 95% from 2015 to 2020 under the recent recruitment, medium-term recruitment, and stock recruitment-curve scenarios. Fishing at a constant catch of 2,850 t could lead to potential increases in spawning biomass of 19% to over 191% by 2020, depending upon the recruitment scenario. In comparison, fishing at the 2010-2012 fishing mortality rate, which is 49% above F_{MSY}, could lead to changes in spawning stock biomass of -18% to +18% by 2020, while fishing at the average 2001-2003 fishing mortality rate ($F_{2001\text{-}2003}$=1.15), which is 82% above F_{MSY}, could lead to spawning stock biomass decreases of -32% to -9% by 2020, depending upon the recruitment scenario.

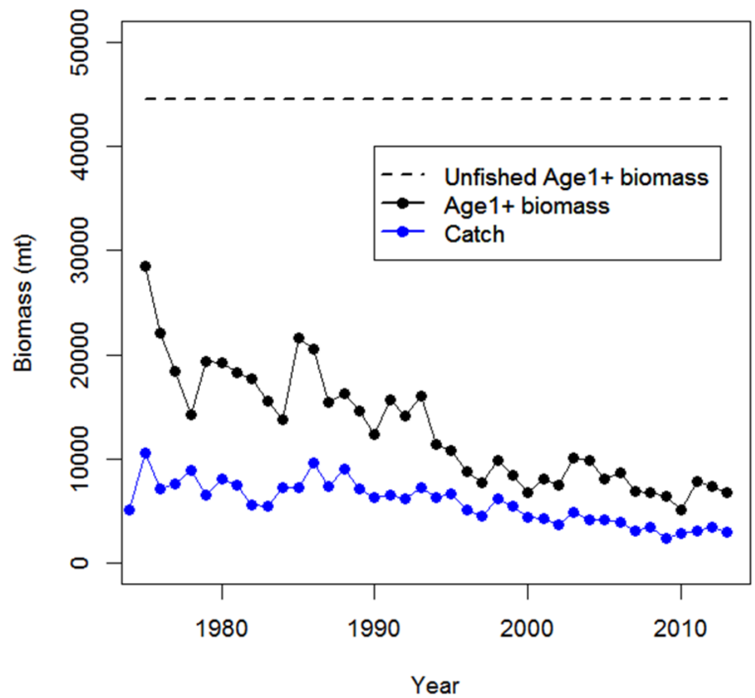


Figure 7-14. Trend in population biomass (1975-2013) and reported catch biomass (1974-2013) of WCNPO MLS relative to unfished biomass.

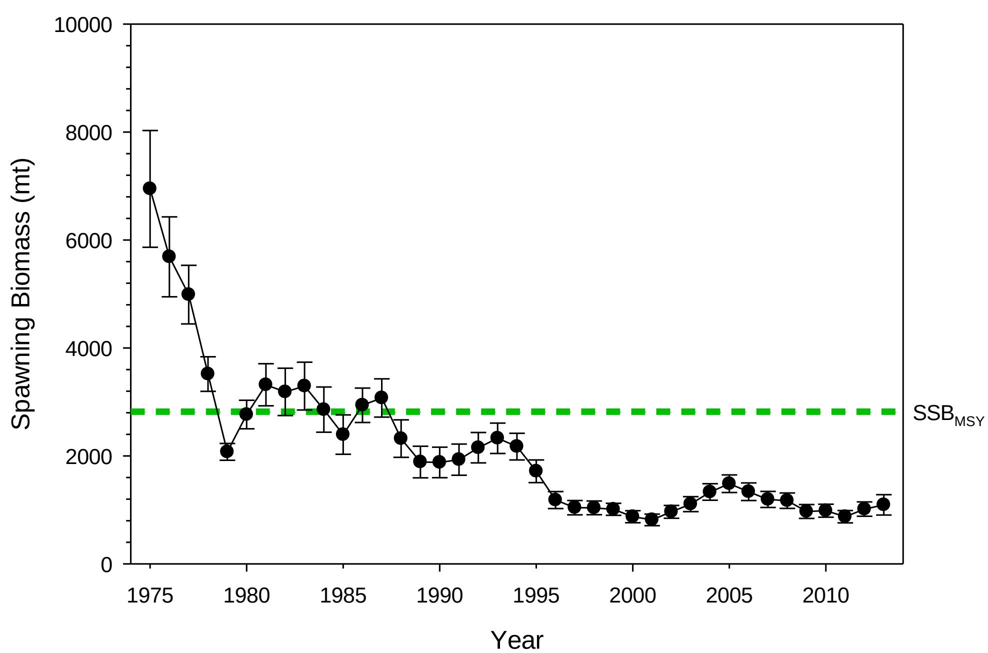


Figure 7-15. Trends in estimates of spawning biomass of WCNPO MLS during 1975-2013 along with 80% confident intervals. The dashed green line is the SSB needed to produce MSY (*SSB_{MSY}*, 2,819 t).

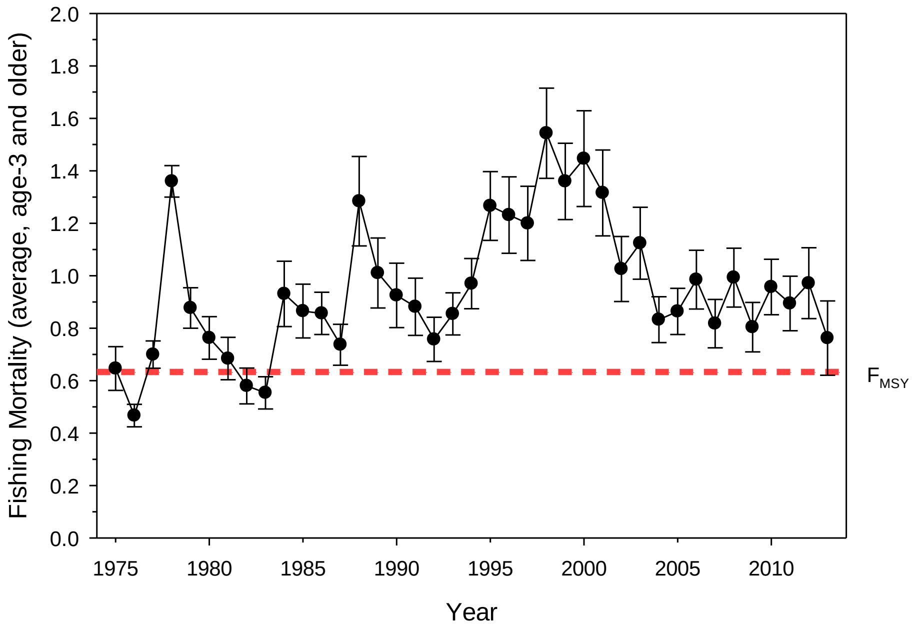


Figure 7-16. Trends in estimates of fishing mortality of WCNPO MLS during 1975-2013 along with 80% confident intervals. The dashed red line is the fishing mortality (F) that produces MSY, F_{MSY} = 0.63.

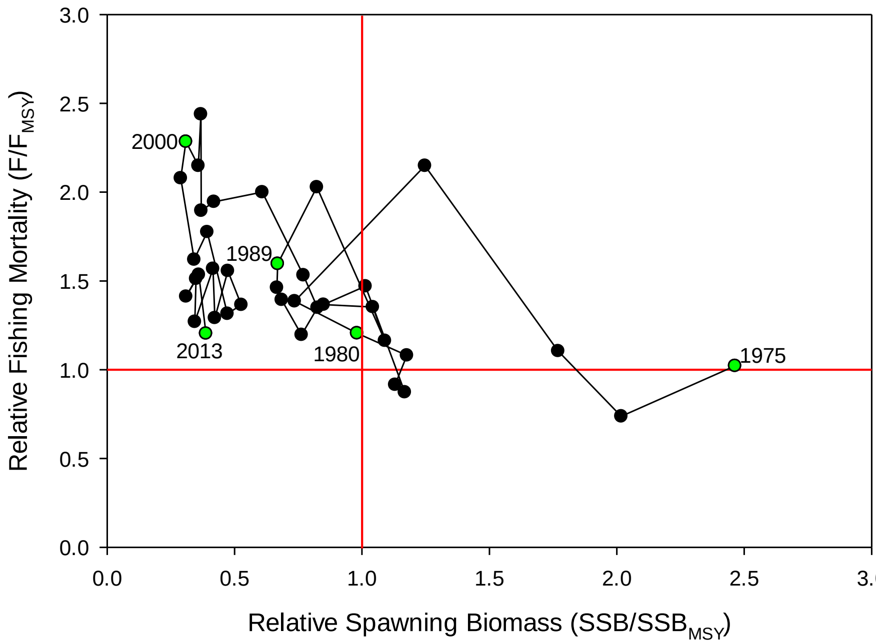


Figure 7-17. Kobe plot of the trends and estimates of relative fishing mortality and relative spawning biomass of WCNPO MLS during 1975-2013.

7.5 Swordfish

J. Brodziak, BILLWG Chair, reported that no new stock assessment for North Pacific swordfish was conducted in 2016. The most recent stock assessment was completed in 2014.

Discussion

The evaluation of more recent catch data relative to the conservation advice was discussed, because the advice references "recent catches." The BILLWG said the Plenary could examine existing reports but beyond that, there is no new catch information that can be provided due to the complex nature of parsing out between the two stocks.

The Plenary reviewed the conservation advice from ISC15 and reiterated that advice.

Stock Status and Conservation Advice

Stock Status

WCNPO: Catches and harvest rates of WCNPO swordfish had a declining trend from 2007-2011, with exploitable biomass fluctuating around 70,000 t. The Kobe plot shows that the WCNPO swordfish stock did not appear to have been overfished or to have experienced overfishing throughout most of the assessment time horizon of 1951-2012 (Figure 7-18).

Results indicated it was unlikely that the WCNPO swordfish population biomass was below B_{MSY} in 2012 ($Pr(B_{2012} < B_{MSY})=14\%$). Similarly, it was extremely unlikely that the swordfish population was being fished in excess of H_{MSY} in 2012 ($Pr(H_{2012} > H_{MSY}) < 1\%$).

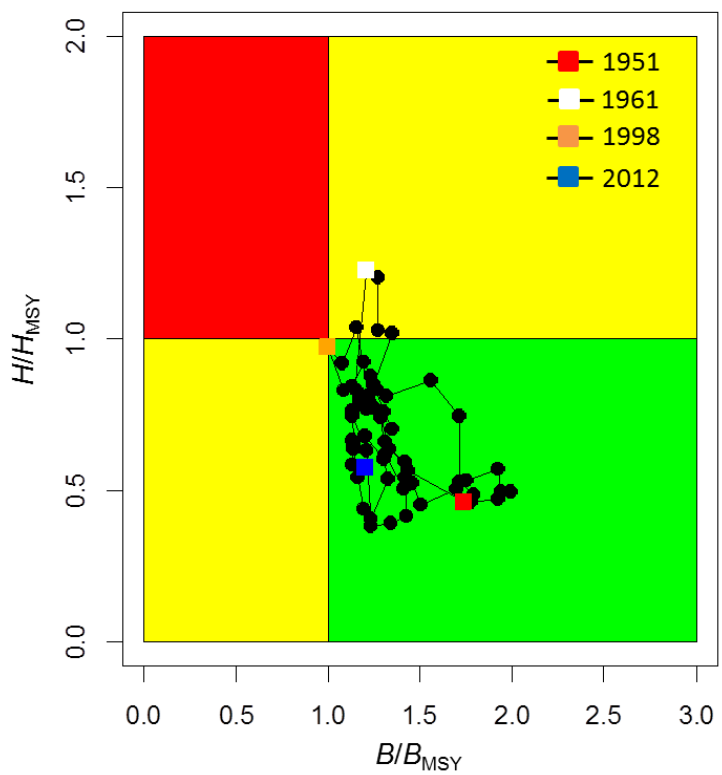


Figure 7-18. Kobe plot showing the estimated trajectories of relative exploitable biomass (B/B_{MSY}) and relative harvest rate (H/H_{MSY}) for SWO in the WCNPO stock area during 1951-2012.

EPO SWO: For the EPO stock, exploitable biomass had a declining trend during 1969-1995 and increased from 31,000 t in 1995 to over 60,000 t in 2010, generally remaining above B_{MSY}. Harvest rates were initially low, have had a long-term increasing trend, and likely exceeded H_{MSY} in 1998, 2002, 2003, as well as in 2012, the terminal year of the stock assessment.

The Kobe plot shows that overfishing likely occurred in only a few years, but may have occurred from 2010 to 2012 (Figure 7-19**). There was a 55% probability that overfishing occurred in 2012, but there was a less than 1% probability that the stock was overfished.**

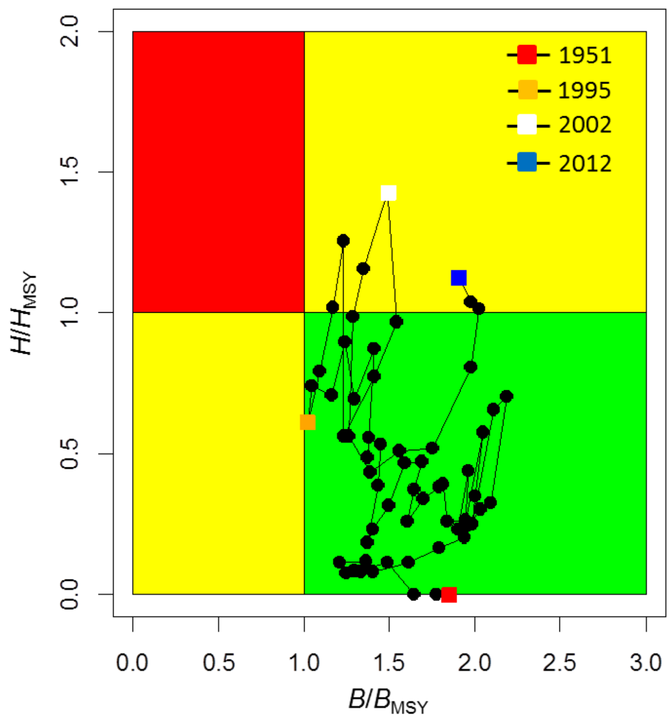


Figure 7-19. Kobe plot showing the estimated trajectories of relative exploitable biomass (B/B_{MSY}) and relative harvest rate (H/H_{MSY}) for SWO in the EPO stock area during 1951-2012.

Conservation Advice

Stochastic projections for the WCNPO stock were conducted using eight harvest scenarios through 2016 (Figure 7-20 and Figure 7-21). Results relative to MSY-based reference points indicated that exploitable biomass would likely remain above 60,720 t (B_{MSY}) through 2016 under the status quo catch or status quo harvest rate scenarios (Figure 7-20). For the high harvest rate scenarios (i.e., maximum observed harvest rate, 150% of H_{MSY}, 125% of H_{MSY}), exploitable biomass was projected to decline below B_{MSY} by 2016 (Figure 7-20) with harvest rates exceeding H_{MSY}. In comparison, the stock would not be expected to experience any overfishing during 2014-2016 under the status quo catch and status quo harvest rate scenarios (Figure 7-20).

Stochastic projections for the EPO stock show that exploitable biomass will likely have a decreasing trajectory during 2014-2016 under the eight harvest scenarios examined (Figure 7-21) Under the high harvest rate scenarios (status quo catch, maximum observed harvest rate, 150% of H_{MSY}), exploitable biomass was projected to decline to 31,170 t (B_{MSY}) by 2016 (Figure 7-21) with corresponding harvest rates above H_{MSY}. In comparison, under the status quo harvest rate scenario, exploitable biomass was projected to decline to only 40,000 t by 2016, well above the B_{MSY} level (Figure 7-21). Overall, the projections showed that if recent high catch levels (9,700 t) persist, exploitable biomass will decrease and a moderate risk (50%) of overfishing will continue to occur.

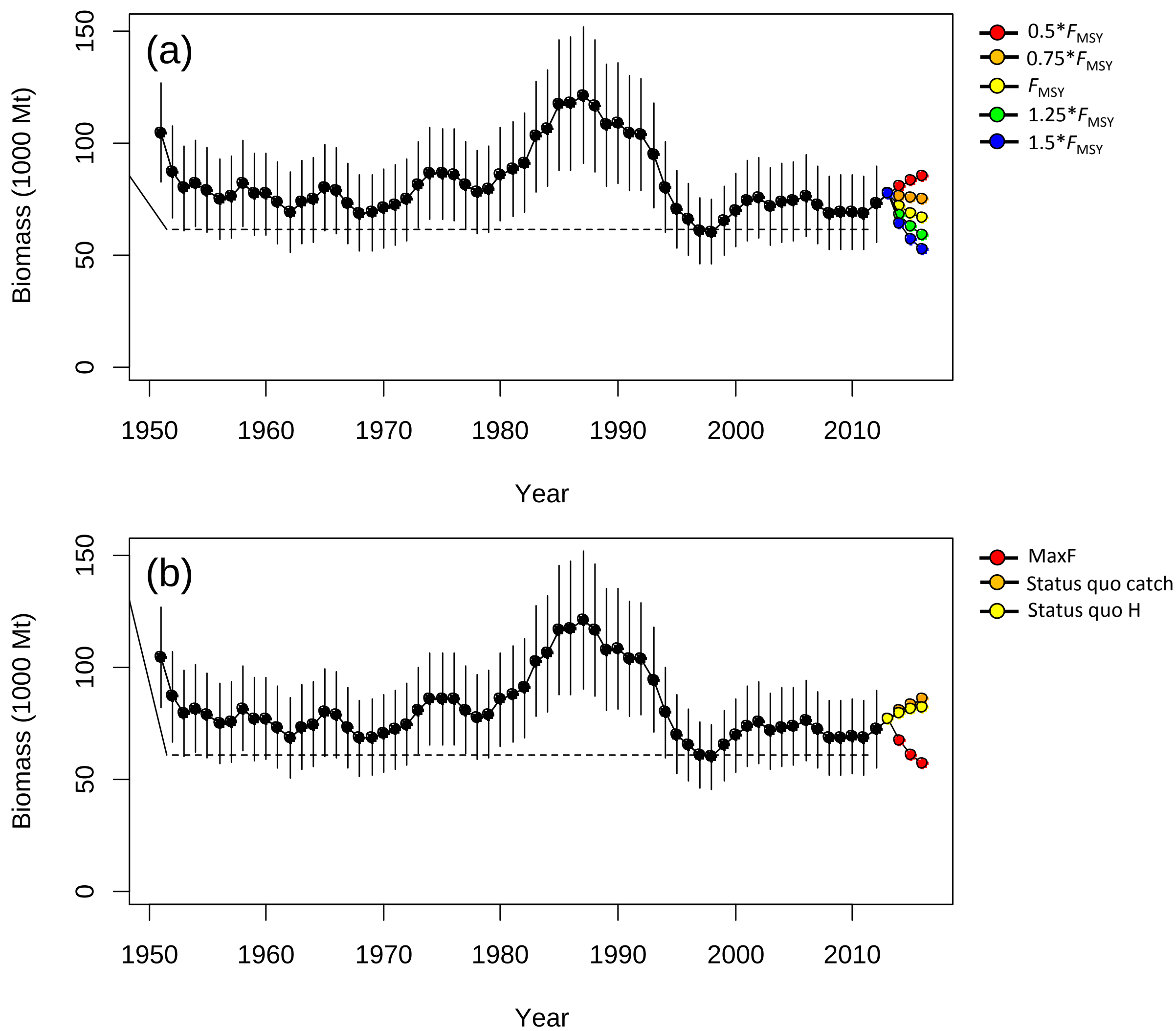


Figure 7-20. Stochastic projections of expected exploitable biomass (1000 metric tons) of SWO in the WCNPO stock area during 2013-2016 under alternative harvest rates. Upper panel (a) shows projection results of applying a harvest rate set to be 50%, 75%, 100%, 125%, and 150% of the value of estimate of H_{MSY} (25%, denoted as F_{MSY} in the Figure). Lower panel (b) shows projection results of applying a status quo harvest rate based on the 2010-2012 average estimates, a status quo catch based on the 2010-2012 average catch, and the maximum observed harvest rate in the 1951-2012 time series. Dashed line represents B_{MSY} = 60,720 t.

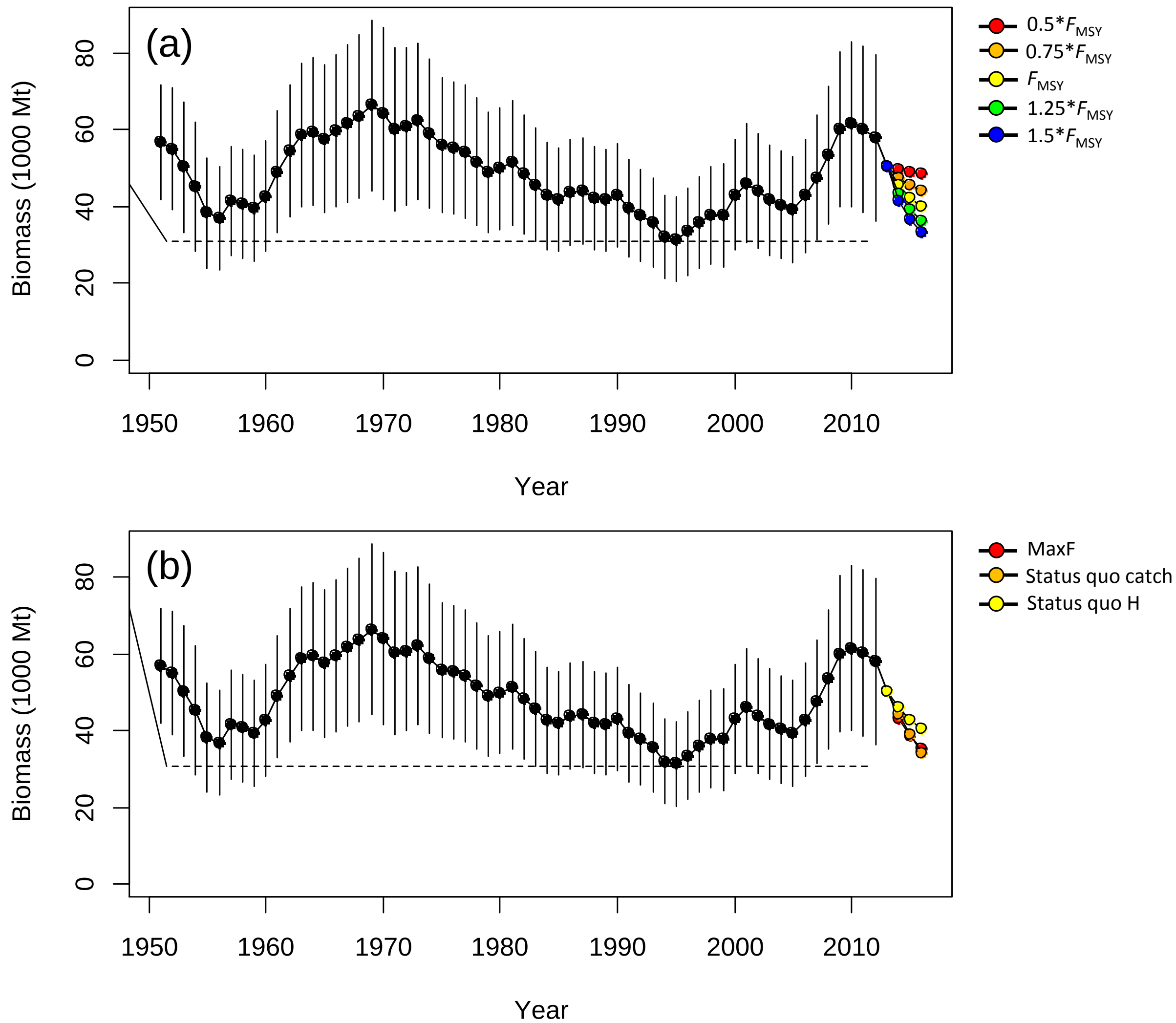


Figure 7-21. Stochastic projections of expected exploitable biomass (1000 metric tons) of SWO in the EPO stock area during 2013-2016 under alternative harvest rates. Upper panel (a) shows projection results of applying a harvest rate set to be 50%, 75%, 100%, 125%, and 150% of the value of estimate of H_{MSY} (18%, denoted as F_{MSY} in the Figure). Lower panel (b) shows projection results of applying a status quo harvest rate based on the 2010-2012 average estimates, a status quo catch based on the 2010-2012 average catch, and the maximum observed harvest rate in the 1951-2012 time series. Dashed line represents B_{MSY} = 31,170 t.

The risk analyses of harvesting a constant annual catch of WCNPO SWO during 2014-2016 showed that there would be less than 1% probability of the stock being overfished or experiencing overfishing in 2016 (Figure 7-22) if current annual catches (2011-2012) of about 10,000 t were maintained.

The risk analyses for harvesting a constant catch of EPO SWO during 2014-2016 showed that the probabilities of overfishing and becoming overfished increased as projected catch increased in the future (Figure 7-22). Maintaining the current (2010-2012) catch of EPO SWO of approximately 9,700 t would lead to a 50% probability of overfishing in 2016 and a less than 1% probability of the stock being overfished in 2016 (see Figure 7-22, panel (b)).

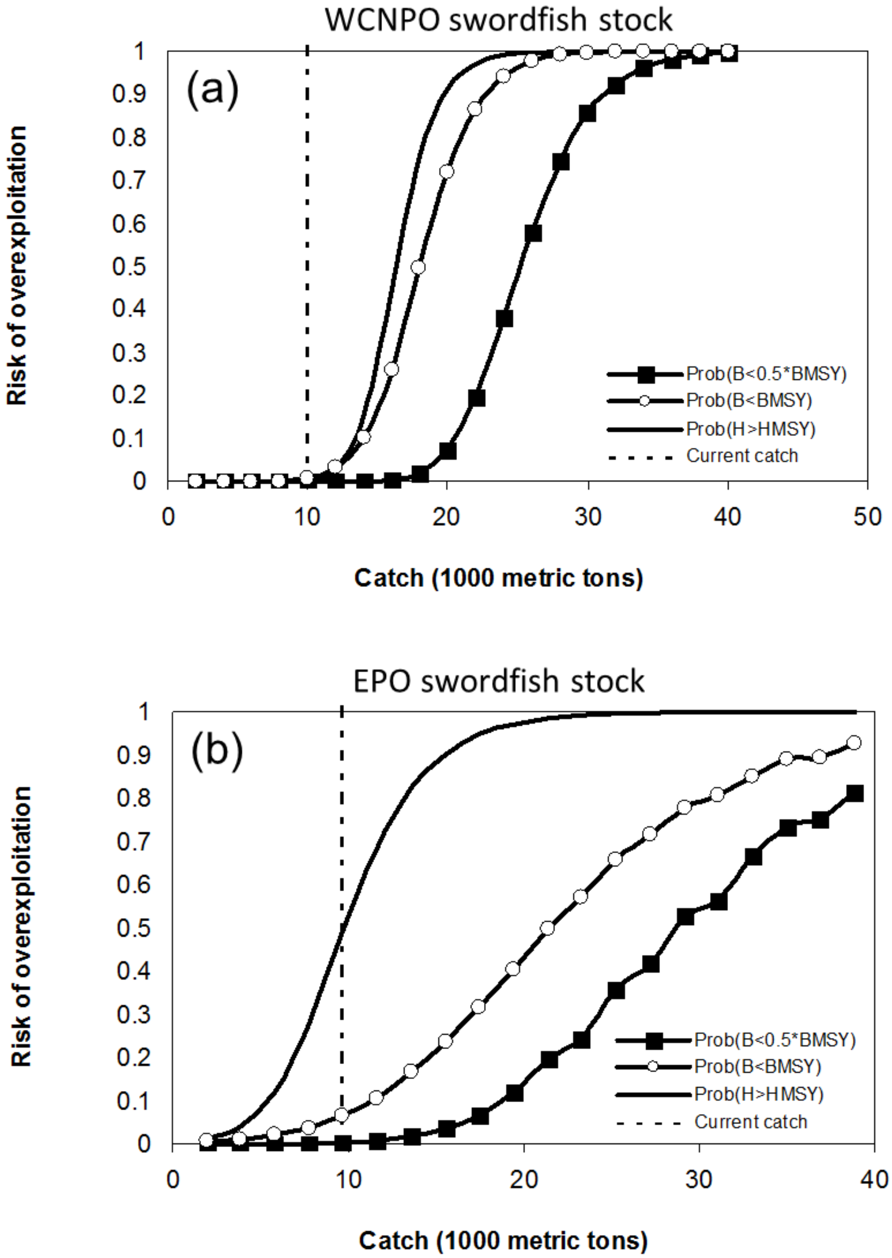


Figure 7-22. Probabilities of experiencing overfishing ($H > H_{MSY}$, solid line), of exploitable biomass falling below B_{MSY} ($B < 0.5*B_{MSY}$, open circles), and of being overfished relative to a reference level of ½B_{MSY} ($B < 0.5*B_{MSY}$, solid squares) in 2016 for SWO in the WCNPO stock area (a) and EPO stock area (b) based on applying a constant catch biomass (x-axis, thousand t) in the stock projections. Current catch = average catch 2011-2012.

The WCNPO SWO stock is healthy ($B_{2010-2012}$>Bmsy) and is above the level required to sustain recent harvest rates ($H_{2010-2012}$<Hmsy).

For the EPO SWO stock, overfishing may have occurred from 2010 to 2012, and the average yield of roughly 10,000 t in those years, or almost two times higher than the estimated MSY, is not likely to be sustainable in the long term. While biomass of the EPO

stock appears to be nearly twice B_{MSY}, any increases in catch above recent (3-year average 2010-2012) levels should consider the uncertainty in stock structure and unreported catch.

7.6 Blue shark

S. Kohin, SHARKWG Chair, reported that no new stock assessment for blue shark was conducted by the SHARKWG in 2016. The most recent stock assessment was completed in 2014.

<u>Discussion</u>

Since no new stock assessment was conducted the Plenary agreed to reiterate the advice from ISC15.

<u>Stock Status and Conservation Advice</u>

Stock Status

Median stock biomass of blue shark in 2011 (B_{2011}) was estimated to be 622,000 t using a Bayesian surplus production (BSP) model and median annual fishing mortality in 2011 (F_{2011}) was approximately 32% of F_{MSY} (Figure 7-23)**. Female spawning stock biomass of blue shark in 2011 (SSB_{2011}) was estimated to be 449,930 t using a Stock Synthesis (SS) model and the estimate of F_{2011} was approximately 34% of F_{MSY}. Target and limit reference points have not yet been established for pelagic sharks in the Pacific.**

Relative to *MSY*, the majority of BSP and SS models run with input parameter values considered more probable based on the biology of blue sharks support the conclusion that the North Pacific blue shark stock is not overfished and overfishing is not occurring. Kobe plots showing the trajectories for the reference runs are shown in Figure 7-23**.**

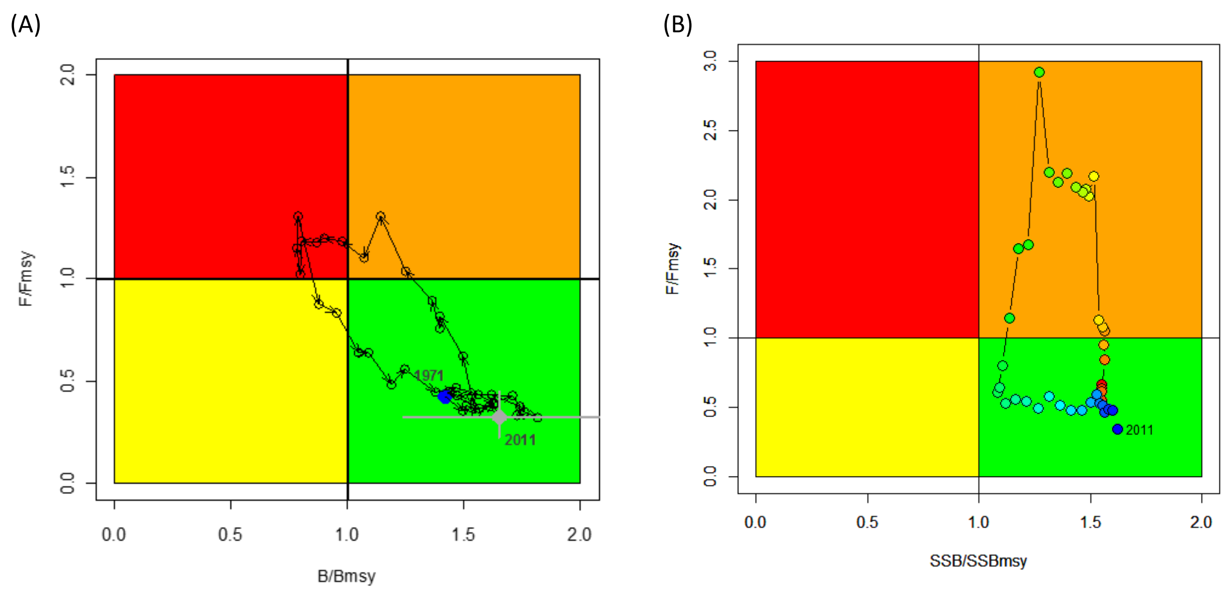


Figure 7-23. (A) Kobe plot showing median biomass and fishing mortality trajectories for the reference case Bayesian Surplus Production model for North Pacific BSH. Solid blue circle indicates the median estimate in

1971 (initial year of the model). Solid gray circle and its horizontal and vertical bars indicate the median and 90% confidence limits in 2011. Open black circles and black arrows indicate the historical trajectory of stock status between 1971 and 2011. (B) Kobe plot showing estimated spawning biomass and fishing mortality trajectories for the reference case Stock Synthesis model for North Pacific BSH. The circles indicate the historical trajectory from 1971-2011 colored from red (first year) to blue (terminal year).

While the results of the sensitivity runs varied depending upon the input assumptions, a few parameters were most influential on the results, including the CPUE series selected as well as the shape parameters for the BSP models and the equilibrium initial catch and form of the low fecundity stock recruitment relationship for the SS models.

Conservation Advice

Future projections of the reference case models show that median BSH biomass in the North Pacific will remain above B_{MSY} and SSB_{MSY} under the catch harvest policies examined (status quo, +20%, -20%). Similarly, future projections under different fishing mortality (F) harvest policies (status quo, +20%, -20%) show that median blue shark biomass in the North Pacific BSH will likely remain above B_{MSY} and SSB_{MSY}.

Given uncertainties regarding the estimated catch and choice of input parameters for the assessment, the catch of and fishing effort on BSH should be carefully monitored. Carefully designed observer programs and logbooks that record sharks by species as well as continued research into the fisheries, biology, and ecology of BSH in the North Pacific are recommended to make improvements prior to the next assessment which is scheduled for 2017.

7.7 Shortfin mako shark

S. Kohin, SHARKWG Chair, reported that no new analysis for shortfin mako shark was conducted by the SHARKWG in 2016. An indicator analysis was completed in 2015.

Discussion

Since no new analysis was conducted, the Plenary agreed to reiterate the advice from ISC15 with minor clarifications.

Stock Status and Conservation Advice

SMA is a data poor species. Recognizing that information on important fisheries is missing, the untested validity of indicators for determining stock status, and conflicts in the available data, stock status (overfishing and overfished) could not be determined. Managers should consider the undetermined stock status of SMA in the North Pacific when developing and implementing management measures.

The SHARKWG reviewed a suite of information to determine the stock status of SMA shark in the North Pacific. Of the three indices considered to have the greatest value in providing stock status information (Japan shallow-set longline, Hawaii shallow-set longline and Hawaii deep-set longline), abundance trends in two of the series appear to be stable or

increasing, while the abundance trend in the Hawaii shallow-set longline fishery CPUE series appears to be declining.

It is recommended that data for fisheries operating in the North Pacific for which catch estimates are not yet available be developed for use in the next stock assessment scheduled for 2018 and that available catch and CPUE data be monitored for changes in trends. It is further recommended that data collection programs be implemented or improved to provide species-specific shark catch data for fisheries in the North Pacific Ocean.

8 REVIEW OF STOCK STATUS OF SECONDARY STOCKS IN THE WESTERN PACIFIC

A. Beeching presented an overview of tuna production by gear and species in the WCPO (*ISC/16/INFODOCS/08/09*), noting reduced provisional catches for all species, and especially for purse seine, in 2015. Fishing patterns for purse seiners were possibly influenced by El Niño conditions and catchability of bigeye tuna may have been affected. There were no stock assessments for the tropical tuna species, hence the stock status and management advice for yellowfin, skipjack and bigeye tuna was largely unchanged from SC10. The remainder of the presentation focused on the SC11 reaction to the south Pacific albacore stock assessment, concluding with a list of upcoming WCPFC meetings and workshops scheduled for the latter half of 2016.

Discussion

When asked if climate and other environmental conditions were taken into consideration when SPC conducts stock assessments, the Plenary's attention was drawn to the SEAPODYM project which was ongoing and was increasingly influencing stock assessment science. It was confirmed that there were no SPC billfish stock assessments reviewed at SC11, but that there would be a South Pacific swordfish assessment next year which will be informed by a CSIRO study on swordfish growth rates which were a weakness of the previous assessment.

9 REVIEW OF STATISTICS

9.1 STATWG report

R.-F. Wu, the STATWG Chair, provided a summary of STATWG activities since ISC15 (*Annex 11*). The STATWG Steering Group scheduled an inter-sessional meeting in Taipei, Taiwan, in May 2016, but cancelled it due to insufficient participation. A meeting of the entire STATWG was held in Sapporo, Hokkaido, Japan, 8-9 July 2016, prior to ISC16; three information papers were submitted for this meeting.

It was noted that Osamu Sakai is the new Data Manager for the PBFWG, and that Darryl Tagami and Mark Smith will need to be replaced as Data Managers for the BILLWG and SHARKWG, respectively.

Since ISC15, the STATWG completed the following activities:

- Data inventory exchange with RFMOs

- Comparison report on Member’s data vs ISC data
- Archival of species working groups’ stock assessment files
- Improvements to the online data submission system and User’s Manual
- Review of new data report format to summarize data used in ISC assessments
- Comparison report on ISC data inventory versus data inventories of WCPFC and IATTC
- Reviewed ISC catch tables versus catch tables in national reports of members
- Documented current data needs of the Species working groups
- Documented updates on members’ data collection systems

The 2016 work plan for the STATWG was presented, as well as recommendations to the ISC16 Plenary.

The recommendations were:

- The ISC Chair should follow-up with China and Mexico to acquire requisite data.
- Working Groups should submit a data report after each assessment that summarizes the data used in the assessment (e.g., see ISC16/STATWG/INFO-3 for guidance). This is as a best practice that provides transparency and ease of access to the data.
- STATWG requests the scheduling of a two-day meeting prior to the ISC17 Plenary in July, 2017.

The STATWG Chair presented the Member data submission report card for 2016.

Member	CAT Ic	CAT Ie	CAT II	CAT III
CAN				
CHN				
JPN				
KOR				
MEX				
TWN				
USA				

On time and complete

Submitted late and incomplete and/or not in ISC format

Not provided

- **Canada, Chinese-Taipei, Japan, Republic of Korea**, and **United States** submitted all

2015 data on time and were complete for all fisheries

- **China** and **Mexico** did not submit any Category I, II, and III data for 2015

It was reported that for ISC assessments in 2013-2015, all assessment files were submitted by the Chairs of the ALBWG, PBFWG, SHARKWG, and BILLWG to the Data Administrator for archiving prior to the ISC16 Plenary.

The STATWG acknowledged the contributions of the former ISC Webmaster, Yumi Okochi, and welcomed the new Webmaster, Kirara Nishikawa.

The STATWG Steering Group will schedule their next meeting in January 2017, in San Diego, USA, and will request the scheduling of a two-day meeting prior to the ISC17 Plenary.

Discussion

It was suggested that instead of the current practice of using the same values as the previous year when data are not submitted, it was recommended that the STATWG could seek information from other sources such as RFMOs or species working groups.

The STATWG was tasked with assisting with website updates. That involves contacting the working group chairs to make sure the information is up to date. That will be discussed at the next STATWG steering group meeting.

9.2 Total catch tables

I. Yamasaki, the Database Administrator, presented the annual catch tables for ISC Member countries for 2014-2015. The catch tables include the following ISC species of interest: albacore, blue shark, Pacific bluefin tuna, striped marlin, swordfish, blue marlin, and shortfin mako shark. Graphs of the historical catch by country were also presented for each species. The catch tables were generated from the ISC database, and are based on Category I data submitted by Data Correspondents for the major fisheries in the North Pacific Ocean of the member countries. These catch tables will be included in the ISC Plenary Report (Tables 15-1-15-7) and serves as the official ISC catch tables.

Discussion

None.

10 REPORT OF THE SEMINAR

H. Shimada provided an overview of the ISC16 Seminar, Dynamics of recruitment of fish - perspectives of survival strategy of pelagic fish (*Annex 12*). Dr. Akihiko Yatsu, Japan Fisheries Information Service Center, Japan presented on Highlights of Japanese studies on population dynamics and early-life survival in small pelagic fishes in the Kuroshio/Oyashio ecosystem: Implications for management and Dr. Yosuke Tanaka, Tohoku National Fisheries Research Institute, Fisheries Research and Education Agency, Japan, presented on Survival processes of

Pacific bluefin tuna in their early life history: Approached by field surveys and rearing experiments.

11 REVIEW OF MEETING SCHEDULE

11.1 Time and Place of ISC17

Canada agreed to host ISC17, tentatively in Vancouver, British Columbia.

11.2 Time and place of Working Group intercessional meetings

A draft schedule of proposed intersessional meetings was reviewed and amended, see Table 11-1.

Table 11-1. Schedule of working group meetings.

Date	Meeting	Contact
	2016	
Sept 6-7	SHARKWG BSH Data prep – Webinar	S. Kohin suzanne.kohin@noaa.gov
Nov 8-15	ALBWG Data prep – Nanaimo, Canada	J. Holmes John.Holmes@dfo-mpo.gc.ca
Nov 14-21	SHARKWG BSH Data prep – Busan, So. Korea	S. Kohin suzanne.kohin@noaa.gov
Dec	BILLWG Research – Webinar	J. Brodziak Jon.Brodziak@noaa.gov
	2017	
Jan 30-31	STATWG TBD – La Jolla, U.S.A.	R.-F. Wu fan@ofdc.org.tw
Feb 29 – Mar 11	PBFWG Research – Shimizu, Japan	H. Nakano hnakano@affrc.go.jp
Mar	BILLWG TBD – Keelung, Taiwan	J. Brodziak Jon.Brodziak@noaa.gov
Mar	SHARKWG BSH Assessment – TBD	S. Kohin Suzanne.Kohin@noaa.gov
Apr	ALBWG Assessment – Shimizu, Japan	J. Holmes John.Holmes@dfo-mpo.gc.ca
Jul	PBFWG (Meeting) – Canada	H. Nakano hnakano@affrc.go.jp
Jul	BILLWG (Meeting) – Canada	J. Brodziak Jon.Brodziak@noaa.gov
Jul	STATWG (Meeting) – Canada	R.-F. Wu fan@ofdc.org.tw
Jul	SHARKWG BSH Assessment Wrap Up – Canada	S. Kohin Suzanne.Kohin@noaa.gov
Jul	ALBWG Assessment Prep – Canada	J. Holmes John.Holmes@dfo-mpo.gc.ca
Jul 12-17	ISC16 (Plenary) – Canada	G. DiNardo Gerard.DiNardo@noaa.gov

Discussion

Reducing the length and number of working group meetings to five days or less was recommended. If there is a reason to schedule a meeting longer than five days, the working group chair should confer with the ISC chair on the need for a longer meeting.

12 ADMINISTRATIVE MATTERS

12.1 Formalization of ISC

ISC has existed in its current form since 1996 when Japan and the US jointly issued a press release announcing its formation. ISC has been discussing a formal structure and agreement for several years and members were asked to approach their governments about their interest in such an agreement. A formal agreement might allow more participation by some members as well as provide a structure to fund ISC operations. A strawman MoU (ISC/16/PLEN/11), based on that under consideration by ISC in 1996 was distributed to members.

Discussion

The draft memorandum of understanding **(ISC/16/PLENARY/11)** was discussed. It was agreed that the text should reference the entire range of fish stocks of interest rather than just their occurrence in the North Pacific Ocean.

The Chair described the process for review and adoption of the MOU and potential alternative arrangements. Initially, member countries' science agency staff should review and propose edits to the draft by 5August 2016. Once this initial review is complete, the MOU would be routed to the appropriate administrative agency for accession by member governments. The process of accession by all member governments is likely to take 5-10 years.

Alternatives to formalization through an intergovernmental MOU would be a relationship between ISC and PICES, which is ongoing. This mechanism should allow governments to contribute funds for ISC function through PICES. A third option is to use the existing relationship with the WCPFC/NC. The WCPFC/NC has established a mechanism to accept voluntary contributions from governments or the private sector. The Chair will investigate these two potential arrangements for financial contributions for Secretariat functions. A minimum annual cost is estimated at USD 300,000, which would support the webmaster and database administration.

12.2 Peer Review of Function and Process for Stock Assessments

A review of ISC's function is required every five years according to ISC operational procedures. The last one was conducted in 2012-2013, so it is necessary to begin planning for the next review, which should begin in 2017. Plenary needs determine the focus of the review and determine how to pay for it. Instituting an independent and rigorous peer review process for stock assessments was a recommendation from the last review, so Plenary was asked to consider this as a topic.

<u>Discussion</u>

ISC agreed that the topic of the next ISC function review will be the identification of potential stock assessment peer review process for the ISC. The USA and Japan offered to fund one reviewer each, and the ISC Chair will work to identify another sponsor for a reviewer. In the meantime, the USA and Japan will develop terms of reference (TOR) for the review panel by the end of August 2016. The Chair thanked USA and Japan for funding the reviewers and for agreeing to develop the TOR.

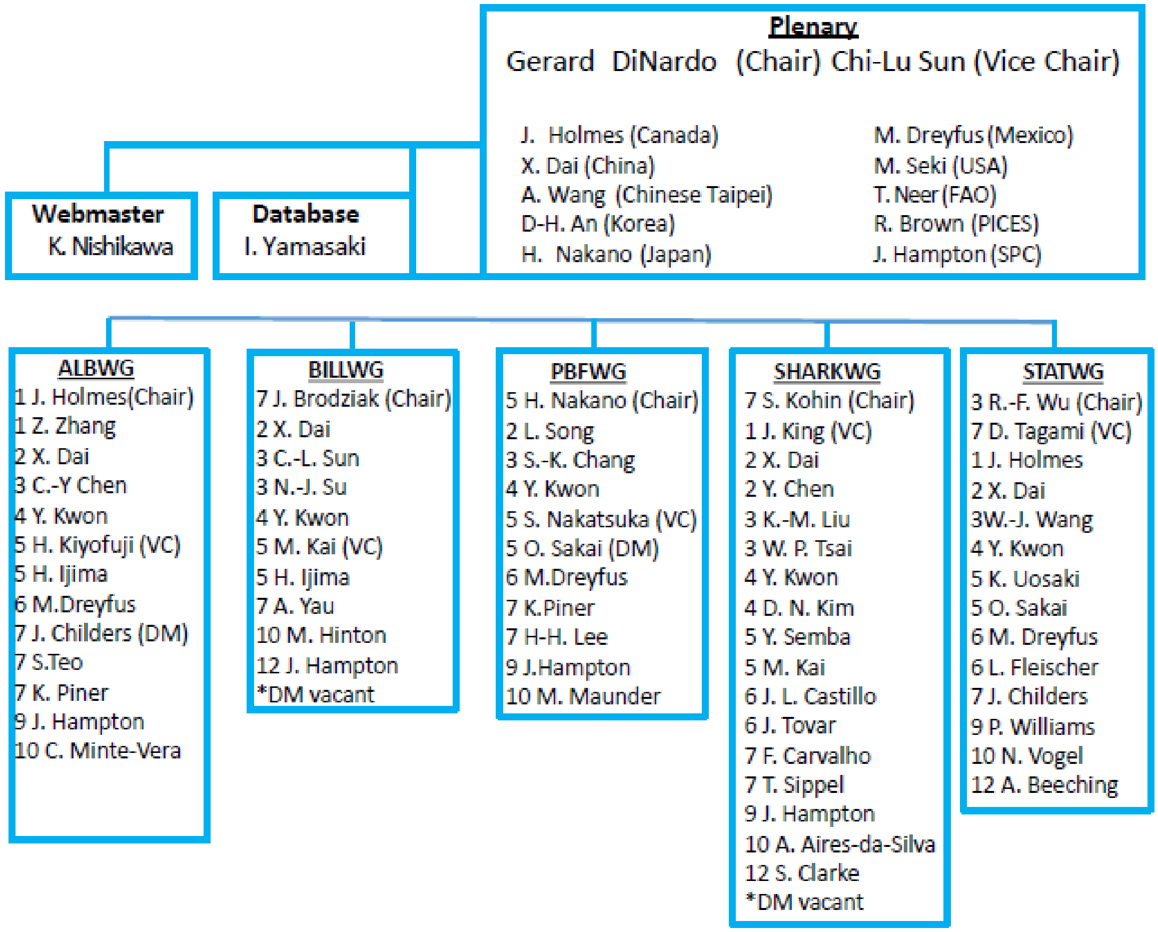
12.3 Upcoming Chairperson Elections

Gerard DiNardo, current ISC Chair, was elected for a one-year extension of his position. DiNardo thanked the Members for their overwhelming support, informing them that this would be his last year (2016-2017) as the ISC Chair.

12.4 Organizational Chart and Contact Persons

Contact persons identified in the chart below, are the points of contact for each working group and is not intended to be a comprehensive list of the actual membership of each working group.

ISC Organizational Chart (July 2016) ISC/16/PLENARY/03



Working Group Key:
1 Canada 2 China 3 Chinese-Taipei 4 Korea 5 Japan 6 Mexico 7 USA 8 PICES 9 SPC 10 IATTC 11 FAO 12 WCPFC
VC Vice Chair DM Database Manager

This is not a comprehensive list but the main points of contact.

12.5 Other Business

The draft agenda of the ISC/PICES business meeting was reviewed and agreed to.

WCPFC has requested that we make a presentation on the MSE. The ALBWG Vice-Chair will make a presentation to SC12 on the NPALB MSE. The ISC16 Report of the Plenary will also be submitted for consideration at SC12.

13 ADOPTION OF REPORT

The Report of the Meeting was adopted.

14 CLOSE OF MEETING

The Chair thanked all participants for their diligence in completing the 16th meeting of the ISC, noting the many accomplishments were achieved over the past year. Each year the breadth and scope of the science conducted within the ISC increases and member should be pleased with these scientific advances. The meeting was closed at 12:30PM 18 July 2016.

15 CATCH TABLES

Table 15-1. North Pacific albacore catches (in metric tons) by fisheries, 1952-2012. “0”; Fishing effort was reported but no catch. “+”; Below 499kg catch. “-“; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	CAN		JPN								KOR		MEX		
		Troll	CAN Total	Set-net	Drift gill-net	Longline	Pole and line	Troll	Others	Purse seine	JPN Total	Longline	KOR Total	Others	Purse seine	MEX Total
Retain ca	1936															
	1937															
	1938															
	1939	1,290	1,290													
	1940	20	20													
	1941	350	350													
	1942															
	1943	130	130													
	1944	2,100	2,100													
	1945	6,480	6,480													
	1946	1,960	1,960													
	1947	360	360													
	1948	9,840	9,840													
	1949	10,120	10,120													
	1950	9,610	9,610													
	1951	860	860													
	1952	710	710	55	-	26,687	41,787	-	237	154	68,920			-	-	-
	1953	50	50	88	-	27,777	32,921	-	132	38	60,956			-	-	-
	1954			6	-	20,958	28,069	-	38	23	49,094			-	-	-
	1955			28	-	16,277	24,236	-	136	8	40,685			-	-	-
	1956	170	170	23	-	14,341	42,810	-	57	-	57,231			-	-	-
	1957	80	80	13	-	21,053	49,500	-	151	83	70,800			-	-	-
	1958	740	740	38	-	18,432	22,175	-	124	8	40,777			-	-	-
	1959	2,120	2,120	48	-	15,802	14,252	-	67	-	30,169			-	-	-
	1960	50	50	23	-	17,369	25,156	-	76	-	42,624			-	-	-
	1961	40	40	111	-	17,437	18,639	-	268	7	36,462			39	2	41
	1962	10	10	20	-	15,764	8,729	-	191	53	24,757			0	0	0
	1963	50	50	4	-	13,464	26,420	-	218	59	40,165			0	31	31
	1964	30	30	50	-	15,458	23,858	-	319	128	39,813			-	0	-
	1965	150	150	70	-	13,701	41,491	-	121	11	55,394			-	0	-
	1966	440	440	64	-	25,050	22,830	-	585	111	48,640			-	0	-
	1967	1,610	1,610	43	-	28,869	30,481	-	520	89	60,002			-	-	-
	1968	10,280	10,280	58	-	23,961	16,597	-	1,109	267	41,992			-	-	-
	1969	13,650	13,650	34	-	18,006	31,912	-	925	521	51,398			-	0	-
	1970	3,900	3,900	19	-	16,222	24,263	-	498	317	41,319			-	0	-
	1971	17,460	17,460	5	-	11,473	52,957	-	354	902	65,691	0	0	-	0	-
	1972	39,210	39,210	6	1	13,022	60,569	-	638	277	74,513	0	0	0	100	100
	1973	14,000	14,000	44	39	16,760	68,767	-	486	1,353	87,449	4	4	-	0	-
	1974	13,310	13,310	13	224	13,384	73,564	-	891	161	88,237	91	91	0	1	1
	1975	1,110	1,110	13	166	10,303	52,152	-	230	159	63,023	7,050	7,050	0	1	1
	1976	2,780	2,780	15	1,070	15,812	85,336	-	270	1,109	103,612	2,212	2,212	5	36	41
	1977	530	530	5	688	15,681	31,934	-	365	669	49,342	500	500	0	3	3
	1978	230	230	21	4,029	13,007	59,877	-	2,073	1,115	80,122	669	669	0	1	1
	1979	5,210	5,210	16	2,856	14,186	44,662	-	1,139	125	62,984	0	0	0	1	1
	1980	2,120	2,120	10	2,986	14,681	46,742	-	1,177	329	65,925	592	592	0	31	31

	1981	2,000	2,000	8	10,348	17,878	27,426	-	699	252	56,611	0	0	0	8		8
	1982	1,040	1,040	11	12,511	16,714	29,614	-	482	561	59,893	4,874	4,874	0	0		0
	1983	2,250	2,250	22	6,852	15,094	21,098	-	99	350	43,515	366	366	0	0		0
	1984	500	500	24	8,988	15,053	26,013	-	494	3,380	53,952	1,925	1,925	6	107		113
	1985	560	560	68	11,204	14,249	20,714	-	339	1,533	48,107	2,789	2,789	35	14		49
	1986	300	300	15	7,813	12,899	16,096	-	640	1,542	39,005	3,833	3,833	0	3		3
	1987	1,040	1,040	16	6,698	14,668	19,082	-	173	1,205	41,842	1,624	1,624	0	7		7
	1988	1,550	1,550	7	9,074	14,688	6,216	-	170	1,208	31,363	799	799	0	15		15
	1989	1,400	1,400	33	7,437	13,031	8,629	-	433	2,521	32,084	561	561	0	2		2
	1990	3,020	3,020	5	6,064	15,785	8,532	-	248	1,995	32,629	29	29	0	2		2
	1991	1,390	1,390	4	3,401	17,039	7,103	-	395	2,652	30,594	4	4	0	2		2
	1992	3,630	3,630	12	2,721	19,042	13,888	-	1,522	4,104	41,289	1	1	0	10		10
	1993	4,940	4,940	3	287	29,933	12,797	-	897	2,889	46,806	2	2	0	11		11
	1994	1,998	1,998	11	263	29,565	26,389	-	823	2,026	59,077	2	2	0	6		6
	1995	1,761	1,761	28	282	29,050	20,981	856	78	1,177	52,452	13	13	0	5		5
	1996	3,321	3,321	43	116	32,440	20,272	815	127	581	54,394	157	157	0	21		21
	1997	2,166	2,166	40	359	38,899	32,238	1,585	135	1,068	74,324	404	404	0	53		53
	1998	4,177	4,177	41	206	35,755	22,926	1,190	104	1,554	61,776	225	225	0	8		8
	1999	2,734	2,734	90	289	33,339	50,369	891	62	6,872	91,912	98	98	57	0		57
	2000	4,531	4,531	136	67	29,995	21,550	645	86	2,408	54,887	15	15	33	70		103
	2001	5,248	5,248	78	117	28,801	29,430	416	35	974	59,851	63	63	18	0		18
	2002	5,379	5,379	109	332	23,585	48,454	787	85	3,303	76,655	111	111	0	28		28
	2003	6,847	6,847	69	126	20,907	36,114	922	85	627	58,850	146	146	0	29		29
	2004	7,857	7,857	30	61	17,341	32,255	772	54	7,200	57,713	77	77	0	104		104
	2005	4,829	4,829	97	154	20,465	16,133	665	234	850	38,598	419	419	0	0		0
	2006	5,833	5,833	55	221	21,168	15,400	460	42	364	37,710	134	134	0	109		109
	2007	6,040	6,040	30	226	22,381	37,768	519	44	5,682	66,650	136	136	0	40		40
	2008	5,464	5,464	101	1,531	19,092	19,060	549	34	825	41,192	400	400	-	10		10
	2009	5,693	5,693	33	149	21,995	31,172	410	43	2,076	55,878	95	95	-	17		17
	2010	6,527	6,527	42	24	21,167	19,561	588	37	330	41,749	107	107	-	25		25
	2011	5,385	5,385	50	12	20,956	25,704	443	78	480	47,723	78	78	-	0		-
	2012	2,484	2,484	48	26	22,828	33,742	610	129	4,193	61,576	156	156	-	0		-
	2013	5,088	5,088	36	14	19,839	33,568	302	211	1,988	55,958	173	173		0		0
	2014	4,780	4,780	24	11	19,970	29,433	197	197	2,009	51,841	116	116		0		0
	2015	4,334	4,334	24	11	16,237	21,216	197	197	2,009	39,890	38	38		-	1	-
Retain catch total		**299,256**	**299,256**	**2,386**	**110,054**	**1,266,785**	**1,943,629**	**13,819**	**22,906**	**80,864**	**3,440,442**	**31,088**	**31,088**	**193**	**913**		**1,106**
Release	2013	1	1														
	2014	7	7														
	2015	14	14														
Release total		**22**	**22**														
Total		**299,278**	**299,278**	**2,386**	**110,054**	**1,266,785**	**1,943,629**	**13,819**	**22,906**	**80,864**	**3,440,442**	**31,088**	**31,088**	**193**	**913**		**1,106**

Numbers in paranthesus are provisional.

1) Mexico did not submit 2015 catch data to ISC16.

2) Total catch does not include Mexican 2015 catch

Table 15-1. Continued

TWN						USA									
Set-net	Gill-net (not specified)	Longline	Others	Purse seine	TWN Total	Drift gill-net	Handline	Longline	Pole and line	Troll	Others	Purse seine	Sport	USA Total	Total
										442				442	**442**
										1,681				1,681	**1,681**
										8,594				8,594	**8,594**
										8,586				8,586	**9,876**
										6,603				6,603	**6,623**
										5,412				5,412	**5,762**
										10,678				10,678	**10,678**
										17,071				17,071	**17,201**
										23,957				23,957	**26,057**
										17,886				17,886	**24,366**
										10,955				10,955	**12,915**
										12,235				12,235	**12,595**
								45		22,457				22,502	**32,342**
								33		24,901				24,934	**35,054**
								27		32,746				32,773	**42,383**
								24		15,629				15,653	**16,513**
								46		23,843			1,373	25,262	**94,892**
								23		15,740			171	15,934	**76,940**
								13		12,246			147	12,406	**61,500**
								9		13,264			577	13,850	**54,535**
								6		18,751			482	19,239	**76,640**
								4		21,165			304	21,473	**92,353**
								7		14,855			48	14,910	**56,427**
								5		20,990			+	20,995	**53,284**
								4		20,100			557	20,661	**63,335**
								5	2,837	12,055	1		1,355	16,253	**52,796**
								7	1,085	19,752	1		1,681	22,526	**47,293**
								7	2,432	25,140			1,161	28,740	**68,986**
								4	3,411	18,388			824	22,627	**62,470**
								3	417	16,542	1		731	17,694	**73,238**
								8	1,600	15,333			588	17,529	**66,609**
-	-	330	189		519			12	4,113	17,814			707	22,646	**84,777**
-	-	216	283		499			11	4,906	20,434			951	26,302	**79,073**
-	-	65	423		488			14	2,996	18,827			358	22,195	**87,731**
-	-	34	59		93			9	4,416	21,032			822	26,279	**71,591**
-	-	20	52		72			11	2,071	20,526			1,175	23,783	**107,006**
-	-	187	-		187			8	3,750	23,600			637	27,995	**142,005**
-	-	-	-		-			14	2,236	15,653			84	17,987	**119,440**
-	-	486	-		486			9	4,777	20,178			94	25,058	**127,183**
-	-	1,240	-		1,240			33	3,243	18,932	10		640	22,858	**95,282**
-	-	686	-		686			23	2,700	15,905	4		713	19,345	**128,676**
-	-	572	-		572			37	1,497	9,969			537	12,040	**62,987**
-	-	6	-		6			54	950	16,613	15		810	18,442	**99,470**
-	-	81	-		81				303	6,781			74	7,158	**75,434**
-	1	249	20		270				382	7,556			168	8,106	**77,044**

1	-	143	12		156			25	748	12,637			195	13,605	**72,380**	
-	-	38	9		47			105	425	6,609	21		257	7,417	**73,271**	
-	-	8	1		9			6	607	9,359			87	10,059	**56,199**	
-	1	-	-		1			2	1,030	9,304		3,728	1,427	15,491	**71,982**	
1	-	-	2		3	2				6,422	118	26	1,176	7,744	**59,252**	
-	-	-	-		-	3				4,713	66	47	196	5,025	**48,166**	
2	2,514	-	-		2,516	5		150		2,772	139	1	74	3,141	**50,170**	
6	7,389	-	-		7,395	15		307		4,221	76	17	64	4,700	**45,822**	
-	8,350	40	-		8,390	4		248		1,896	10	1	160	2,319	**44,756**	
-	16,701	4	39		16,744	29		177		2,733	20	71	24	3,054	**55,478**	
-	3,398	12	-		3,410	17		312		1,917	20		6	2,272	**37,672**	
-	7,866	-	-		7,866			334		4,626	40		2	5,002	**57,798**	
-	-	5	-		5			438		6,325	194		25	6,982	**58,746**	
-	-	83	-		83	38		544		11,068	66		106	11,822	**72,988**	
-	-	4,280	-		4,280	52		882		8,302	4		102	9,342	**67,853**	
-	-	7,596	-	-	7,596	83		1,185		17,150	10	11	88	18,527	**84,016**	
-	-	9,456	-	-	9,456	60		1,653		14,458	12	2	1,018	17,203	**103,606**	
-	-	8,810	-	-	8,810	80		1,120		14,577	15	33	1,208	17,033	**92,029**	
-	-	8,393	-	-	8,393	149		1,542		10,451	61	48	3,621	15,872	**119,066**	
-	-	8,842	-	-	8,842	55		940		9,834	24	4	1,798	12,655	**81,033**	
-	1	8,684	+	-	8,685	94		1,295		11,543	39	51	1,635	14,657	**88,522**	
-	-	7,965	-	-	7,965	30		525		11,003	13	4	2,357	13,932	**104,070**	
-	-	7,166	-	-	7,166	16		524		14,246	8	44	2,214	17,052	**90,090**	
-	-	4,988	-	-	4,988	12		361		13,630	3	1	1,506	15,513	**86,252**	
-	-	4,472	-	-	4,472	20		296		8,654	1		1,719	10,690	**59,008**	
-	-	4,317	-	-	4,317	3		270		12,642	+		385	13,300	**61,403**	
-	+	2,916	-	-	2,916	4	94	250		11,911	+	77	461	12,797	**88,579**	
-	-	3,069	-	-	3,069	1	28	354		11,762	+		418	12,563	**62,698**	
-	-	2,378	-	-	2,378	4	97	203		12,343	+	31	944	13,622	**77,683**	
+	-	2,818	-	-	2,818	5	53	421		11,691	0		862	13,032	**64,258**	
+	1	3,434	2	0	3,437	5	84	708		10,147	0		421	11,365	**67,988**	
2	2	2,643	-	-	2,647	8	253	660		14,152	2	5	1,212	16,292	**83,155**	
1	+	4,427	-	-	4,428	5	46	317		12,312	0		839	13,519	**79,166**	
1	1	2,617	+	-	2,619	+	49	208		13,372			1,045	14,674	**74,030**	
(1)	(1)	(3,020)	+	-	(3,022)	1	62	243		11,573	7		924	12,810	**(60,094)**	2
(15)	**(46,226)**	**(116,796)**	**(1,091)**	-	**(164,128)**	**800**	**766**	**17,120**	**52,932**	**1,037,232**	**1,001**	**4,202**	**46,345**	**1,185,338**	**(5,121,358)**	2
															1	
															7	
															14	
															21	
(15)	**(46,226)**	**(116,796)**	**(1,091)**	-	**(164,128)**	**800**	**766**	**17,120**	**52,932**	**1,037,232**	**1,001**	**4,202**	**46,345**	**1,185,338**	**(5,121,379)**	2

Table 15-2. Pacific bluefin tuna catches (in metric tons) by fisheries, 1952-2012. “0”; Fishing effort was reported but no catch. “+”; Below 499kg catch. “-“; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN							KOR					
		Set-net	Longline [1]	Pole and line	Troll [2]	Others	Purse seine	JPN Total	Set-net	Longline	Purse seine	Trawl	Troll	KOR Total [3]
Retain catch	1952	2,145	2,694	2,198	667	1,700	7,680	17,084						
	1953	2,335	3,040	3,052	1,472	160	5,570	15,629						
	1954	5,579	3,088	3,044	1,656	266	5,366	18,999						
	1955	3,256	2,951	2,841	1,507	1,151	14,016	25,722						
	1956	4,170	2,672	4,060	1,763	385	20,979	34,029						
	1957	2,822	1,685	1,795	2,392	414	18,147	27,255						
	1958	1,187	818	2,337	1,497	215	8,586	14,640						
	1959	1,575	3,136	586	736	167	9,996	16,196						
	1960	2,032	5,910	600	1,885	369	10,541	21,337						
	1961	2,710	6,364	662	3,193	599	9,124	22,652						
	1962	2,545	5,769	747	1,683	293	10,657	21,694						
	1963	2,797	6,077	1,256	2,542	294	9,786	22,752						
	1964	1,475	3,140	1,037	2,784	1,884	8,973	19,293						
	1965	2,121	2,569	831	1,963	1,106	11,496	20,086						
	1966	1,261	1,370	613	1,614	129	10,082	15,069						
	1967	2,603	878	1,210	3,273	302	6,462	14,728						
	1968	3,058	500	983	1,568	217	9,268	15,594						
	1969	2,187	878	721	2,219	195	3,236	9,436						
	1970	1,779	607	723	1,198	224	2,907	7,438						
	1971	1,555	697	938	1,492	317	3,721	8,720		0				0
	1972	1,107	512	944	842	197	4,212	7,814		0				0
	1973	2,351	838	526	2,108	636	2,266	8,725		0				0
	1974	6,019	1,177	1,192	1,656	754	4,106	14,904		0				0
	1975	2,433	1,061	1,401	1,031	808	4,491	11,225		3				3
	1976	2,996	320	1,082	830	1,237	2,148	8,613		5				5
	1977	2,257	338	2,256	2,166	1,052	5,110	13,179		0				0
	1978	2,546	648	1,154	4,517	2,276	10,427	21,568		3				3
	1979	4,558	729	1,250	2,655	2,429	13,881	25,502		0				0
	1980	2,521	811	1,392	1,531	1,953	11,327	19,535		0				0
	1981	2,129	590	754	1,777	2,653	25,422	33,325		0				0
	1982	1,667	718	1,777	864	1,709	19,234	25,969		0	31			31
	1983	972	217	356	2,028	1,117	14,774	19,464		0	13			13
	1984	2,234	142	587	1,874	868	4,433	10,138		1	4			5
	1985	2,562	105	1,817	1,850	1,175	4,154	11,663		0	1			1
	1986	2,914	102	1,086	1,467	719	7,412	13,700		0	344			344
	1987	2,198	211	1,565	880	445	8,653	13,952		13	89			102
	1988	843	157	907	1,124	498	3,605	7,134		0	32			32
	1989	748	209	754	903	283	6,190	9,087		0	71			71
	1990	716	309	536	1,250	455	2,989	6,255		0	132			132
	1991	1,485	218	286	2,069	650	9,808	14,516		0	265			265
	1992	1,208	513	166	915	1,081	7,162	11,045		0	288			288
	1993	848	812	129	546	365	6,600	9,300		0	40			40
	1994	1,158	1,206	162	4,111	398	8,131	15,166		0	50			50
	1995	1,859	678	270	4,778	586	18,909	27,080		0	821			821
	1996	1,149	901	94	3,640	570	7,644	13,998		0	102			102
	1997	803	1,300	34	2,740	811	13,152	18,840		0	1,054			1,054
	1998	874	1,255	85	2,876	700	5,391	11,181		0	188			188
	1999	1,097	1,157	35	3,440	709	16,173	22,611		0	256			256
	2000	1,125	953	102	5,217	689	16,486	24,572		0	2,401	0		2,401
	2001	1,366	791	180	3,466	782	7,620	14,205		0	1,176	10		1,186
	2002	1,100	841	99	2,607	631	8,903	14,181		0	932	1		933
	2003	839	1,237	44	2,060	446	5,768	10,394		0	2,601	0		2,601
	2004	896	1,847	132	2,445	514	8,257	14,091		0	773	0		773
	2005	2,182	1,925	549	3,633	548	12,817	21,654		0	1,318	9		1,327
	2006	1,421	1,121	108	1,860	777	8,880	14,167		0	1,012	3		1,015
	2007	1,503	1,762	236	2,823	657	6,840	13,821		0	1,281	4		1,285
	2008	2,358	1,390	64	2,377	770	10,221	17,180		0	1,866	10		1,876
	2009	2,236	1,080	50	2,003	575	8,077	14,021		0	936	4		940
	2010	1,603	890	83	1,583	495	3,742	8,396		0	1,196	16		1,212
	2011	1,651	837	63	1,820	283	8,340	12,994		0	670	14	+	684
	2012	1,932	673	113	570	343	2,462	6,093		0	1,421	2	1	1,424
	2013	1,415 *4	784	8	904	529	2,771	6,411	1	0	604	0	+	605
	2014	1,907	683	5	1,023	499	5,456	9,573	6	0	1,305	0	0	1,311
	2015	1,290	(647) *5	9	462	415	3,364	(6,187)	1	0	676	0	0	677
Retain catch total		**128,268**	**(89,538)**	**54,676**	**128,425**	**46,474**	**554,401**	**(1,001,782)**	**7**	**25**	**23,949**	**73**	**1**	**24,054**
Total		**128,268**	**(89,538)**	**54,676**	**128,425**	**46,474**	**554,401**	**(1,001,782)**	**7**	**25**	**23,949**	**73**	**1**	**24,054**

Numbers in paranthesis are provisional.
1) Japanese coastal longline and others catch data from 2007 to 2013 was revised as a result of deleting double counting and changing the data source (ISC15/STATWG/WP-4).
2) Japanese troll catch since 1998 includes catch from farming.
3) Catch statistics of Korea were derived from Japanese Import statistics for 1982-1999.
4) Catch of set net in 2013 were updated based on the Japanese official statistics of annual catch.
5) Catch of Japanese coastal longline in 2015 is provisional value.
6) USA in 1952-1958 contains catch from other countries - primarily Mexico. Other includes catches from gillnet, troll, pole-and-line, and longline.

Table 15-2. Continued

MEX			TWN							USA								
Others	Purse seine	MEX Total	Set-net	Gill-net (not specified)	Drift gill-net	Longline	Others	Purse seine	TWN Total	Drift gill-net	Longline	Pole and line	Troll	Others	Purse seine	Sport	USA Total [6]	Total
-	-	-													2,076	2	2,078	**19,162**
-	-	-													4,433	48	4,481	**20,110**
-	-	-													9,537	11	9,548	**28,547**
-	-	-													6,173	93	6,266	**31,988**
-	-	-													5,727	388	6,115	**40,144**
-	-	-													9,215	73	9,288	**36,543**
-	-	-													13,934	10	13,944	**28,584**
32	171	203										56			3,506	13	3,575	**19,974**
-	-	-										+			4,547	1	4,548	**25,885**
-	130	130										16			7,989	23	8,028	**30,810**
-	294	294										+			10,769	25	10,794	**32,782**
-	412	412										28			11,832	7	11,867	**35,031**
-	131	131										39			9,047	7	9,093	**28,517**
-	289	289				54			54			11	+	66	6,523	1	6,601	**27,030**
-	435	435				-			-			12			15,450	20	15,482	**30,986**
-	371	371				53			53			+			5,517	32	5,549	**20,701**
-	195	195				33			33			8			5,773	12	5,793	**21,615**
-	260	260				23			23			9			6,657	15	6,681	**16,400**
-	92	92				-			-			+			3,873	19	3,892	**11,422**
-	555	555				1			1			+			7,804	8	7,812	**17,088**
-	1,646	1,646				14			14			3		42	11,656	15	11,716	**21,190**
-	1,084	1,084				33			33			5	+	20	9,639	54	9,718	**19,560**
-	344	344				47	15		62			+	+	30	5,243	58	5,331	**20,641**
-	2,145	2,145				61	5		66			83		1	7,353	34	7,471	**20,910**
-	1,968	1,968				17	2		19			22	+	3	8,652	21	8,698	**19,303**
-	2,186	2,186				131	2		133			10		3	3,259	19	3,291	**18,789**
-	545	545				66	2		68			4		2	4,663	5	4,674	**26,858**
-	213	213				58	-		58			5		1	5,889	11	5,906	**31,679**
-	582	582				114	5		119			+		24	2,327	7	2,358	**22,594**
-	218	218				179	-		179	4		+	10	+	867	9	890	**34,612**
-	506	506			2	207	-		209	9		1		+	2,639	11	2,660	**29,375**
-	214	214			2	175	-	9	186	31		59		2	629	33	754	**20,631**
-	166	166			-	477	8	5	490	6	1	5		18	673	49	752	**11,551**
-	676	676			11	210	-	80	301	8				20	3,320	89	3,437	**16,078**
-	189	189			13	70	-	16	99	16				41	4,851	12	4,920	**19,252**
-	119	119			14	365	-	21	400	2				18	861	34	915	**15,488**
1	447	448			37	108	25	197	367	4				46	923	6	979	**8,960**
-	57	57			51	205	3	259	518	3				18	1,046	112	1,179	**10,912**
-	50	50			299	189	16	149	653	11				81	1,380	65	1,537	**8,627**
-	9	9			107	342	12	-	461	4	2			+	410	92	508	**15,759**
-	0	-			3	464	5	73	545	9	38			14	1,928	110	2,099	**13,977**
-	-	-				471	3	1	475	32	42			29	580	283	966	**10,781**
2	63	65				559	-		559	28	30			1	906	86	1,051	**16,891**
-	11	11				335	2		337	20	29			+	657	245	951	**29,200**
-	3,700	3,700	-	-		956	-	-	956	43	25		2	+	4,639	40	4,749	**23,505**
-	367	367	-	-		1,814	-	-	1,814	58	26		1	48	2,240	131	2,504	**24,579**
0	1	1	-	-		1,910	-	-	1,910	40	54		128	59	1,771	422	2,474	**15,754**
35	2,369	2,404	-	-		3,089	-	-	3,089	22	54		20	88	184	408	776	**29,136**
99	3,019	3,118	-	1		2,780	1	-	2,782	30	19		1	11	693	319	1,073	**33,946**
-	863	863	-	2		1,839	2	-	1,843	35	6		6	1	292	344	684	**18,781**
2	1,708	1,710	-	3		1,523	1	-	1,527	7	2		1	2	50	613	675	**19,026**
43	3,211	3,254	-	10		1,863	11	-	1,884	14	1			3	22	355	395	**18,528**
14	8,880	8,894	-	1		1,714	2	-	1,717	10	1			+		50	61	**25,536**
-	4,542	4,542	1	-		1,368	1	-	1,370	5	1			1	201	73	281	**29,174**
-	9,927	9,927	1	-		1,149	-	-	1,150	1	1			+		94	96	**26,355**
-	4,147	4,147	2	8		1,401	-	-	1,411	2	+			+	42	12	56	**20,720**
15	4,392	4,407	1	1		979	-	-	981	1	+			+		63	64	**24,508**
-	3,019	3,019	1	10		877	-	-	888	3	1		0	2	410	156	572	**19,440**
-	7,746	7,746	29	7		373	-	-	409	1	0			0		88	89	**17,852**
1	2,730	2,731	16	7		292	1	0	316	18	0		0	100		225	343	**17,068**
1	6,667	6,668	2	-		210	2	-	214	4	0		0	38		400	442	**14,841**
	3,154	3,154	2	1		331	-	-	334	7	1		0	3		809	820	**11,324**
	4,862	4,862	38	4		483	-	-	525	5	0		+	2	401	436	844	**17,115**
	(3,082)	(3,082)	(38)	(4)		(577)	-	-	(619)	4	0			6	86	359	455	**(11,020)**
245	**(95,159)**	**(95,404)**	**(131)**	**(59)**	**539**	**(30,589)**	**126**	**810**	**(32,254)**	**497**	**334**	**376**	**169**	**844**	**241,764**	**7,665**	**251,649**	**######**
245	**(95,159)**	**(95,404)**	**(131)**	**(59)**	**539**	**(30,589)**	**126**	**810**	**(32,254)**	**497**	**334**	**376**	**169**	**844**	**241,764**	**7,665**	**251,649**	**######**

Table 15-3. Annual catch of swordfish (*Xiphias gladius*) in metric tons for fisheries monitored by ISC for assessments of North Pacific Ocean stocks, 1951-2010. "0"; Fishing effort was reported but no catch. "+"; Below 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

		JPN						KOR		MEX		
Catch disposition	Year	Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	KOR Total	Others	Sport	MEX Total
Retain catch	1951	78	10	7,246	4,246	98	11,678					
	1952	68	-	8,890	2,721	12	11,691					
	1953	21	-	10,796	1,484	107	12,408					
	1954	18	-	12,563	909	121	13,611					
	1955	37	-	13,064	850	160	14,111					
	1956	31	-	14,596	786	73	15,486					
	1957	18	-	14,268	895	70	15,251					
	1958	31	-	18,525	1,111	67	19,734					
	1959	31	-	17,236	956	44	18,267					
	1960	67	1	20,058	1,243	30	21,399					
	1961	15	2	19,715	1,386	30	21,148					
	1962	15	-	10,607	1,449	44	12,115					
	1963	17	-	10,322	845	59	11,243					
	1964	16	4	7,669	1,097	66	8,852					
	1965	14	0	8,742	2,027	208	10,991					
	1966	11	0	9,866	1,841	45	11,763					
	1967	12	0	10,883	1,075	38	12,008					
	1968	14	0	9,810	1,775	50	11,649					
	1969	11	0	9,702	1,567	56	11,336					
	1970	9	0	7,715	1,784	39	9,547					
	1971	37	1	7,369	491	48	7,946	0	0			
	1972	1	55	7,316	293	22	7,687	0	0			
	1973	23	720	7,564	131	29	8,467	0	0			
	1974	16	1,304	6,523	336	29	8,208	0	0			
	1975	18	2,672	7,659	223	60	10,632	0	0			
	1976	14	3,488	8,786	372	182	12,842	0	0			
	1977	7	2,344	9,255	247	73	11,926	0	0			
	1978	22	2,475	9,022	177	111	11,807	0	0			
	1979	15	983	9,627	226	49	10,900	0	0			
	1980	15	1,746	6,873	423	30	9,087	135	135			
	1981	9	1,848	7,789	181	61	9,888	0	0			
	1982	7	1,257	6,963	230	59	8,516	166	166			
	1983	9	1,033	8,708	210	32	9,992	47	47			
	1984	13	1,053	8,375	153	98	9,692	27	27			
	1985	10	1,133	10,368	210	69	11,790	12	12			
	1986	9	1,264	9,738	200	47	11,258	18	18			
	1987	11	1,051	10,370	128	45	11,605	50	50			
	1988	8	1,234	9,304	186	19	10,751	27	27			
	1989	10	1,596	7,482	372	21	9,481	7	7			
	1990	4	1,074	6,595	131	13	7,817	46	46		-	-
	1991	5	498	5,682	161	20	6,366	37	37		-	-
	1992	6	887	8,497	389	16	9,795	32	32		-	-
	1993	4	292	9,777	309	44	10,426	27	27		-	-
	1994	4	421	8,723	308	37	9,493	4	4		-	-
	1995	7	561	7,808	424	34	8,834	9	9		-	-
	1996	4	428	7,979	601	45	9,057	15	15		-	-
	1997	5	365	8,215	347	62	8,994	99	99		-	-
	1998	2	471	7,419	480	68	8,440	153	153		-	-
	1999	5	724	6,604	418	47	7,798	131	131		-	-
	2000	5	808	7,292	506	49	8,660	202	202	602	-	602
	2001	15	732	7,831	239	30	8,847	438	438	516	-	516
	2002	11	1,164	7,185	211	29	8,600	438	438	215	-	215
	2003	4	1,198	6,434	154	28	7,818	380	380	237	-	237
	2004	4	1,062	6,900	233	30	8,229	410	410	268	-	268
	2005	3	956	6,647	193	337	8,136	403	403	234	-	234
	2006	5	796	7,687	247	343	9,078	465	465	328	-	328
	2007	2	829	8,123	124	368	9,446	453	453	172	-	172
	2008	3	648	6,187	175	349	7,362	794	794	242	-	242
	2009	3	682	6,006	240	249	7,180	993	993	394	-	394
	2010	8	494	5,398	112	230	6,241	662	662	222	-	222
	2011	2	193	4,019	12	233	4,460	962	962	-	-	-
	2012	8	371	4,026	63	288	4,755	856	856	-		-
	2013	13	290	4,240	168	291	5,002	1,071	1,071	-		-
	2014	(7)	(269)	(4,368)	(2)	(291)	(4,936)	829	829	-		-
	2015	(7)	(269)	(4,955)	(2)	(291)	(5,524)	776	776	- [1]		- [1]
Retain catch total		**(0,934)**	**(43,756)**	**#######**	**(41,085)**	**(6,323)**	**(668,057)**	**11,174**	**11,174**	**3,430** [2]	**-**	**3,430** [2]
Release	2010											
	2011											
Release total												
Total		**(0,934)**	**(43,756)**	**#######**	**(41,085)**	**(6,323)**	**(668,057)**	**11,174**	**11,174**	**3,430**	**-**	**3,430**

Numbers in paranthesus are provisional.
1) Mexico did not submit 2015 catch data to ISC16.
2) Total catch does not include Mexican 2015 catch

Table 15-3. Continued.

TWN							USA										
Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Drift gill-net	Harpoon	Handline	Longline	Pole and line	Troll	Others	Purse seine	Sport	USA Total	Total
																	11,678
																	11,691
			-			-											12,408
			-			-											13,611
			-			-											14,111
			-			-											15,486
			-			-											15,251
			-			-											19,734
			427			427											18,694
			520			520											21,919
			318			318											21,466
			494			494											12,609
			343			343											11,586
			358			358											9,210
			331			331											11,322
			489			489											12,252
-	-	5	646	30		681											12,689
-	8	3	763	1		775											12,424
-	1	6	843	-		850											12,186
-	1	5	904	-		910		612		5						617	11,074
-	-	3	992	-		995		99		1						100	9,041
-	-	12	862	-		874		171								171	8,732
-	-	113	860	6		979		399								399	9,845
-	-	98	881	38		1,017		406								406	9,631
-	-	152	928	1		1,081		557								557	12,270
-	-	159	636	35		830		42								42	13,714
-	2	139	578	-		719		318		17						335	12,980
-	3	10	546	-		559		1,699		9						1,708	14,074
-	5	24	668	4		701		329		7						336	11,937
-	4	72	613	1		690	160	566		5						731	10,643
-	3	18	658	4		683	473	271		3	2					749	11,320
-	3	46	856	-		905	945	156		5	3	6	1			1,116	10,703
-	3	164	783	-		950	1,693	58		5	2	3	1	1		1,763	12,752
43	5	259	733	-		1,040	2,647	104		15	49			26		2,841	13,600
3	29	166	566	61		825	2,990	305	4	2			104			3,405	16,032
3	1	201	456	6		667	2,069	291	4	2			109			2,475	14,418
-	-	187	1,331	3		1,521	1,529	235	4	24			31			1,823	14,999
-	1	80	777	183		1,041	1,376	198	6	24			64			1,668	13,487
3	2	61	1,541	35		1,642	1,243	62	7	218			56			1,586	12,716
4	2	118	1,452	88		1,664	1,131	64	5	2,437			43			3,680	13,207
4	2	205	1,430	56		1,697	944	20	6	4,535			44			5,549	13,649
12	1	287	1,494	33		1,827	1,356	75	1	5,762			47			7,241	18,895
13	3	194	1,228	100		1,538	1,412	168	4	5,936			161			7,681	19,672
12	3	211	1,155	9		1,390	792	157	4	3,807			24			4,784	15,671
6	2	14	1,185	203		1,410	771	97	6	2,981			29			3,884	14,137
10	2	19	710	1	-	742	761	81	5	2,848			15			3,710	13,524
8	1	27	1,397	1	-	1,434	708	84	7	3,393			11			4,203	14,730
15	9	17	1,198	-	-	1,239	931	48	7	3,681			19			4,686	14,518
5	5	51	1,455	+	-	1,516	606	81	9	4,329			27			5,052	14,497
5	6	74	3,716	-	-	3,801	649	90		4,834			33			5,606	18,871
8	18	64	4,853	-	-	4,943	375	52		1,969			19			2,415	17,159
16	8	1	5,400	1	-	5,426	302	90		1,524			3			1,919	16,598
8	3	-	4,771	-	-	4,782	216	107	10	1,958			11			2,302	15,519
7	6	1	4,248	2	-	4,264	182	69	7	1,185			44			1,487	14,658
5	3	16	3,964	2	-	3,990	220	77	5	1,622			5			1,929	14,692
7	2	49	4,382	3	-	4,443	443	71	4	1,211			5			1,734	16,048
2	2	20	4,099	2	-	4,125	490	59	5	1,735		1				2,290	16,486
3	6	39	3,745	+	-	3,793	405	48	6	2,014			19			2,492	14,683
83	7	31	3,550	-	-	3,671	253	50	5	1,817		0	0			2,125	14,363
6	4	42	2,844	-	-	2,896	62	37	3	1,676			18			1,796	11,817
8	17	52	3,577	1	+	3,655	119	24	5	1,623			90			1,861	10,938
3	15	30	3,746	+	-	3,794	118	5	6	1,395		1	1			1,526	10,931
2	8	0	2,846	1	-	2,857	95	6	6	1,270		1	7			1,385	10,315
4	4	0	2,817	+	+	2,825	124	5	7	1,665		1	+			(1,802)	(10,392)
(4)	(4)	(0)	(3,199)	+	-	(3,207)	66	5	5	1,515		1	1		+	(1,593)	(11,100) [2]
(312)	**(214)**	**(3,545)**	**(96,162)**	**(911)**	**(0)**	**(101,144)**	**28,656**	**8,548**	**153**	**69,064**	**56**	**14**	**1,042**	**27**	**+**	**(107,560)**	**(891,365)** [2]
														0		0	0
														0		0	0
														0		**0**	**0**
(312)	**(214)**	**(3,545)**	**(96,162)**	**(911)**	**(0)**	**(101,144)**	**28,656**	**8,548**	**153**	**69,064**	**56**	**14**	**1,042**	**27**	**+**	**107,560**	**(891,365)** [2]

Table 15-4. Annual catch of striped marlin (*Kajikia audax*) in metric tons for fisheries monitored by ISC for assessments of North Pacific Ocean stocks, 1951-2011 "0"; Fishing effort was reported but no catch. "+"; Below 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recents years are provisional.

Catch disposition	Year	JPN						KOR		MEX	
		Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	KOR Total	Sport	MEX Total
Retain catch	1951	92	-	2,494	1,822	39	4,447				
	1952	203	-	2,901	2,043	40	5,187				
	1953	126	-	2,138	840	36	3,140				
	1954	82	-	3,068	990	67	4,207				
	1955	106	-	3,082	878	82	4,148				
	1956	133	-	3,729	1,881	41	5,784				
	1957	71	-	3,189	2,431	76	5,767				
	1958	82	3	4,106	2,981	127	7,299				
	1959	87	2	4,152	3,061	200	7,502				
	1960	161	4	3,862	1,790	87	5,904				
	1961	161	2	4,420	1,707	98	6,388				
	1962	197	8	5,739	1,717	108	7,769				
	1963	92	17	6,135	1,590	292	8,126				
	1964	81	2	14,304	2,264	41	16,692				
	1965	81	1	11,602	2,659	73	14,416				
	1966	226	2	8,419	1,425	31	10,103				
	1967	82	3	11,698	1,521	75	13,379				
	1968	71	0	15,913	1,144	58	17,186				
	1969	71	3	9,144	2,519	81	11,818				
	1970	55	3	13,686	1,005	153	14,902				
	1971	61	10	11,632	1,933	307	13,943	0	0		
	1972	72	243	7,843	972	94	9,224	0	0		
	1973	80	3,265	6,989	594	146	11,074	0	0		
	1974	90	3,112	7,027	630	104	10,963	0	0		
	1975	105	6,534	5,567	530	89	12,825	0	0		
	1976	37	3,561	5,380	475	107	9,560	0	0		
	1977	103	4,424	3,275	352	107	8,261	0	0		
	1978	93	5,593	4,200	237	243	10,366	0	0		
	1979	66	2,532	5,927	348	133	9,006	0	0		
	1980	80	3,467	6,985	402	59	10,993	73	73		
	1981	88	3,866	4,365	397	69	8,785	0	0		
	1982	52	2,351	5,653	489	128	8,673	102	102		
	1983	124	1,867	4,042	557	156	6,746	49	49		
	1984	144	2,333	3,892	407	177	6,953	39	39		
	1985	81	2,363	4,608	523	153	7,728	13	13		
	1986	131	3,584	7,303	376	103	11,497	14	14		
	1987	102	1,888	8,725	250	167	11,132	15	15		
	1988	63	2,211	7,023	407	205	9,909	16	16		
	1989	47	1,664	5,821	358	145	8,035	24	24		
	1990	65	1,945	3,493	290	193	5,986	1	1	-	-
	1991	56	1,329	4,042	323	131	5,881	7	7	-	-
	1992	71	1,204	4,202	147	95	5,719	53	53	-	-
	1993	27	828	5,199	309	373	6,736	568	568	-	-
	1994	73	1,443	4,195	219	92	6,022	556	556	-	-
	1995	58	970	5,334	142	86	6,590	307	307	-	-
	1996	39	703	3,787	29	88	4,646	429	429	-	-
	1997	34	813	3,520	64	68	4,499	1,017	1,017	-	-
	1998	34	1,092	3,759	125	147	5,157	635	635	-	-
	1999	28	1,126	3,159	70	90	4,473	433	433	-	-
	2000	41	1,062	2,261	173	91	3,628	536	536	-	-
	2001	51	1,077	2,311	161	36	3,636	253	253	-	-
	2002	80	1,264	1,560	187	28	3,119	187	187	-	-
	2003	41	1,064	1,855	138	27	3,125	205	205	-	-
	2004	23	1,339	1,699	35	34	3,130	75	75	-	-
	2005	28	1,214	1,230	36	35	2,543	136	136	-	-
	2006	30	1,190	1,161	34	32	2,447	55	55	-	-
	2007	21	970	1,166	25	38	2,220	46	46	-	-
	2008	26	1,302	999	53	28	2,408	29	29	-	-
	2009	17	821	788	55	39	1,720	22	22	-	-
	2010	20	913	1,019	68	36	2,056	18	18	-	-
	2011	30	347	1,251	87	26	1,741	48	48	-	-
	2012	52	597	1,306	62	34	2,051	33	33		
	2013	39	336	1,457	52	34	1,918	65	65		
	2014	(35)	(173)	(1,111)	(35)	(22)	(1,376)	82	82		
	2015	(35)	(173)	(1,237)	(35)	(22)	(1,502)	44	44		
Retain catch total		**(4,933)**	**(80,213)**	**(313,139)**	**(49,459)**	**(6,422)**	**(454,166)**	**6,185**	**6,185**	**-**	**-**
Release	2010										
	2011										
Release total											
Total		**(4,933)**	**(80,213)**	**(313,139)**	**(49,459)**	**(6,422)**	**(454,166)**	**6,185**	**6,185**	**-**	**-**

Numbers in paranthesus are provisional.

Table 15-4. Continued.

TWN							USA							
Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Handline	Longline	Troll	Others	Purse seine	Sport	USA Total	Total
														4,447
												23	23	**5,210**
				-		-						5	5	**3,145**
				-		-						16	16	**4,223**
				-		-						5	5	**4,153**
				-		-						34	34	**5,818**
				-		-						42	42	**5,809**
			543	387		930						59	59	**8,288**
			391	354		745						65	65	**8,312**
			398	350		748						30	30	**6,682**
			306	342		648						24	24	**7,060**
			332	211		543						5	5	**8,317**
			560	199		759						68	68	**8,953**
			392	175		567						58	58	**17,317**
			355	157		512						23	23	**14,951**
			370	180		550						36	36	**10,689**
-	-	141	387	63		591						49	49	**14,019**
-	40	134	333	34		541						51	51	**17,778**
-	5	159	573	28		765						30	30	**12,613**
-	8	175	495	6		684						18	18	**15,604**
-	16	101	449	18		584						17	17	**14,544**
-	1	124	389	1		515						21	21	**9,760**
-	4	115	569	20		708						9	9	**11,791**
-	7	53	674	58		792						55	55	**11,810**
-	7	86	796	3		892						27	27	**13,744**
-	9	61	379	70		519						31	31	**10,110**
-	9	207	541	3		760						41	41	**9,062**
-	7	70	618	1		696						37	37	**11,099**
2	18	104	458	-		582						36	36	**9,624**
-	39	92	284	1		416						33	33	**11,515**
-	25	70	508	-		603						60	60	**9,448**
-	26	112	404	-		542						41	41	**9,358**
-	31	144	555	39		769						39	39	**7,603**
-	16	314	965	-		1,295						36	36	**8,323**
1	6	152	513	23		695			18			42	60	**8,496**
-	13	119	179	16		327			19			19	38	**11,876**
1	2	132	414	16		565	1	272	29			28	330	**12,042**
7	12	70	464	80		633		504	54			30	588	**11,146**
-	23	124	192	10		349	+	612	24			52	688	**9,096**
12	16	207	139	21		395	+	538	27			23	588	**6,970**
-	81	173	290	32		576	+	663	41			12	716	**7,180**
-	11	163	220	24		418	1	459	37			25	522	**6,712**
3	7	132	226	-		368	1	471	67			11	550	**8,222**
4	5	176	138	11		334	+	326	35			17	378	**7,290**
4	5	67	110	6		192	+	543	52			14	609	**7,698**
3	8	30	188	6	-	235	1	418	53			20	492	**5,802**
3	9	33	351	-	-	396	1	352	37			21	411	**6,323**
6	16	19	304	-	-	345	+	378	26			23	427	**6,564**
5	8	26	197	-	-	236	1	364	27			12	404	**5,546**
6	18	29	315	1	-	369		200	15			10	225	**4,758**
5	16	30	250	-	-	301		351	44			+	395	**4,585**
8	15	6	477	-	-	506	+	226	30			+	256	**4,068**
5	27	11	922	+	-	965	+	538	29			+	567	**4,862**
5	10	7	522	2	-	546	2	376	31			+	409	**4,160**
9	9	5	783	9	-	815	+	511	20			+	531	**4,025**
-	30	117	741	+	-	888	+	611	21			+	632	**4,022**
-	29	141	301	-	-	471		276	13			+	289	**3,026**
-	43	168	270	2	-	483		427	14				441	**3,361**
-	46	92	262	-	-	400		258	10				268	**2,410**
-	42	131	253	3	-	429		165	19		1		185	**2,688**
1	27	95	343	4	0	470		362	16		0		378	**2,637**
+	34	114	443	1	+	592		282	11				293	**2,969**
+	24	197	372	+	+	593		398	8				406	**2,982**
+	5	64	140	+	1	210		426	12			1	439	**(2,107)**
+	(5)	(64)	(228)	+	-	(297)		494	11	+		+	505	**(2,348)**
(90)	**(870)**	**(5,156)**	**(23,571)**	**(2,967)**	**(1)**	**(32,655)**	**8**	**11,801**	**850**	**+**		**1,484**	**14,144**	**(507,150)**
											1		1	**1**
											0		0	**0**
											1		**1**	**1**
(90)	**(870)**	**(5,156)**	**(23,571)**	**(2,967)**	**(1)**	**(32,655)**	**8**	**11,801**	**850**	**+**	**1**	**1,484**	**14,145**	**(507,151)**

Table 15-5. Retained catches (metric tons, whole weight) of ISC members of blue marlin (*Makaira nigricans*) by fishery in the North Pacific Ocean, north of the equator. "0"; Fishing effort was reported but no catch. "+"; Below 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN		KOR			MEX		TWN							USA						Total
		Longline	JPN Total	Longline	Purse seine	KOR Total	Sport	MEX Total	Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Handline	Longline	Troll	Others	Purse seine	USA Total	
Retain catch	1953											-			-							-
	1954											-			-							-
	1955											-			-							-
	1956											-			-							-
	1957											-			-							-
	1958											887			887							**887**
	1959											781			781							**781**
	1960											948			948							**948**
	1961											703			703							**703**
	1962											628			628							**628**
	1963											691			691							**691**
	1964											934			934							**934**
	1965											1,016			1,016							**1,016**
	1966											957			957							**957**
	1967								-	-	317	898	167		1,382							**1,382**
	1968								-	30	649	1,433	120		2,232							**2,232**
	1969								-	58	465	1,232	103		1,858							**1,858**
	1970								1	21	604	1,385	70		2,081							**2,081**
	1971	5,461	5,461	0		0			-	13	473	1,331	118		1,935							**7,396**
	1972	6,772	6,772	0		0			-	14	490	1,205	50		1,759							**8,531**
	1973	6,453	6,453	0		0			-	12	275	1,650	265		2,202							**8,655**
	1974	6,545	6,545	0		0			1	6	355	2,144	146		2,652							**9,197**
	1975	4,374	4,374	0		0			-	3	421	2,638	207		3,269							**7,643**
	1976	5,018	5,018	0		0			-	9	511	1,315	162		1,997							**7,015**
	1977	4,780	4,780	0		0			-	11	391	1,183	110		1,695							**6,475**
	1978	5,900	5,900	0		0			1	15	364	1,633	7		2,020							**7,920**
	1979	5,949	5,949	0		0			3	19	362	1,646	164		2,194							**8,143**
	1980	5,613	5,613	155		155			-	35	444	1,185	170		1,834							**7,602**
	1981	5,518	5,518	0		0			-	35	313	1,840	69		2,257							**7,775**
	1982	6,051	6,051	351		351			-	7	306	2,139	120		2,572							**8,974**
	1983	4,796	4,796	82		82			-	26	741	2,122	127		3,016							**7,894**
	1984	6,248	6,248	155		155			-	22	960	1,789	111		2,882							**9,285**
	1985	5,164	5,164	45		45			9	11	747	1,187	43		1,997			145			145	**7,351**
	1986	5,922	5,922	86		86			4	90	839	1,723	107		2,763			220			220	**8,991**
	1987	5,370	5,370	89		89			12	9	973	4,627	1		5,622		51	261			312	**11,393**
	1988	5,054	5,054	133		133			20	8	658	2,822	589		4,097		102	266			368	**9,652**
	1989	5,117	5,117	50		50			10	14	640	2,691	9		3,364		356	326			682	**9,213**
	1990	4,116	4,116	44		44	-	-	3	24	427	1,749	143		2,346		378	295			673	**7,179**
	1991	4,094	4,094	75		75	-	-	4	50	338	2,288	152		2,832		297	346			643	**7,644**
	1992	3,721	3,721	60		60	-	-	25	40	432	3,786	110		4,393		347	260			607	**8,781**
	1993	4,600	4,600	36		36	-	-	44	41	400	4,135	82		4,702		339	311			650	**9,988**
	1994	5,832	5,832	2		2	-	-	12	30	206	3,007	7		3,262		362	298			660	**9,756**
	1995	5,907	5,907	0		0	-	-	15	36	895	3,896	5		4,847		570	315			885	**11,639**
	1996	3,260	3,260	10		10	-	-	13	35	270	3,337	10	-	3,665		467	409			876	**7,811**
	1997	3,697	3,697	145		145	-	-	5	48	194	3,683	-	-	3,930		487	378			865	**8,637**
	1998	3,438	3,438	335		335	-	-	8	59	91	3,624	1	-	3,783		395	242			637	**8,193**
	1999	3,751	3,751	164		164	-	-	21	32	135	3,417	-	-	3,605		357	293			650	**8,170**
	2000	3,606	3,606	96		96	-	-	24	40	186	4,131	2	-	4,383		314	235			549	**8,634**
	2001	3,594	3,594	166		166	-	-	18	57	229	4,733	-	-	5,037		399	291			690	**9,487**
	2002	2,976	2,976	152		152	-	-	13	63	32	4,448	6	-	4,562		264	225	1		490	**8,180**
	2003	2,836	2,836	158		158	-	-	20	107	52	7,685	4	-	7,868		363	210			573	**11,435**
	2004	2,977	2,977	226		226	-	-	14	93	36	6,672	9	-	6,824		283	188	5		476	**10,503**
	2005	2,506	2,506	303		303	-	-	8	65	48	7,630	16	-	7,767		337	187			524	**11,100**
	2006	2,414	2,414	217		217	-	-	12	15	30	5,729	-	-	5,786		409	160			569	**8,986**
	2007	2,016	2,016	120		120	-	-	3	17	20	5,117	+	-	5,157	1	262	127			390	**7,683**
	2008	2,096	2,096	219		219	-	-	10	16	15	5,477	1	-	5,519	1	349	198			548	**8,382**
	2009	1,840	1,840	224		224	-	-	9	12	9	4,638	1	-	4,669	1	360	15			376	**7,109**
	2010	2,457	2,457	257		257	-	-	5	27	15	4,959	1	-	5,007	2	306	148			456	**8,177**
	2011	2,211	2,211	684		684	-	-	3	18	17	4,625	9	2	4,674	2	373	199			574	**8,143**
	2012	1,839	1,839	587		587			6	13	16	4,097	+	12	4,144	2	298	141			441	**7,011**
	2013	1,991	1,991	963		963			2	6	16	4,607	+	9	4,640	3	406	137			546	**8,140**
	2014	(1,766)	(1,766)	801		801			4	11	124	4,861	5	7	5,012	4	535	159			698	**8,277**
	2015	(1,421)	(1,421)	531		531			(4)	(11)	(124)	(4,306)	(5)	(3)	(4,453)	3	624	196			823	**(7,228)**
Retain catch total		**#######**	**#######**	**7,721**		**7,721**	**-**	**-**	**(366)**	**(1,434)**	**(16,655)**	**(166,000)**	**(3,604)**	**(33)**	**(188,092)**	**19**	**10,390**	**7,181**	**6**		**17,596**	**(400,476)**
Release	2010																			1	1	**1**
	2011																			6	6	**6**
	2013													5	5							**5**
	2015				+	+								3	3							**3**
Release total					**+**	**+**								**8**	**8**					**7**	**7**	**15**
Total		**#######**	**#######**	**7,721**	**+**	**7,721**	**-**	**-**	**(0,366)**	**(1,434)**	**(16,655)**	**(166,000)**	**(3,604)**	**(0,041)**	**(188,100)**	**19**	**10,390**	**7,181**	**6**	**7**	**17,603**	**(400,491)**

Numbers in paranthesus are provisional.

Table 15-6. Retained catches (metric tons, whole weight) of ISC members of blue sharks (*Prionace glauca*) by fishery in the North Pacific Ocean, north of the equator. "0"; Fishing effort was reported but no catch. "+"; Below 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN						KOR		MEX		TWN		USA						Total
		Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	KOR Total	Others	MEX Total	Longline	TWN Total	Drift gill-net	Longline	Troll	Others	Sport	USA Total	
Retain catch	1985													+			1		1	**1**
	1986													1			1		2	**2**
	1987													1			1		2	**2**
	1988													+			3		3	**3**
	1989																6		6	**6**
	1990													+			20		20	**20**
	1991													+			1		1	**1**
	1992													1			1		2	**2**
	1993													+			+		0	**0**
	1994			20,062			20,062							+			12		12	**20,074**
	1995			18,427			18,427							+			5		5	**18,432**
	1996			21,251			21,251							+			+		0	**21,251**
	1997			26,105			26,105							+			+		0	**26,105**
	1998			23,988			23,988							+			1		1	**23,989**
	1999			26,541			26,541							+			+		0	**26,541**
	2000			27,511			27,511							+			+		0	**27,511**
	2001			28,126			28,126			-	-						+		+	**28,126**
	2002			26,345			26,345			-	-						+		+	**26,345**
	2003			26,278			26,278			-	-			+			+		0	**26,278**
	2004			22,470			22,470			-	-						+		+	**22,470**
	2005			21,887			21,887			-	-						+		+	**21,887**
	2006			19,063			19,063			-	-						+		+	**19,063**
	2007			15,190			15,190			2,073	2,073			9	8		+		17	**17,280**
	2008			21,773			21,773			3,531	3,531				7				7	**25,311**
	2009	6	908	19,260	730	1	20,905			3,261	3,261	11,541	11,541	1	9		1		11	**35,718**
	2010	9	733	22,633	802	1	24,177			3,700	3,700	7,670	7,670	+	7		0		7	**35,554**
	2011	7	438	18,780	862	3	20,090			3,366	3,366	13,117	13,117		13		0		13	**36,586**
	2012	2	631	12,937	764	3	14,336			4,108	4,108	10,606	10,606		16		0		16	**29,066**
	2013	4	898	16,316	635	2	17,855	75	75	4,494	4,494	6,321	6,321		1	0	0		1	**28,746**
	2014	2	868	15,614	598	2	17,083	100	100	5,513	5,513	8,151	8,151		0		+	+	0	**30,847**
	2015	(2)	(868)	(15,614)	(598)	(2)	(17,083)	53	53	- [1]	- [1]	(8,272)	(8,272)				1	0	1	**(25,409)** [2]
Retain catch total		**(32)**	**(5,344)**	**(466,171)**	**(4,989)**	**(14)**	**(476,546)**	**228**	**228**	**30,046** [2]	**30,046** [2]	**(65,678)**	**(65,678)**	**13**	**61**	**0**	**54**	**0**	**128**	**(572,626)** [2]
Release	2015							+	+											+
Release total								+	+											+
Total		**(32)**	**(5,344)**	**(466,171)**	**(4,989)**	**(14)**	**(476,546)**	**228**	**228**	**30,046** [2]	**30,046** [2]	**(65,678)**	**(65,678)**	**13**	**61**	**0**	**54**	**0**	**128**	**(572,626)** [2]

Numbers in paranthesus are provisional.
Sharks catch is all retained, and no discard data.
1) Mexico did not submit 2015 catch data to ISC16.
2) Total catch does not include Mexican 2015 catch

Table 15-7. Retained catches (metric tons, whole weight) of ISC members of shortfin mako sharks (*Isurus oxyrhinchus*) by fishery in the North Pacific Ocean, north of the equator. “0”; Fishing effort was reported but no catch. “+”; Below 499kg catch. “-“; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	KOR		MEX		TWN			USA							Total
		Longline	KOR Total	Others	MEX Total	Longline	Purse seine	TWN Total	Drift gill-net	Harpoon	Troll	Others	Purse seine	Sport	USA Total	
Retain catch	1985			43	43				129	1		19			149	**192**
	1986			84	84				250	1		59			310	**394**
	1987			197	197				208	3		188			399	**596**
	1988			248	248				106	3		214			323	**571**
	1989			135	135				117	1		137			255	**390**
	1990			288	288				229	3		141			373	**661**
	1991			228	228				125	1		91			217	**445**
	1992			376	376				118	3		19			140	**516**
	1993			442	442				87	1		32			120	**562**
	1994			336	336				80	1		46			127	**463**
	1995			333	333				79	1		14			94	**427**
	1996			413	413				85	1		9			95	**508**
	1997			401	401				118	3		11			132	**533**
	1998			386	386				85	1		12			98	**484**
	1999			439	439				52	+		9			61	**500**
	2000			539	539				64	+		12			76	**615**
	2001			491	491				30	1		10			41	**532**
	2002			488	488				69	+		12			81	**569**
	2003			471	471				57	+		9			66	**537**
	2004			865	865				38	1		13			52	**917**
	2005			609	609				25	1		8			34	**643**
	2006			641	641				38	+		7			45	**686**
	2007			689	689				37	+		6			43	**732**
	2008	-	-	609	609				27	1		5			33	**642**
	2009	-	-	653	653	78		78	21	1	0	7			29	**760**
	2010	-	-	760	760	54		54	10	0		10			20	**834**
	2011	-	-	758	758	208		208	8	0		8			16	**982**
	2012	-	-	715	715	74		74	9	0	0	11			20	**809**
	2013	8	8	711	711	107		107	16	0		12			28	**854**
	2014	8	8	-	-	119		119	7	+		9		9	25	**152**
	2015	0	0	- [1]	- [1]	322 [2]		322 [2]	6 [2]		+ [2]	5 [2]		1 [2]	12 [2]	**334**
Retain catch total		**16**	**16**	**13,348** [3]	**13,348** [3]	**962**		**962**	**2,330**	**29**	**+**	**1,145**		**10**	**3,514**	**17,840** [3]
Release	2011												0		0	**0**
	2012						0	0								**0**
Release total							**0**	**0**					**0**		**0**	**0**
Total		**16**	**16**	**13,348** [3]	**13,348** [3]	**962**	**0**	**962**	**2,330**	**29**	**+**	**1,145**	**0**	**10**	**3,514**	**17,840** [3]

Numbers in paranthesus are provisional.
Sharks catch is all retained, and no discard data.
1) Mexico did not submit 2015 catch data to ISC16.
2) Chinese Taipei and USA data provided mako shark data as MAK (shortfin mako and longfin mako shark).
3) Total catch does not include Mexican 2015 catch