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

WCPFC-NC14-2018/IP-01

ISC[1]

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

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

PLENARY SESSION

July 11-16, 2018
Yeosu, Republic of Korea

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ACRONYMS AND ABBERVIATIONS

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

FAO Code	Common 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	Hidetada Kiyofuji (Japan)
BILLWG	Billfish Working Group	Jon Brodziak (U.S.A.)
PBFWG	Pacific Bluefin Working Group	Shuya Nakatsuka (Japan)
SHARKWG	Shark Working Group	Mikihiko Kai (Japan)
STATWG	Statistics Working Group	John Holmes (ISC Chair)

<u>Other Abbreviations and Acronyms Used in the Report</u>

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)
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 Program, 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

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 Wildlife Fund for Nature - Japan
GRT	Gross registered tons

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Highlights of the ISC18 Plenary Meeting

The 18th ISC Plenary, held in Yeosu, Republic of Korea from 11 to 16 July 2018 was attended by Members from Canada, Chinese Taipei, Japan, Korea, Mexico, 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. The ISC Plenary endorsed the findings that the North Pacific shortfin mako shark (SMA) stock is likely not in an overfished condition and overfishing is likely not occurring relative to MSY-based abundance and fishing intensity reference points, and considers the 2018 benchmark stock assessment to be the best available scientific information. The ISC Plenary also endorsed the findings that the Western and Central North Pacific (WNCPO) swordfish (SWO) stock is not likely overfished and is not likely experiencing overfishing relative to MSY-based or 20% of unfished spawning biomass-based reference points and considers the WNCPO SWO stock assessment to be best available scientific information. An update assessment of Pacific bluefin tuna (PBF) found that the stock is overfished and experiencing overfishing and that the probabilities of attaining the first and second rebuilding targets under current management measures were 98% and 96%, respectively. The ISC Plenary endorsed these findings and considers them to be the best available scientific information on PBF. The ISC Plenary re-iterated stock status and conservation information proffered at ISC17 for North Pacific albacore, Pacific blue shark, Eastern Pacific Ocean Swordfish, WNCPO striped marlin, and Pacific blue marlin. A science seminar on ecosystem-based fisheries assessment and management was held and the ISC Plenary agreed to a template to standardize stock status and conservation information to the extent possible. Meetings were schedule for the Ad-hoc Working Group assessing the feasibility of developing an multinational PBF tagging program and the PBF Close-kin genetic progject. Observers from Pew Charitable Trusts, World Wildlife Fund for Nature – Japan, Monterey Bay Aquarium, and the Western Pacific Fisheries Management Council attended. The ISC workplan for 2018-19 includes completing WNCPO Striped Marlin assessment, updating information on biological reference points for ISC species of interest improving catch and CPUE time series and advancing biological information for shark species, conducing the second PBF MSE workshop, reviewing initial simulation results from the ALB MSE process, and enhancing database and website management. The next ISC Plenary will be held in the Chinese-Taipei in July 2019.

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 several 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 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) in the north Pacific Ocean by ISC Members estimated from available information exceeds 100,000 metric tons (t) annually and is dominated by Albacore (ALB), Blue Shark (BSH), and Pacific Bluefin Tuna (PBF) [1]. In 2017, the catch of priority species monitored by ISC Member countries was 48,836 t of North Pacific ALB, 14,691 t of PBF, 9,611 t of North Pacific swordfish (SWO), 2,159 t of North Pacific striped marlin (MLS), 7,893 t of Pacific blue marlin (BUM), 1,081 t of shortfin mako shark (SMA) and 20,704 t of North Pacific BSH. The total estimated catch of these seven species is 104,975 t, or more than 99% of the 2016 total estimated catch of 105,013 t. Annual catches of priority stocks throughout their ranges are shown in Tables 15-1 through 15-7.

1.2 Opening of the Meeting

The Eighteenth Plenary session of the ISC (ISC18) was convened in Yeosu, Republic of Korea, at 0900 on 11 July 2018 by the ISC Chairman, J. Holmes. A roll call confirmed the presence of delegates from Canada, Chinese Taipei, Japan, Republic of Korea, Mexico, and U.S.A. (**ISC/18/ANNEX/01**). A representative from the Western and Central Pacific Fisheries Commission (WCPFC) was also present. Pew Charitable Trusts, World Wildlife Fund for Nature - Japan (WWF), Monterey Bay Aquarium, and the Western Pacific Fisheries Management Council were present as observers.

ISC Member China, as well as the non-voting Members the Secretariat of the Pacific Community (SPC), the Fisheries and Agriculture Organization of the United Nations (FAO), and the Inter-

[1] FAO three-letter species codes are used throughout this report interchangeably with common names. See the list of common and scientific names and FAO codes on page 6 of this report.

American Tropical Tuna Commission (IATTC), while extended an invitation, did not attend the Plenary.

J. Holmes introduced Dong Woo Lee, Manager, Fundamental Research Department, National Institute of Fisheries Science, Republic of Korea, who gave the welcome address for the meeting.

2 ADOPTION OF AGENDA

The proposed agenda for the session (**ISC/18/ANNEX/02**) was considered and adopted. 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 **ISC/18/ANNEX/03**.

3 DELEGATION REPORTS ON FISHERY MONITORING, DATA COLLECTION AND RESEARCH

3.1 Canada

Z. Zhang presented the National Report of Canada (**ISC/18/PLENARY/04**). Canada has one fishery for highly migratory species in the Pacific Ocean, a troll fishery targeting juvenile north Pacific Albacore Tuna (*Thunnus alalunga*). There were 121 fishing vessels, and the fishery continued to be largely coastal in its operations in 2017. The fishing season was between June and October. Fishing effort and catch concentrated in the waters of the US exclusive economic zone (EEZ) in June and July, and started to shift towards the Canadian EEZ in August. However, fishing effort was more widely distributed in 2017 than in the past few years, likely due to low albacore abundance in the coastal areas in 2017 relative to past years. Fishing effort spent in the high seas in 2017 was more than 12 times as high as in 2016, and five Canadian vessels entered the north Pacific WCPFC Convention Area.

Estimated albacore catch and fishing effort were 1,831 t and 4,978 vessel-days, respectively. Fishing effort decreased 7.1%, but the catch fell 36% relative to 2016. The 2017 catch was nearly as low as the lowest catch reported since 1995. The estimated catch per unit of effort (CPUE) in 2017 was also nearly as low as the lowest estimated since 1995. The proportion of albacore catch in the US EEZ increased in 2017 relative to past few years. Albacore were caught in waters with sea surface temperatures ranging from 12 to 22°C in 2017, and 93% of the fish were harvested in waters within the15-18°C temperature range. More than 10 thousand albacore were measured. Fork lengths of these albacore varied from 50 to 96 cm with a single mode at 66-68 cm. There were 545 small and unmarketable albacore released in 2017, almost the same as in 2016. However, estimated mean weight of the released albacore was about 20% lower in 2017 than in 2016. Reported bycatch was 19 fish composed of five species.

There was a significant and positive correlation between albacore catch rates from the Canadian fishery and the North Pacific Gyre Oscillation (NPGO) indices with a time lag of 4 or 5 years, although it is unknown whether there is a causal relationship. Statistically, the NPGO explains about 35% of the variation in the catch rates. The major factor or factors regulating the abundance of albacore in the Canadian harvesting areas are unknown.

Discussion

It was explained that fishermen visually estimate the average weight of released undersized albacore, which is recorded in the logbooks. A comparison of the weight of retained catch estimated by vessel captains closely agrees with landed weights, which provides some confidence that the weight estimates of discarded fish should be reasonably accurate.

Low catch and CPUE in 2017 was likely due to the relative availability of fish in nearshore fishing grounds. Although still small in absolute terms, catch increased on the high seas compared to previous years and more vessels fished on the high seas.

Possible explanations for the correlation between the positive NPGO values and CPUE in the Canadian albacore fishery were discussed. The NPGO positively affects ocean production and thus may be a recruitment driver, producing a lagged effect on fishery CPUE. Analysis of the relationship between the NPGO and CPUE for specific year classes could shed further light on a possible relationship.

3.2 Chinese-Taipei

W. Wang presented the Chinese-Taipei National Report (**ISC/18/PLENARY/05**). 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 including harpoon, setnet, and gillnet 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 are composed of 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 SWO, MLS, BUM, BLM, and SFA) for longline fishery (including the catch of LTLL and STLL) in the North Pacific Ocean was 31,228 t in 2017. For the purse seine fishery, the total catch was 167,239 t in the whole Pacific Ocean in 2017.

For the LTLL fishery, Category I data are estimated based on logbooks and commercial data from individual fishing vessels. Categories II and III data are all compiled from logbook data. Fishermen are required to record the length and weight of the first 30 fish caught in each set. For the STLL fishery, the sources of Category I data include landings and auction records of local fish markets, reports of market sales, and electronic logbooks from individual fishing vessels. Category I, II and III data for the purse seine fishery are compiled from logbooks.

A catch documentation scheme (CDS) was established and implemented for vessels fishing for PBF in March 2010. In addition to prior authorization, fishing vessels targeting PBF are required to notify the relevant authority and attach a tag to every PBF caught. Moreover, port samplers are dispatched to measure length and weight of each PBF. Chinese-Taipei has also collected 1,480 PBF tissue samples in 2017 for the Close-Kin Mark Recapture project.

An observer program on the LTLL fleet has been implemented in the Pacific Ocean since 2002. The program has gradually expanded in recent years with an increasing number of observers recruited. The observers started deploying on the STLL fleet in 2012. Sixty-six observers were deployed on longline vessels in 2017 in total, including 15 observers for LTLL vessels, and 51 observers for STLL vessels.

Discussion

It was explained that the decline in the number of STLL vessels in 2017 resulted from a review by port city government of the target species of small longline vessels (<20 GRT) operating only in the Taiwan EEZ. The decline was due to the exclusion of non-tuna targeting vessels.

In 2017 Chinese Taipei substantially increased the number of observers it employs to meet its target of a 5% observer coverage rate across its fisheries.

In Tables 7 and 8 of the National Report, the minus sign indicates that the catch information is not available and the plus sign indicates cases where the estimated catch is less than 0.499 t.

3.3 Japan

H. Okamoto presented the Japan National Report (**ISC/18/PLENARY/06**). Japanese tuna fisheries consist of the three major fisheries (i.e., longline, purse seine, pole-and-line) and other miscellaneous fisheries including troll, drift-net, and set-net. This National Report describes recent trends in Japanese tuna fisheries in the North Pacific Ocean and updates the statistics given in the previous National Report for ISC17. The total catch of tunas (excluding skipjack) by Japanese fisheries in the North Pacific Ocean was 93,151 t in 2016 and 96,903 t in 2017. The total catch of tunas (including skipjack) by Japanese fisheries in the North Pacific Ocean was 246,894 t in 2016 and 228,229 t in 2017. The total catch of swordfish and striped marlin was 7,661 t in 2016 and 6,202 t in 2017. In addition to fisheries information, brief descriptions are provided of Japanese research activities on tuna and tuna-like species in the Pacific Ocean in 2017.

Discussion

The decline in albacore catch in the longline fishery was noted. This trend also was observed across a number of fisheries of ISC member countries.

The set-net catch of PBF increased substantially in 2017; although a large proportion of this catch was comprised age-0 and 1 fish, a wide range of age classes were caught in this fishery.

The definitions for the tuna purse seine and the small pelagic purse seine fisheries were explained. These fisheries are defined primarily by the size and species of fish that are targeted, although different nets may be used. Tuna purse seine fisheries target large PBF (> 30 kg) whereas the pelagic purse seine fisheries target small PBF (< 30 kg).

It was noted that the PBFWG is discussing how to integrate the PBF recruitment index developed by Japan from electronic monitoring data into future stock assessments and will be continuing these discussions at its next intersessional workshop.

Japan described its work on the close-kin genetic analysis of PBF. This research is being carried out independently of the ISC close-kin analysis project, although results will be fed back to ISC members. The importance of taking a common analytical approach among member countries engaged in close-kin research project was emphasized by other ISC members, because it is very difficult to calibrate results from different laboratories if a common set of analytical standards are not employed. It was noted that an ISC-sponsored workshop on close-kin analysis is planned for October 2018 to discuss possible common analytical standards and coordinate other aspects of the project.

3.4 Republic of Korea

D. Kim presented the Korea National Report (**ISC/18/PLENARY/07**). The Korea distant water fishery has two types of fishing gears that engage in fishing for tuna and tuna-like species in the Pacific Ocean: purse seine and longline. The total number of active vessels belonging to purse seine and longline fisheries in 2017 were 26 and 95, respectively. Total catch by the longline fishery in the North Pacific Ocean was 16,867 t, which is 6,000 t greater than in 2016. In contrast, purse seine catch in the North Pacific Ocean was 32,361 t in 2017, a sharp decrease to less than half the catch in 2016. The dominant species caught in the longline fishery were BET, which was more than 61% of the total catch; YFT, and BUM accounted for 22.4% and 8.6%, respectively. SKJ accounted for about 70% of the purse seine fishery catch. The PBF catch in 2017 was 734 t, and about 99% were caught by the offshore large purse seine fishery. The main fishing ground for PBF in Korean waters is around Jeju Island. Large PBF (≥30 kg) was 5% of the total PBF catch. Two hundred and forty-five PBF tissue samples were collected for close-kin analysis in 2017.

<u>Discussion</u>

The more northerly distribution of the Korean longline fishery in 2017 and the abrupt increase of longline effort in the North Pacific were noted. These changes in distribution and effort occurred because of difficulty with access agreements to EEZs, resulting in more catch in northern high seas areas. It was also noted that while Korean longline vessels operate in both the WCPO and EPO, purse seine vessels operate only in the WCPO.

Korea noted that an explanation for the decrease in purse seine catch between 2016 and 2017 is still being investigated.

3.5 Mexico

M. Dreyfus presented the Mexico National Report (**ISC/18/PLENARY/08**). The Mexican fleet primarily targets YFT and complements its catch with SKJ tuna. A small number of these vessels also participate each year in the PBF fishery and this catch is transferred to the fish farms in northwest Baja California Peninsula. The PBF commercial fishery has operated under an annual quota since 2012. Mexico has also provided size composition of its PBF catch from 2013 through 2017 to the assessment. Catch in 2017 was composed of 135 cm PBF and another group of 165 cm average size PBF. Mexico has sampled 750 PBF tin 2016 and 2017 for the Close Kin project.

No new Pacific shark fisheries catch information is available for recent years but Mexican scientists have started to participate actively in the ISC SHARKWG over the past 3 years, providing data and analysis for the shortfin mako and blue shark assessments.

Billfishes, except swordfish, are reserved for the sport fishery in Mexico since the 1980s. Most sport fishing activities are located in areas near the southern tip of the Baja California Peninsula.

This fishery is a catch and release fishery where most of the catch is dolphinfish (dorado; *Coryphaena hippurus*) and about 20% are billfishes, dominated by striped marlin.

Discussion

It was noted that the very short season for catching PBF is primarily a function of availability of fish to the fleet.

3.6 U.S.A.

M. Seki presented the United States National Report to the Plenary (**ISC/18/PLENARY/09**). The Pacific Ocean produces about 69% of the global tuna catch and about 79% of the tuna catch in the Pacific Ocean is from the Western Pacific Ocean (WPO). Purse seine gear accounts for 68.5% of the tuna catch, followed by longline (9%) and pole-and-line (7%). In 2017, there were 494 vessels in the U.S.A. albacore troll fishery in the North Pacific Ocean, the fewest since 1995 when there were 471 vessels. The 2017 albacore troll catch was 7,216 t. The number of vessels in the U.S.A. purse seine fishery in the North Pacific Ocean was 41 in 2017. Total U.S.A. purse-seine catch in the North Pacific Ocean was 60,542 t in 2017, a slight decrease from 2016. The catch consisted of 76% skipjack and 18% yellowfin tuna. The 2014-2017 catches are considered preliminary, because the species composition of juvenile YFT and BET have not been adjusted. U.S.A. longline fishing activity for BET and SWO has remained stable since 2014. In 2017, 145 longline vessels landed a total of 13,991 t, of which 7,984 t were BET, and 1,617 t were SWO.

Research highlights were provided on PBF foraging ecology, recreational size sampling efforts, reproductive biology and sizes in the eastern Pacific Ocean (EPO), PBF close-kin sample collection and a workshop planned for October 2018. Regarding non-target species, research on marine mammal interactions with the longline fisheries, use of observer data for ecosystem-based fisheries management, and post-release survival of sharks was also presented. Additionally, studies concerning the impact of climate change on North Pacific fisheries and historical shifts in the Hawaii-based deep set longline fishing effort were highlighted. Finally, two modeling developments were noted: a new stock assessment tool called JABBA (Just Another Bayesian Biomass Assessment) intended to be a transparent, reproducible, and customizable tool for use on fish stocks worldwide and an analysis calculating population-level fishing mortality for single- vs. multi-area models.

Discussion

It was explained that the purse seine fishery for PBF is a small coastal fishery occurring in southern California waters.

The shift of the longline fishery into the EPO was noted. In response, this shift can best be explained by fishermen's intuition on where fish are more abundant, which may be a function of changes in thermal structure across the north Pacific Ocean (NPO). It is also partially the result of reaching annual BET set quotas adopted by the WCPFC, but this shift began occurring before years that these quotas were reached.

It was clarified that the tags being used to assess post release mortality of sharks in the longline fishery are pop-off satellite archival tags affixed to the animal.

An increase in high seas fishing, like that described for the Canadian fishery, was observed in the US north Pacific ALB fishery in 2018. However, the explanation was thought to be more tightly aggregated fish in inshore areas resulting in crowding on the fishing grounds, which prompted some vessels to search offshore areas.

Wider application of the "Just Another Bayesian Biomass Assessment" (JABBA) platform is expected, because it is an open source application easily obtained off the World Wide Web. This allows for modeling techniques to be more transparent. Questions on the JABBA platform can be directed to Dr. Felipe Carvalho of NOAA.

4 REPORT OF THE CHAIRMAN

The ISC had another busy year since the ISC Plenary met in Vancouver, Canada, in July 2017. The year was spent completing the first benchmark stock assessment of shortfin mako shark, an update assessment for North Pacific bluefin tuna, a benchmark assessment of Western and Central Pacific Ocean Swordfish, advancing research collaborations with PICES, as well as advancing the management strategy evaluation process for North Pacific albacore tuna and undertaking preliminary workshops with managers and stakeholders to develop a management strategy evaluation (MSE) process for Pacific bluefin tuna. Finally, the process to formalize the structure/existence of the ISC continued, although not as quickly as hoped. While the ISC continues to advance its scientific integrity, we cannot afford to waiver from our scientific mission of providing the best available scientific information on northern stocks of highly migratory species. The ISC is an independent science-focused organization, which means we need to avoid the politics that sometimes infects international fisheries management, appoint leaders with proper scientific credentials, and continuously seek to improve the scientific excellence.

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. Seven intersessional workshops and two webinars were held to facilitate collaboration among Member scientists in implementing ISC work plans and coordinating research on the stocks. In addition, the ISC convened a workshop in Yokohama, Japan, to develop objectives in advance of a planned Pacific Bluefin Tuna Management Strategy Evaluation, completed the third international workshop on Management Strategy Evaluations for north Pacific albacore in October 2017 in Vancouver, BC, Canada, and held the third Shark Age and Growth Workshop in November 2017 that focused on shortfin mako shark age and growth in advance of the benchmark assessment for that species. We continue to address recommendations stemming from the 2013 peer review of the ISC function and look forward to the recommendations from the 2017 peer review of the ISC function and stock assessment. Jon Brodziak (U.S.A.) and Ren-Fen Wu (Chinese-Taipei) were re-elected for their second one-year terms as Chairs of the ISC Billfish and Statistics Working Groups, respectively, and Hidetada Kiyofuji (Japan) and Mikihiko Kai (Japan) were elected as Chairs of the ISC Albacore Working Group and the Shark Working Group for their first of many terms.

The past year was a transition year for the ISC leadership. The new leadership team of John Holmes (Chair) and Shui-Kai Chang (Vice-Chair) has relied on the former ISC Chair, Gerard DiNardo, for support and advice during this period. Managing ISC activities continues to be challenging because the 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. The Working Groups depend on in-kind contributions from Members who elect to participate in specific Working Groups, particularly those Members who serve as Chairs and Vice-Chairs. To date, support for the administration of ISC activities has been provided by the US, and to a lesser extent Canada, 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. This support is vital to the ability of the ISC to deliver its scientific mandate and is greatly appreciated. The effort to formalize the ISC through a Memorandum of Understanding (MOU) is moving forward and is expected to provide the necessary framework to address many of ISC operational concerns, including support for a fulltime Secretariat.

I am deeply grateful to the former ISC Chair for his efforts to significantly increase the scientific stature, commitment, and competency of ISC over the past seven years. These efforts have been richly rewarded largely due to the unwavering dedication and integrity of ISC scientists. At the same time, the breadth/scope of the organization’s research, scientific partnerships, and visibility have also expanded and flourished due to the persistence of its scientists. With your support, I hope to carry this process forward in the coming years.

My first year as ISC Chair has come and gone. 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 support of Shui-Kai Chang, Vice-Chairman, for his advice, and gentle prodding to do things is appreciated, as well as the services of Freddie Logan, Tarah Sullivan, and Stephanie Flores. Special thanks and appreciation are owed to the Chairs and Vice-Chairs of the working groups, namely Ren- Fen Wu, Jon Brodziak, Hidetada Kiyofuji and Steve Teo, Hideki Nakano and Shuya Nakatsuka, and Mikihiko Kai, who provided unselfish leadership in guiding the work of the Working Groups. In addition, the leadership role of Hiroaki Okamoto in guiding the Data Administrator and Webmaster, 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 writing, editing 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. Sarah along with Tarah Sullivan tag-teamed to keep me apprised of ongoing preparations and work of the ISC; I would be lost without them. Thanks to all of you for contributing to another successful year for ISC and for your support and service.

5 REPORT OF SPECIES WORKING GROUPS AND REVIEW OF ASSIGNMENTS

5.1 Albacore

H. Kiyofuji reported on the activities of the ALBWG over the past year (**ISC/18/ANNEX/04, 13**). The WG held the Third ISC Management Strategy Evaluation (MSE) workshop 19 – 20 October 2017 in Vancouver, Canada, to discuss the MSE framework for North Pacific albacore with 23 participants, managers, stakeholders, NGOs, and scientists from five countries and four different organizations (**ISC/18/ANNEX/04**). Two albacore workshops were held 20 – 21 October, 2017, in Vancouver, Canada, and 30 Apr – 5 May, 2018, in La Jolla, California, U.S.A. (**ISC/18/ANNEX/13**) to discuss development of the MSE operating model (OM). The WG agreed that the original work plan was overly ambitious and the MSE model runs would not be completed in time for the ISC Plenary in July 2018. Therefore, the WG decided to provide a progress report on the MSE work instead of a full MSE report. As part of the work plan after the ISC Plenary, the ALBWG agreed to hold a fourth MSE workshop with managers, stakeholders, NGO representatives, and scientists, mainly to (1) discuss preliminary MSE results in detail, (2) create a proposal for biological reference points and harvest control rules to present to the WCPFC-NC and IATTC based on those results, and (3) propose refinements to MSE.

The ALBWG proposed a schedule for 2018/19 as follows:

Date	**Location**	**Task/Event**
August 2018	Busan, Korea	SC14: provide MSE progress report
September 2018	TBD, Japan	NC14: provide MSE progress report
March 2019	Yokohama, Japan	Fourth ISC MSE workshop (tentative) ALBWG: to discuss MSE framework
November, 2019	Shimizu, Japan	ALBWG: data preparatory (tentative)
April, 2020	La Jolla, CA, U.S.A.	ALBWG: stock assessment (tentative)

Discussion

It was noted that a large number of OMs were suggested by stakeholders and developed by the WG. These OMs were reduced to a small subset of the initial list. Further explanation of how the alternative OMs were selected for the MSE was provided. In addition to excluding OMs that did not converge, those OMs that provided duplicative output were excluded.

It was acknowledged that presenting the MSE results in a way that will be understandable to managers and other stakeholders will be challenging.

Approaches for speeding up the MSE model runs were discussed, including reducing the number of alternative reference point combinations that are tested, at least initially, and increasing the computing resources available. It was noted that the harvest strategy adopted by the WCPFC Northern Committee (NC) focuses on the use of the MSE to identify a target reference point while a limit reference point has already been selected. Reporting progress to the Northern Committee (NC) on MSE development for ALB was discussed and it was noted that no specific results should be provided at this stage given that it is still at a developmental stage.

The MSE work plan was discussed. Specifically, it was agreed that if the initial round of MSE results cannot be produced by September 2019, then work on the MSE by the ALBWG will have to be put aside to focus on completing the next ALB stock assessment. However, the principal MSE modeler will not be involved in the assessment and could continue work on the MSE modeling work during this period, if necessary. It was also recognized that the ISC will have to consider how to respond to NC requests for further MSE work once the initial round is completed. This issue will likely have to be dealt with on a case-by-case basis when additional requests are made. The ISC must also consider how to interact with the IATTC in terms of reporting on results and fielding requests for additional MSE work.

5.2 Pacific Bluefin Tuna

5.2.1 Report of the Pacific Bluefin Tuna Workgroup

S. Nakatsuka reported on the activities of PBFWG over the past year (**ISC/18/ANNEX/09**). The PBFWG held a stock assessment workshop 5-12 March 2018 in La Jolla, California, U.S.A. The PBFWG conducts benchmark assessments every four years and update assessments at the mid-point between benchmark assessments; 2018 was an update assessment year. The update assessment was conducted with updated data for the latest two years (2015-2016) and the same assumptions and model structure as the 2016 assessment. The WG also reviewed the Japanese recruitment monitoring index.

The Harvest Strategy adopted by WCPFC (Harvest Strategy 2017-02) requests that the ISC provide catch reduction options if the projection results indicate that the initial rebuilding target will not be achieved or to provide relevant information for potential catch increases if the probability of achieving the initial rebuilding target exceeds 75%. The PBFWG noted that there was some difficulty interpreting this request and how to fulfill it. However, since the base case projection results show that the probability of achieving the PBF rebuilding targets exceeded the specified thresholds by 2024 and 2034, the PBF WG conducted additional projections to explore potential catch increases that could be implemented while still achieving the rebuilding targets within the timeframes and probabilities specified in the Harvest Strategy. These additional projection results are shown in Appendix 1 of the stock assessment (**ISC/18/ANNEX/14**).

H. Nakano, who served as PBFWG Chair since 2015, retired and the PBFWG Chair position is currently vacant. The PBFWG is planning to elect a new Chair at the next scheduled workshop.

The PBFWG proposed schedule for 2018/19 as follows:

Meeting	Dates	Location	Goals
WCPFC SC14	8-16 Aug. 2018	Busan, Korea	Report results of new assessment.
WCPFC NC14	3-7 Sep. 2018	Fukuoka, Japan	Report results of new assessment and MSE Workshop
WG Workshop	Feb.-Mar. 2019	Busan (?), Korea	Discuss the plan for benchmark assessment in 2020. Respond to requests from RFMOs.
MSE Workshop	2019	To Be Determined	Further develop MSE for PBF

<u>Discussion</u>

The PBFWG hopes to incorporate the recruitment index based on electronic monitoring data developed by Japan, into the next assessment if a thorough evaluation can be completed first. It should be noted, however, that this time series has relatively few data points at present.

5.2.2 First PBF Management Strategy Evaluation Workshop

G. DiNardo presented a summary report of the Pacific bluefin tuna MSE workshop sponsored by the ISC and Fisheries Research Agency, Japan, in Yokohama, Japan 30-31May 2018 (**ISC/18/ANNEX/08**). The request for a PBF MSE stems from the WCPFC Harvest Strategy on PBF (2017-02) adopted in 2017 in which the ISC is requested to initiate development of the MSE in 2019 with a completion date of 2024. The ISC was also requested to organize MSE workshops in early 2018 and 2019 to introduce MSE requirements to stakeholders. To facilitate development of the PBF MSE the WCPFC will provide the ISC with one candidate target reference point, two limit reference points, and one harvest control rule, as well as funds to hire two MSE experts, by 2019.

Approximately 70 stakeholders participated in the 2018 PBF MSE workshop. The objectives, benefits, and requirements for implementing MSEs were reviewed, as well as the roles and responsibilities of stakeholders and recent progress made by tuna-RFMOs towards adopting and implementing the MSE process. The role of the PBF MSE was clarified as evaluating long-term management strategies of PBF robust to perceived uncertainties, including environmental variability, while also evaluating current rebuilding strategies. While there were initial discussions on management objectives and performance indicators, finalizing them will require additional input from stakeholders. The organizational structure to advance development of the PBF MSE was discussed, including a potential partnership with NGOs to facilitate the educational component of MSE development. Future considerations and work plan to complete development of the PBF MSE were presented and discussed. Workshop participants agreed that MSE development is an iterative process and time consuming.

Discussion

The proposal to recruit NGOs to assist with stakeholder engagement with the PBF MSE was discussed. It was noted that presenting some aspects of the MSE is better done by scientists, but NGOs could potentially play a useful role with educating stakeholders about the MSE process and their roles and responsibilities concerning management objectives and performance indicators. It was agreed that such engagement with NGOs merits further consideration but the ISC would not commit to their role until a detailed proposal could be considered and NGOs consulted.

Although the inclusion of economic performance indicators into MSE is recognized as important to stakeholders, relevant economic performance indicators have not yet been identified; resource economists and fishermen could help with this task.

5.3 Billfish

J. Brodziak provided the BILLWG Report (**ISC/18/ANNEX/07/12/16**). The BILLWG held three meetings during the work cycle for providing assessment information and conservation advice for ISC18.

First, the BILLWG held a swordfish Data Preparation Workshop in Honolulu, U.S.A., for the 2018 benchmark Western and Central North Pacific Ocean SWO stock assessment in January 2018. Participants came from Japan, Taiwan, U.S.A., and the IATTC. Data for the SWO stock assessment in 2018, including catch by quarter data, standardized catch-per-unit effort data, size composition data by quarter, tagging data, and life history parameters, were reviewed.

The BILLWG work assignments addressed at the January 2018 workshop were:

1. Submit all outstanding catch, CPUE, and size composition data for the North Pacific swordfish stock assessment to the BILLWG Chair.
2. Provide draft working papers, noting that all working papers submitted at this meeting (n=10) will need to be finalized by February 13, 2018.
3. Prepare information, as needed, to make any corrections to the North Pacific swordfish catch, CPUE, and size composition data table for the April 2018 BILLWG stock assessment meeting.

The BILLWG agreed that the SWO base case SS ver. 3.30 model would incorporate the following features:

- Use a 1-area model for the Western Central North Pacific Ocean (WCNPO)
- Use 2 genders, females and males
- Use 4 seasons
- Use best available catch data
- Use best available standardized CPUE
- Use best available size composition data
- Use best available life history parameters

The BILLWG also agreed to conduct a set of sensitivity analyses similar to the analyses in the 2016 Pacific blue marlin assessment:

1. Sensitivity to natural mortality rate
2. Sensitivity to stock-recruitment resilience
3. Sensitivity to growth rate
4. Sensitivity to maturation rate

Last, at the January 2018 workshop the BILLWG agreed to conduct stochastic projections for the 2018 benchmark WCNPO SWO stock assessment to better inform fishery stakeholders about the risk of alternative decisions. Five future harvest scenarios were analyzed:

1. F Current Scenario with $F = F_{2013\text{-}2015} = F_{43\%}$
2. F at MSY Scenario with $F = F_{MSY} = F_{18\%}$
3. F at tropical tuna LRP Scenario with $F = F_{20\%SSB(F=0)} = F_{22\%}$
4. F High Scenario with $F = F_{20\%}$
5. F Low Scenario with $F = F_{50\%}$

Second, the BILLWG conducted a stock assessment modeling workshop for the 2018 benchmark WCNPO SWO stock assessment in Shimizu, Japan, during April 2018. Participants came from Japan, Taiwan, and U.S.A. Two working papers were provided, reviewed, and finalized. The goal of this workshop was to conduct modeling analyses for a benchmark stock assessment of the WCNPO SWO stock. These analyses included fitting the base case SS ver. 3.30 model, running sensitivity analyses, and conducting stock projections.

The primary work assignment to be addressed at the April 2018 workshop as defined in the January 2018 WG workshop report (**ISC/18/ANNEX/07**) was:

1. The WG will use the fishery statistics information agreed upon at the 2018 swordfish data preparation meeting report to construct the base case WCNPO swordfish stock assessment using the SS ver. 3.30.

Other work assignments to be addressed at the April 2018 workshop as defined in the January 2018 WG workshop report (**ISC/18/ANNEX/12**) included:

1. Update the 2014 Bayesian surplus production assessment model for the WCNPO swordfish using the new data for 2018; and
2. Conduct stochastic stock projections for the WCNPO swordfish stock under alternative harvest strategies.

Third, the BILLWG held a preparation workshop for the ISC18 Plenary Workshop in Yeosu, Republic of Korea, in July 2018. Participants came from Korea, U.S.A., WCPFC, Japan, and Taiwan. The BILLWG work assignments addressed at the July 2018 workshop included:

1. Review stock assessment results for the WCNPO swordfish stock and prepare presentation information for the ISC18 Plenary meeting;
2. Review and revise the draft ISC18 conservation advice for WCNPO swordfish stock, and Pacific blue marlin and WCNPO striped marlin, as needed;
3. Develop the BILLWG work plan for 2018-2019; and
4. Report on the election of Jon Brodziak as ISC Billfish WG Chair for 2018-2019.

BILLWG Work Plan for 2018-2019

The WG discussed future work and agreed to conduct a benchmark assessment of the WCNPO MLS stock in 2018-2019. This is the primary goal for the WG next year. The WG also agreed to the following work and research activities:

1. Develop the capacity to conduct stochastic projections for rebuilding plans using AGEPRO, i.e., http://nft.nefsc.noaa.gov/AGEPRO.html;
2. Improve information to characterize the seasonal spatiotemporal patterns of billfish stocks and fisheries;
3. Update the BILLWG web page information; and
4. Conduct assessment methods research, e.g., develop standardized software package to characterize the resilience of the stock-recruitment relationship.

Dates and Locations of BILLWG Intercessional Meetings 2018-2019:

- Hold data preparation teleconference calls in September, October, and November 2018;
- Hold the WCNPO striped marlin assessment data preparation meeting in Honolulu in early December 2018 or January 2019;
- Hold assessment modeling teleconference calls in January, February, and March 2019; and
- Hold the WCNPO MLS assessment modeling meeting in April 2019 at location TBD (La Paz? or Honolulu? or other).

Last, it was noted that Dr. Hirotaka Ijima was elected vice chair of the BILLWG.

Discussion

The benefits of using the AGEPRO modeling platform for the next WCNPO MLS stock assessment were discussed. This platform can be used to answer many pertinent management questions and can produce a wide variety of outputs.

Identifying management scenarios for the 2019 MLS stock assessment would best result from engagement with the WCPFC. Managers should be reminded of the current depleted status of the stock to spur engagement. As a starting point, it would be useful for the BILLWG Chair to discuss this with the NC Chair.

5.4 Shark

M. Kai, SHARKWG Chair, provided a summary of SHARKWG activities over the past year (**ISC/18/ANNEX/05/06/11**). The focus of the SHARKWG was on SMA with the goal of completing a benchmark North Pacific SMA stock assessment by ISC18. Full meetings of the SHARKWG since ISC17 were held in Shimizu, Japan (**ISC/18/ANNEX/06**), and La Jolla, California, U.S.A. (**ISC/18/ANNEX/11**). The SHARKWG also held two webinars between meetings to review data updates and plan for the SMA assessment and an aging workshop before the data preparation meeting to improve estimates of growth curves and other biological parameters (**ISC/18/ANNEX/05**). Other SHARKWG activities included a meeting of a modeling subgroup in advance of the full assessment workshop, and participation in a short meeting in advance of ISC18 to conduct administrative business and plan for the coming year. Canada, Chinese Taipei, Japan, Korea, Mexico, U.S.A., IATTC, and the WCPFC all actively participated in at least one SHARKWG meeting or webinar.

The SHARKWG Chair expressed appreciation to Japan for hosting the aging workshop and SMA data preparation meeting and to the U.S.A. for hosting the assessment workshop. Through the hard work of Working Group members at the meetings and during the intercessional webinars, the SHARKWG completed a very thorough and rigorous, fully-integrated SMA benchmark assessment that is based on the best available data for SMA (**ISC/18/ANNEX/15**).

The SHARKWG work plans for the intercessional period are focused on improvement the accuracy of assessments for BSH and SMA. The SHARKWG recognizes the difficulty in estimating shark catch and discards and the challenges presented by spatial segregation of pelagic sharks by size and sex. In addition, life history parameters for pelagic sharks are still rather uncertain. Work leading up to ISC19 will concentrate on improving catch and CPUE time series for SMA and BSH and advancing research on biological parameters for both sharks. In addition, the SHARKWG agreed to start collecting and compiling the fishery data (catch, CPUE, and size data) with spatial information (e.g. 10° x 10° squares) to conduct the stock assessment for BSH and SMA using an age-structured assessment model (SS) with spatial structure.

Former SHARKWG Chair Suzanne Kohin completed her final term and former Vice-Chair Mikihiko Kai of Japan was elected Chair of the SHARKWG in November 2017, Michael Kinney of U.S.A. was elected Vice-Chair of the SHARKWG in April 2018, and Yasuko Smeba of Japan was elected data manager. All will serve 3-year terms.

The SHARKWG established the following tentative meeting schedule:

- 6 – 12 Nov. 2018, Kaohsiung, Taiwan: Intersessional meeting to improve the fishery data, biological parameter and modeling methods.

Discussion

The ISC Chair requested a copy of the WCPFC Science Committee (SC) paper reviewing information upon which to base a decision on classifying BSH as a northern stock. Since the paper is still in draft form, there was reluctance to distribute it at this time. It was noted that the paper was inconclusive as to whether BSH should be classified as a northern stock, in part because the WCPFC Convention's criterion is vague, referring to stocks that occur "mostly" north of 20°N latitude. Without specification of a proportion constituting "mostly" it is difficult to reach a conclusion.

5.5 Biological Reference Point Update Task

In anticipation of requests for information on biological reference points to the species WGs, the ISC Chair tasked the WGs with updating the information in **ISC/10/PLENARY/04** as part of their work plans for 2018-2019.

6 STOCK STATUS AND CONSERVATION INFORMATION

6.1 Albacore

H. Kiyofuji, ALBWG Chair, summarized estimates of total catch in 2017 and recommendations on stock status and conservation for NPALB. The preliminary estimate of total catch in 2017 is 51,264 t (ISC and non-member countries combined – 48,836 t were caught by ISC members). While catch has been decreasing since 2012, an explanation for this decline is not available at present. The ALBWG Chair noted that the latest stock assessment was in 2017, and no new information was provided to update stock status and conservation information for this species. Therefore, the ALBWG recommends no changes to the stock status and conservation information provided by ISC17.

Discussion

The ISC Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC17 for NPALB (p. 31-40; ISC17 Plenary Report), except for the omission of accompanying figures and tables and slight clarification modifications if necessary. The recent downward trend in catches should be noted.

Stock Status and Conservation Information

The stock status and conservation information adopted by the ISC17 Plenary was endorsed and is reproduced below.

Stock Status

The following information on the status of the north Pacific albacore stock is provided:

1. **The stock is likely not overfished relative to the limit reference point adopted by the Western and Central Pacific Fisheries Commission (20%$SSB_{current\ F=0}$), and**

2. **No F-based reference points have been adopted to evaluate overfishing. Stock status was evaluated against seven potential reference points. Current fishing intensity ($F_{2012-2014}$) is below six of the seven potential reference points, except $F_{50\%}$.**

Conservation Information

1. **If a constant fishing intensity ($F_{2012-2014}$) is applied to the stock, then median female spawning biomass is expected to undergo a moderate decline, with a < 0.01% probability of falling below the limit reference point established by the WCPFC by 2025. However, expected catches in this scenario will be below the recent average catch level for this stock[2].**
2. **If a constant average catch ($C_{2010-2014}$ = 82,432 t) is removed from the stock in the future[3], then the decline in median female spawning biomass will be greater than in the constant F intensity scenario and the probability that SSB falls below the LRP will be greater by 2025 (30%). Additionally, the estimated fishing intensity will double relative to the current level ($F_{2012-2014}$) by 2025 as spawning biomass declines.**

6.2 Shortfin Mako Shark Assessment

F. Carvalho presented the first benchmark assessment of shortfin mako shark (*Isurus oxyrinchus*) in the North Pacific Ocean (**ISC/18/ANNEX/15**). The SMA stock was assessed using a length-based statistical catch-at-age Stock Synthesis model (SS Version 3.24U) fit to time series of standardized CPUE and sex-specific size composition data. Catch and size composition data were grouped into 17 fisheries and standardized CPUE data for five fleets were used to measure trends in relative abundance. Sex-specific growth curves and natural mortality rates were used to account for the sexual dimorphism of adult SMA. A Beverton-Holt stock recruitment relationship was used to characterize productivity of the stock based on plausible life history information available for North Pacific SMA. Models were fit to relative abundance indices and size composition data in a likelihood-based statistical framework. Sensitivity runs (20in total) were conducted to assess the influence of uncertainties related to the catch estimation, especially in the early period (1975-1993), the precision of the early Japan shallow-set CPUE index (1975-1993), initial conditions, and the stock recruitment relationship, on estimated biomass trends and fishing mortality levels.

SMA are distributed throughout the pelagic, temperate North Pacific Ocean and a single stock is assumed in the North Pacific Ocean based on evidence from genetics, tagging studies, and lower catch rates of SMA near the equator than in temperate areas. However, within the North Pacific Ocean some regional substructure is apparent as the majority of tagged SMA have been recaptured within the same region where they were originally tagged, and examination of catch

[2] Median future catch for the constant F scenario is expected to be below the average catch level for 2010-2014 (82,432 t). This result is likely due to low estimated recruitment in 2011, which is expected to reduce female SSB beginning in 2015, the first year of the projection period.

[3] It should be noted that the constant catch scenario is inconsistent with current management approaches for NPALB adopted by the IATTC and the WCPFC.

records by size and sex demonstrates some regional and seasonal segregation across the North Pacific.

The total reported catch of north Pacific SMA reached a peak of 7,068 mt in 1981 and then declined in the early 2000s, followed by a recovery in later years with catches fluctuating between 1,948 and 2,395 t since the early1990s (Figure 6-1). Drift gillnets have accounted for the highest catches of SMA early in the modeled catch time-series; however since 1993 catches are predominantly from longline fisheries.

Discussion

It was noted that an indicator-based analysis of the status of SMA was conducted in 2015, because fishery and biological information was lacking. The SHARKWG worked hard to compile time-series of catch, relative abundance, and sex-specific length composition from multiple fisheries for the period between 1975 and 2016. In addition, new biological information, and research into parameterization of the Beverton-Holt stock recruitment relationship enabled the development of a size-structured model. This work has contributed to a major advance in the assessment of the North Pacific SMA stock in 2018.

It was recommended that catch estimates from Korean and Taiwanese gillnet fisheries be included in future assessments.

The Plenary endorsed the North Pacific SMA stock assessment and considers it to be the best available scientific information for management decision-making.

Stock Status and Conservation Information

The reproductive capacity of the North Pacific SMA stock was calculated as spawning abundance (SA; i.e., number of mature female sharks) rather than spawning biomass, because the number of pups produced is not related to female size (i.e., larger female sharks do not produce more pups). Spawning potential ratio (SPR) was used to describe the impact of fishing on this stock. The SPR of this population is the ratio of SA per recruit under fishing to the SA per recruit under virgin (or unfished) conditions. Therefore, 1-SPR is the reduction in the SA per recruit due to fishing and can be used to describe the overall impact of fishing on a fish stock.

Recruitment was estimated on average to be 1.1 million age-0 sharks during the modeling timeframe (1975-2016) (Figure 6-2A). During the same period, the SA was estimated, on average, to be 910,000 sharks (Error! Reference source not found.). The current spawning bundance (SA_{2016}) was estimated to be 860,200 sharks (CV=46%) (Error! Reference source not found.) and was 36% (CV=30%) higher than the estimated spawning abundance at MSY (SA_{MSY}). The recent annual fishing intensity ($1\text{-}SPR_{2013\text{-}2015}$) was estimated to be 0.16 (CV=38%) and was 62% (CV=38%) of fishing intensity at MSY ($1\text{-}SPR_{MSY}$; 0.26) (Figure 6-2. Base case model estimates of shortfin make shark (Isurus oxyrinchus) (A) age-0 recruitment, (B) spawning abundance (SA; number of mature female sharks), and (C) fishing intensity (1-SPR), in the north Pacific Ocean during the 1975-2016 period. Error bars around recruitment estimates (A) show the 95% confidence intervals; and closed circle indicates recruitment under unfished conditions. Dashed lines in (B) show the 95% confidence intervals of SA; and closed circle and error bars indicate the estimated SA and 95% confidence intervals under unfished conditions

(SA_0). The blue solid line shows the estimate of SA at maximum sustainable yield (SA_{MSY}) in the base case model. Dashed lines in (C) show the 95% confidence intervals. Blue solid line is the estimate of fishing intensity (1-SPR) at maximum sustainable yield (1-SPR_{MSY}).**Error! Reference source not found.**.

Stock Status

Based on these findings, the following information on the status of the SMA stock is provided:

1. **Target and limit reference points have not been established for pelagic sharks in the Pacific Ocean. Stock status is reported in relation to MSY.**
2. **The results from the base case model show that, relative to MSY, the North Pacific shortfin mako stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring relative to MSY-based abundance and fishing intensity reference points (Error! Reference source not found.**3A**).**

Stock status was also examined under six alternative states of nature that represented the most important sources of uncertainty in the assessment. Results of these models with alternative states of nature were consistent with the base case model and showed that, relative to MSY, the SMA stock is likely (>50%) not in an overfished condition and overfishing is likely (>50%) not occurring (Error! Reference source not found.B**).**

Conservation Information

Stock projections of biomass and catch of SMA from 2017 to 2026 were performed assuming three alternative constant fishing mortality scenarios: 1) status quo, average of 2013-2015 ($F_{2013-2015}$); 2) $F_{2013-2015}$ + 20%; and 3) $F_{2013-2015}$ - 20% (Figure 6-4).

Based on these future projections, the following conservation information is provided:

1. **If fishing mortality remains constant at $F_{2013-15}$ or is decreased 20%, then the SA is expected to increase gradually;**
2. **If fishing mortality is increased 20% relative to $F_{2013-2015}$, then the SA is expected to decrease in the final years of the projection.**
3. **It should be noted that, given the uncertainty in fishery data and key biological processes within the model, especially the stock recruitment relationship, the models' ability to project into the future is highly uncertain.**

Research Needs

There is uncertainty in the estimated historical catches of SMA. Substantial time and effort was spent on estimating historical catch and more work remains to be conducted. In particular, the SHARKWG identified two future improvements that are critical: 1) identify all fisheries that catch SMA in the NPO, including fisheries that catch SMA not previously identified by the SHARKWG; and 2) methods to estimate SMA catches should be improved, especially for the early period from 1975 to 1993.

Table 6-1. Summary of reference points and management quantities for the shortfin mako shark (*Isurus oxyrinchus*) base case model. The percentages in brackets are the CV of the estimated quantity in the base case model.

Management Quantity	**Symbol**	**Units**	**Basecase**
Spawning abundance (number of mature female sharks	SA_0	1000s of sharks	1465.8 (23.3%)
Maximum Sustainable Yield (MSY)	C_{MSY}	Metric tonnes (t)	3127.1 (22.2%)
Spawning Abundance at MSY	SA_{MSY}	1000s of sharks	633.7 (23.3%)
Fishing Intensity at MSY	$1\text{-}SPR_{MSY}$	NA	0.26
Current spawning abundance relative to MSY	$SA2016/SA_{MSY}$	NA	1.36
Current spawning abundance relative to unfished level	SA_{2016}/SA_0	NA	0.58
Recent fishing Intensity relative to MSY	$(1\text{-}SPR_{2013\text{-}15})/(1\text{-}SPR_{MSY})$	MSY	0.62

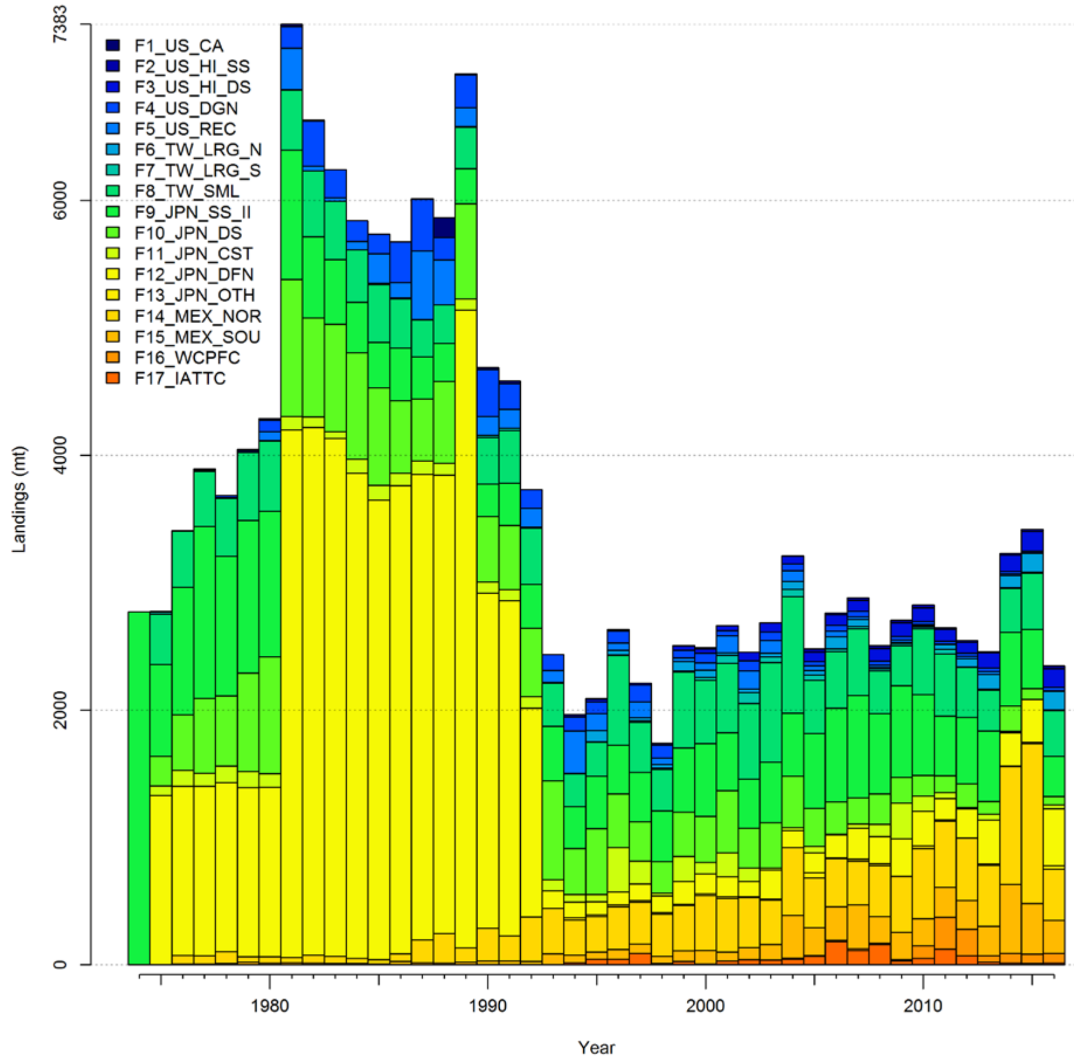


Figure 6-1. Total catch (total dead removals) of North Pacific shortfin mako shark (*Isurus oxyrinchus*) by fleet (1975-2016).

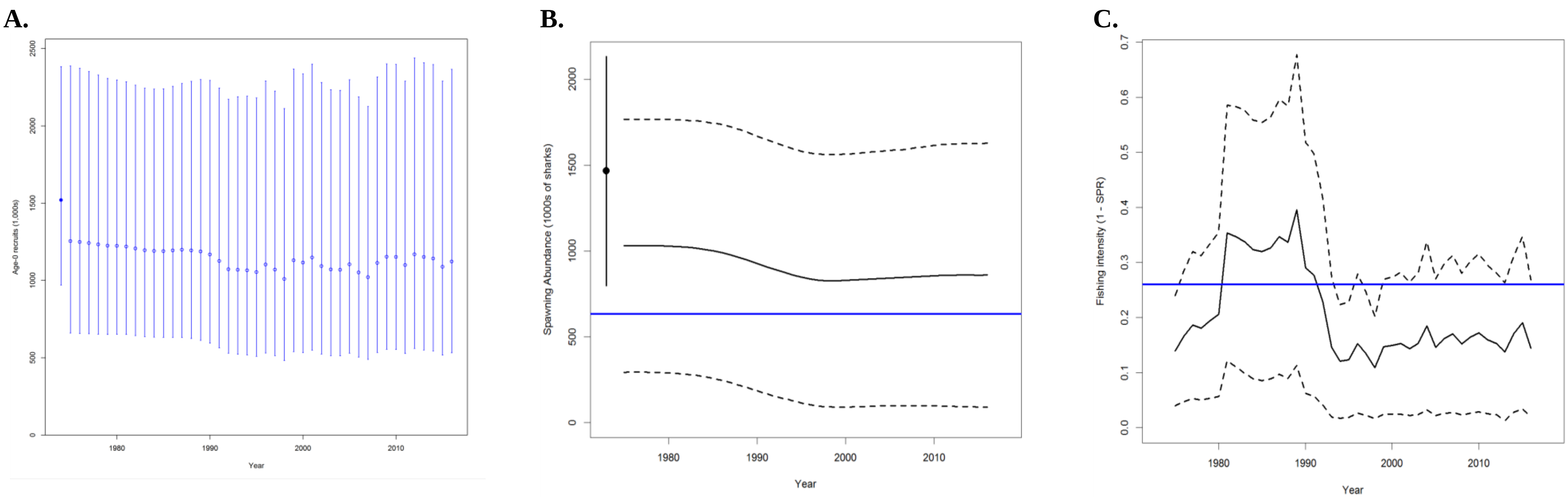


Figure 6-2. Base case model estimates of shortfin mako shark (Isurus oxyrinchus) (A) age-0 recruitment, (B) spawning abundance (SA; number of mature female sharks), and (C) fishing intensity (1-SPR), in the north Pacific Ocean during the 1975-2016 period. Error bars around recruitment estimates (A) show the 95% confidence intervals; and closed circle indicates recruitment under unfished conditions. Dashed lines in (B) show the 95% confidence intervals of SA; and closed circle and error bars indicate the estimated SA and 95% confidence intervals under unfished conditions (SA_0). The blue solid line shows the estimate of SA at maximum sustainable yield (SA_{MSY}) in the base case model. Dashed lines in (C) show the 95% confidence intervals. Blue solid line is the estimate of fishing intensity (1-SPR) at maximum sustainable yield ($1\text{-}SPR_{MSY}$).

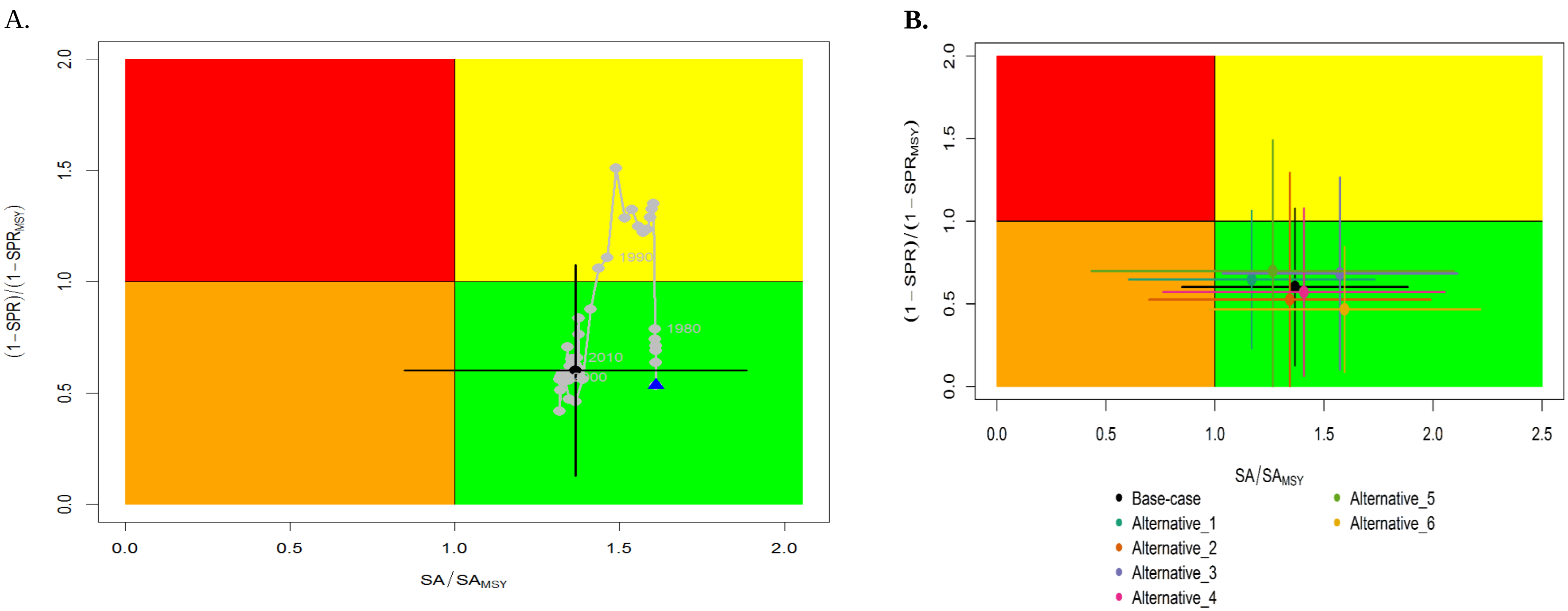


Figure 6-3. Kobe plots of shortfin mako shark in the North Pacific Ocean showing (A) the time series of the ratio of SA to SA at MSY (SA_{MSY}) and fishing intensity to fishing intensity at MSY ($1\text{-}SPR_{MSY}$), and (B) the same ratios for the terminal year (2016) for six alternative states of nature. SA is spawning abundance measured as the number of mature females. Fishing intensity is estimated as 1-SPR. Values for the start (1975) and end (2016) years in the time series (A) are indicated by the blue triangle and black circle, respectively. Black error bars are 95% confidence intervals. Gray numbers indicate selected years. Alternative states of nature in (B) include: Alternative_1) higher catch, Alternative_2) lower catch; Alternative_3) higher uncertainty on Japan shallow-set CPUE index (1975-1993) (CV=0.3); Alternative_4) fit to Japan offshore distant water longline shallow-set fleet (JPN_SS_I; 1975-2016) and Hawaii longline shallow-set fleet (US_SS; 2005-2016), and no fit to initial equilibrium catch; Alternative_5) low steepness, h=0.260; and Alternative_6) high steepness, h=0.372. Solid lines indicate 95% confidence intervals.

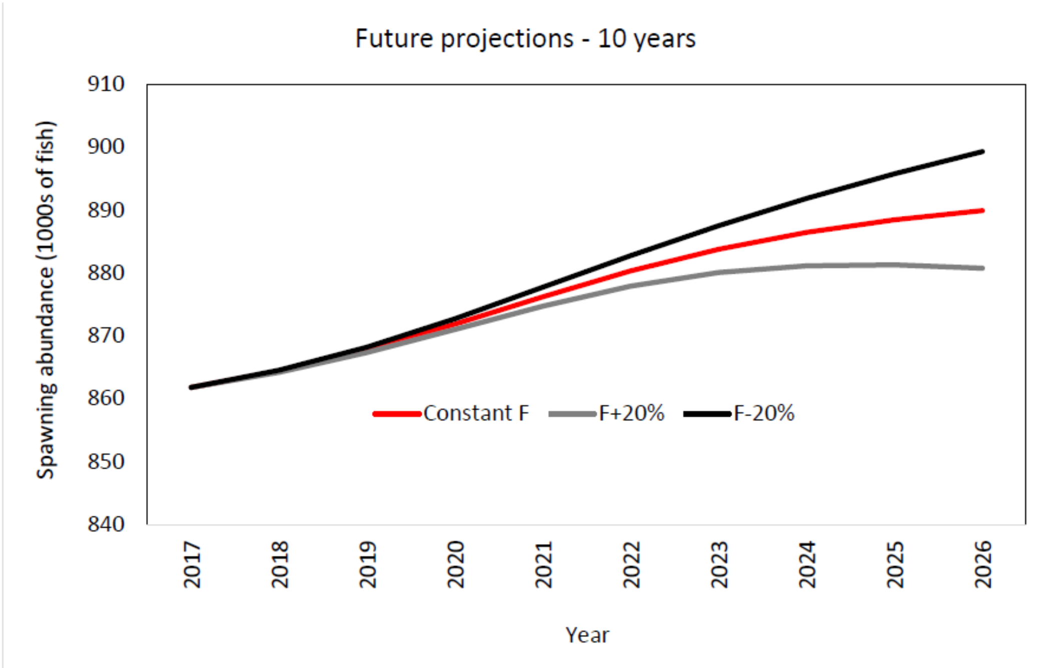


Figure 6-4. Comparison of future projected North Pacific shortfin mako (*Isurus oxyrinchus*) spawning abundance under different F harvest policies (Constant F $_{2013\text{-}2015}$, +20%, -20%) using the base case model. Constant F was based on the average from 2013-2015.

6.3 Blue shark

M. Kai noted that a BSH stock assessment was not conducted by the SHARKWG in 2017-2018.

Discussion

The ISC Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC17 for BSH (see pp. 40-44 in the ISC17 Plenary Report), except for the omission of accompanying figures and tables and including slight clarifying modifications as necessary.

Stock Status and Conservation Information

Stock Status

Target and limit reference points have not yet been established for pelagic sharks by the WCPFC or the IATTC, the organizations responsible for management of pelagic sharks caught in international fisheries for tuna and tuna-like species in the Pacific Ocean.

Results of the reference case model showed that the spawning stock biomass was near a time-series high in the late 1970s, declined to its lowest level between 1990 to 1995, subsequently increased gradually to reach the time-series high again in 2005, and has since shown small fluctuations with no apparent trend (see **ISC/17/ANNEX/13**, Figure 7-8B) close to the time-series high. Recruitment has fluctuated around 37,000,000 age-0 sharks annually with no apparent trend (see **ISC/17/ANNEX/13**, Figure 7-8 A). Stock status is reported in relation to maximum sustainable yield (MSY) based reference points. Based on these findings, the following information on the status of the North Pacific blue shark stock is provided:

1. **Female spawning biomass in 2015 (SSB_{2015}) was 69% higher than at MSY and estimated to be 295,774 t (ISC/17/ANNEX/13, Table 7-2; Figure 7-8);**
2. **The recent annual fishing mortality ($F_{2012-2014}$) was estimated to be well below F_{MSY} at approximately 38% of F_{MSY} (ISC/17/ANNEX/13, Table 7-2; Figure 7-8); and**
3. **The reference run produced terminal conditions that were predominately in the lower right quadrant of the Kobe plot (not overfished and overfishing not occurring) (ISC/17/ANNEX/13, Figure 7-9).**

Conservation Information

Future projections under different fishing mortality (F) harvest policies (status quo, +20%, -20%, F_{MSY}) show that median BSH spawning biomass in the North Pacific will likely remain above SSB_{MSY} in the foreseeable future (**ISC/17/ANNEX/13**, Table 7-3, Figure 7-10). Other potential reference points were not considered in these evaluations.

Research Needs

Improvements in the monitoring of blue shark catches and discards, through carefully designed observer programs and species-specific logbooks, as well as continued research into the fisheries, biology, and ecology of blue shark in the North Pacific are recommended.

6.4 Western and Central North Pacific Swordfish Assessment

J. Brodziak, Chair of the BILLWG, noted that North Pacific swordfish was comprised of two separate stocks (Figure 6-5) and he presented the new benchmark stock assessment that was conducted for the Western and Central North Pacific Ocean (WCNPO) swordfish stock by the BILLWG in 2017-2018 (**ISC/18/ANNEX/16**). It was also noted that there was no new stock assessment information for the Eastern Pacific Ocean (EPO) swordfish stock.

The WCNPO swordfish stock area consists of waters of the North Pacific Ocean contained in the boundaries north of the equator and west of the diagonal purple line in Figure 6-5 labeled stock Area 1. All available fishery data from this area were used for the stock assessment. It was assumed that there was an instantaneous mixing of fish throughout the stock area on a quarterly basis so that observations of CPUE and size composition data could be modeled.

WCNPO swordfish catches exhibited a variable trend and averaged about 12,933 t during 1975-1999. Annual catches increased to an average of 14,343 t during 2000-2009 and have declined to an average of 10,498 t since 2010. Since the 1980s catches by the Japanese and Chinese Taipei fleets have decreased while catches by the US and other WCPF) and IATTC countries have increased (Figure 6-6). Overall, longline gear has accounted for the majority of Western and Central North Pacific Ocean SWO catches since the 1970s.

Catch and size composition data were collected from ISC countries (Japan, Taiwan, and U.S.A.), IATTC member countries, and the WCPFC (**ISC/18/ANNEX/16**, Table 6-1). Standardized CPUE data used to measure trends in relative abundance were provided by Japan, U.S.A., and Chinese Taipei. The WCNPO swordfish stock was assessed using an age-, length-, and sexstructured assessment Stock Synthesis (SS) 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 swordfish. The value for stock-recruitment steepness used for the base case model was *h* = 0.9. 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 natural mortality rate, the stock-recruitment steepness, the growth curve parameters, and the female age at 50% maturity.

Biological reference points were computed for the base case model with SS (Table 6-3). The point estimate of maximum sustainable yield was MSY =14,941 t. The point estimate of the spawning stock biomass to produce MSY (adult female biomass) was SSB_{MSY} = 15,702 t. The point estimate of F_{MSY}, the fishing mortality rate to produce MSY (average fishing mortality on ages 1 to 10) was F_{MSY} = 0.17 yr^{-1} and the corresponding equilibrium value of spawning potential ratio at MSY was SPR_{MSY} = 18%.

Discussion

The reasons for using a fully integrated model (Stock Synthesis) instead of a production model were discussed.

It was recommended that the summary include an explanation for the difference between the estimates of MSY in the current assessment and the previous assessment, which is due to the fact that this assessment used female SSB while the estimate in the previous assessment was based on exploitable biomass (age 2+ fish).

It was agreed to add sections describing projections of stock status under alternative harvest scenarios and future research needs.

The ISC Plenary endorsed the WCNPO SWO stock assessment and considers it to be the best available scientific information for management decision-making.

Stock Status and Conservation Information for the Stock

Stock Status

Estimates of total stock biomass show a relatively stable population, with a slight decline until the mid-1990s followed by a slight increase since 2000. Population biomass (age-1 and older) averaged roughly 97,919 t in 1974-1978, the first 5 years of the assessment time frame, and has declined by only 20% to 71,979 t in 2016 (Figure 6-7). Female spawning stock biomass was estimated to be 29,403 t in 2016, or about 90% above SSB_{MSY} (**Error! Reference source not ound.** and Table 6-3). Fishing mortality on the stock (average F, ages 1 – 10) averaged roughly F = 0.08 yr^{-1} during 2013-2015, or about 45% below F_{MSY}. The estimated SPR (the predicted spawning output at the current F as a fraction of unfished spawning output) is currently SPR_{2016} = 45%. Annual recruitment averaged about 717,000 recruits during 2012-2016, and no long-term trend in recruitment was apparent. Overall, the time series of spawning stock biomass and recruitment estimates indicate a stable spawning stock biomass and suggest a fluctuating pattern without trend for recruitment (Figure 6-7). The Kobe plot depicts the stock status relative to MSY-based reference points for the base case model (Figure 6-8) and shows that spawning stock biomass declined to almost the MSY level in the mid-1990s, but SSB has remained above SSB_{MSY} throughout the time series (**Error! Reference source not found.**).

For this 2018 benchmark assessment, note that biomass status is based on female spawning stock biomass, whereas for the 2014 update assessment, biomass status was based on exploitable biomass (effectively age-2+ biomass). It is also important to note that there are no currently agreed upon reference points for the WCNPO swordfish stock and that retrospective analyses show that the assessment model appears to underestimate spawning stock biomass in recent years.

Based on these findings, the following information on the status of the WCNPO SWO stock is provided:

1. **The WCNPO swordfish stock has produced annual yields of around 10,200 t per year since 2012, or about 2/3 of the MSY catch amount.**
2. **There is no evidence of excess fishing mortality above F_{MSY} ($F_{2013-2015}$ is 45% of F_{MSY}) or substantial depletion of spawning potential (SSB_{2016} is 87% above SSB_{MSY}).**
3. **Overall, the WCNPO swordfish stock is not likely overfished and is not likely experiencing overfishing relative to MSY-based or 20% of unfished spawning biomass-based reference points.**

Conservation Information

Stock projections were conducted using a two-gender projection model. The five stock projection scenarios were: (1) F status quo, (2) F_{MSY}, (3) F at 0.2*$SSB_{(F=0)}$, (4) $F_{20\%}$, and (5) $F_{50\%}$ (Figure 6-9). These projection scenarios were applied to the base case model results to evaluate the impact of alternative levels of fishing intensity on future spawning biomass and yield for swordfish in the Western and Central North Pacific Ocean. The projected recruitment pattern was generated by stochastically sampling the estimated stock-recruitment model from the base case model. The projection calculations employed model estimates for the multi-fleet, multi-season, size- and age-selectivity, and structural complexity in the assessment model to produce consistent results.

Based on these findings, the following conservation information is provided:

1. **The results show that projected female spawning biomasses is expected to increase under all of the harvest scenarios (Table 6-4 and Figure 6-9), with greater increases expected under lower fishing mortality rates.**
2. **Similarly, projected catch is expected to increase under each of the five harvest scenarios, with greater increases expected under higher fishing mortality rates (Table 6-4 and Figure 6-9).**

Research Needs

The lack of sex-specific size composition data and the simplified treatment of the spatial structure of swordfish population dynamics remained as two important sources of uncertainty for this benchmark assessment.

Table 6-2. Reported catch (t) used in the stock assessment along with annual estimates of population biomass (age-1 and older, mt), female spawning biomass (mt), relative female spawning biomass (SSB/SSB_{MSY}), recruitment (thousands of age-0 fish), fishing mortality (average F, ages 1 to 10, yr^{-1}), relative fishing mortality (F/F_{MSY}), and spawning potential ratio of WCNPO swordfish.

Year	2010	2011	2012	2013	2014	2015	2016	Mean[1]	Min[1]	Max[1]
Reported Catch	12,716	9,971	10,608	9,241	9,211	11,672	10,068	12,863	9,211	17,793
Population Biomass	66,417	66,087	68,117	67,885	69,560	71,951	71,979	67,487	51,856	97,919
Spawning Biomass	26,136	26,448	26,569	27,546	28,580	28,865	29,404	24,442	17,191	44,100
Relative Spawning Biomass	1.66	1.68	1.69	1.75	1.82	1.84	1.87	1.56	1.09	2.81
Recruitment (age 0)	789	565	671	710	683	742	781	761	401	1241
Fishing Mortality	0.10	0.08	0.09	0.07	0.07	0.09	0.07	0.12	0.07	0.18
Relative Fishing Mortality	0.57	0.46	0.51	0.44	0.40	0.51	0.44	0.72	0.40	1.05
Spawning Potential Ratio	38%	41%	39%	45%	47%	39%	45%	29%	17%	47%

[1] During 1975-2016

Table 6-3. Estimates of biological reference points along with estimates of fishing mortality (F), spawning stock biomass (SSB), recent average yield (C), and SPR of WCNPO swordfish, derived from the base case model assessment model, where "MSY" indicates reference points based on maximum sustainable yield.

Reference Point	Estimate
F_{MSY}	0.17 yr^{-1}
$F_{0.2*SSB(F=0)}$	0.16 yr^{-1}
$F_{2013-2015}$	0.08 yr^{-1}
SSB_{MSY}	15,702 mt
SSB_{2016}	29,403 mt
$SSB_{F=0}$	97,286 mt
MSY	14,941 mt
$C_{2012-2016}$	10,160 mt
SPR_{MSY}	18%
SPR_{2016}	45%

Table 6-4 Projected values of WCNPO swordfish spawning stock biomass (SSB, mt) and catch (mt) under five constant fishing mortality rate (F, yr^{-1}) scenarios during 2017-2026.

Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Scenario 1: F = $F_{2013-2015}$										
SSB	32,118	33,207	34,599	35,476	36,270	37,082	37,951	38,967	40,083	41,087
Catch	8,851	9,135	9,407	9,599	9,794	10,022	10,275	10,595	11,053	11,142
Scenario 2: F = F_{MSY}										
SSB	28,267	23,963	21,443	19,458	18,303	17,618	17,293	17,197	17,253	17,263
Catch	20,885	18,323	16,509	15,294	14,666	14,353	14,308	14,520	14,650	14,348
Scenario 3: F = F20%SSB(F=0)										
SSB	28,425	24,384	21,800	19,735	18,530	17,874	17,496	17,586	17,818	17,779
Catch	20,691	18,122	16,454	15,261	14,653	14,361	14,319	14,554	14,665	14,384
Scenario 4: F = $F_{20\%}$										
SSB	29,007	25,431	23,527	21,763	20,736	20,131	19,893	19,883	19,981	20,066
Catch	18,680	16,933	15,657	14,726	14,242	14,033	14,050	14,292	14,496	14,253
Scenario 5: F = $F_{50\%}$										
SSB	32,559	34,334	36,290	37,666	38,836	39,984	41,148	42,490	44,049	45,625
Catch	7,556	7,973	8,343	8,605	8,847	9,101	9,366	9,692	10,087	10,223

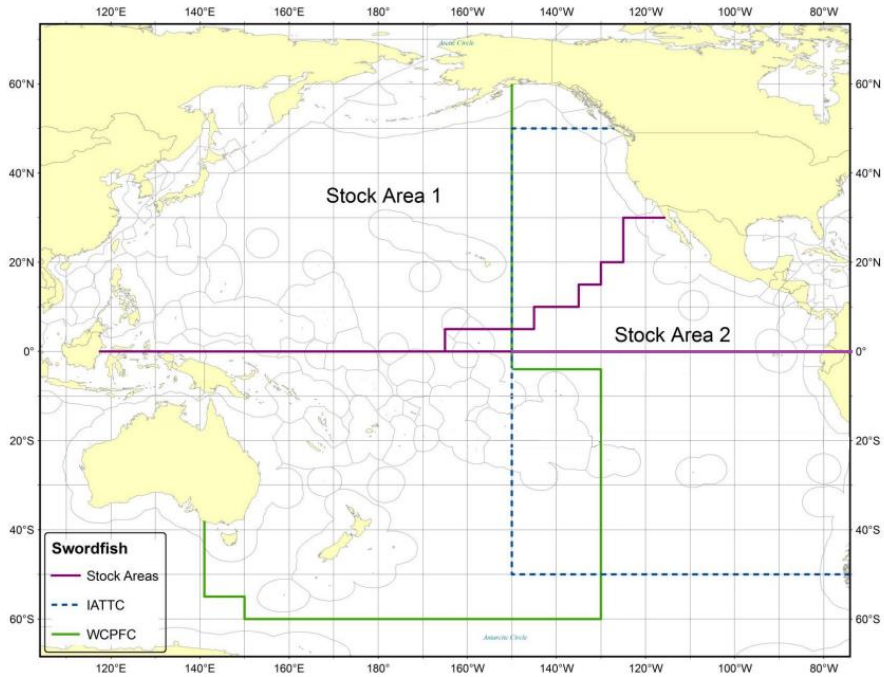


Figure 6-5. Stock boundaries used for this assessment of North Pacific Ocean swordfish: purple lines indicate stock area divisions; stock area 1 was assessed as the WCNPO stock, stock area 2 contains the Eastern Pacific Ocean stock, the green line indicates Western Central Pacific Fisheries Commission convention area, blue dashed line indicates IATTC convention area.

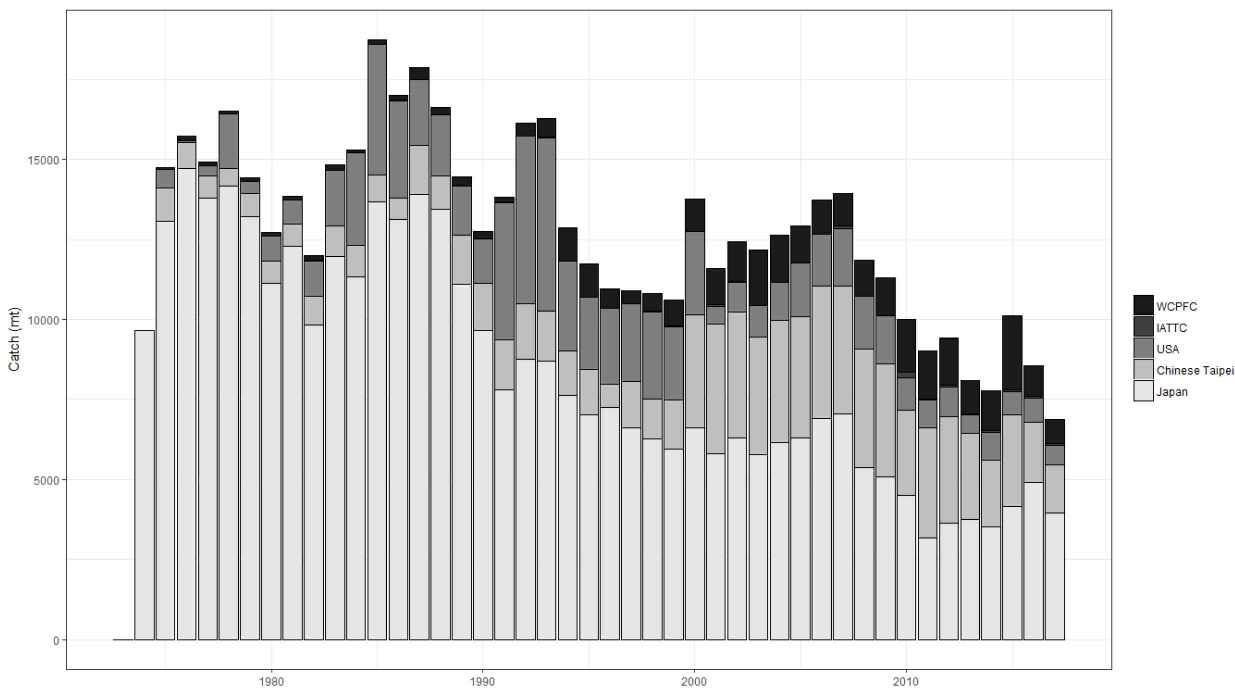


Figure 6-6. Annual catch biomass (t) of WCNPO swordfish (*Xiphias gladius*) by country for Japan, Chinese Taipei, the U.S.A., and all other countries during 1975-2016.

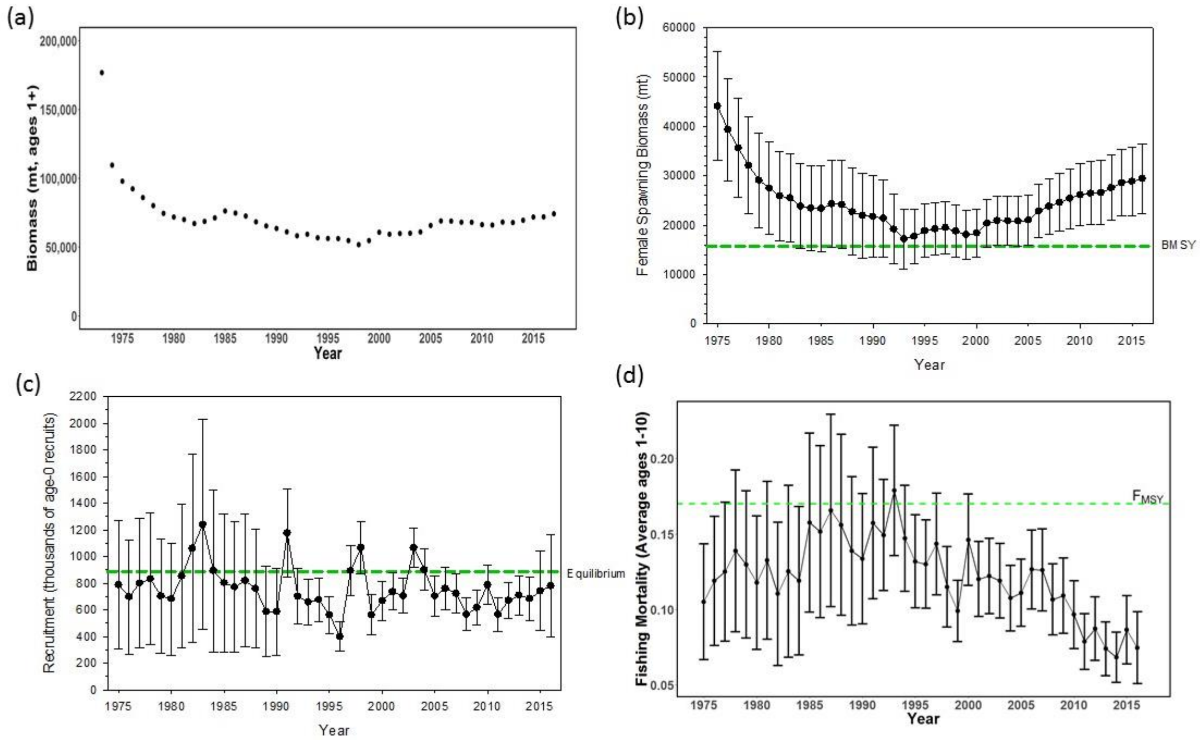


Figure 6-7. Time series of estimates of (a) population biomass (age 1+) (first point in time series represents unfished biomass), (b) spawning biomass, (c) recruitment (age-0 fish), and (d) instantaneous fishing mortality (average for ages 1 to 10, yr^{-1}) for WCNPO swordfish (*Xiphias gladius*) derived from the 2018 stock assessment. The solid circles are the maximum likelihood estimates by year for each quantity and the error bars represent the uncertainty of the estimates (80% confidence intervals), green dashed lines indicate B_{MSY}, equilibrium recruitment, and F_{MSY} except for the population biomass time series.

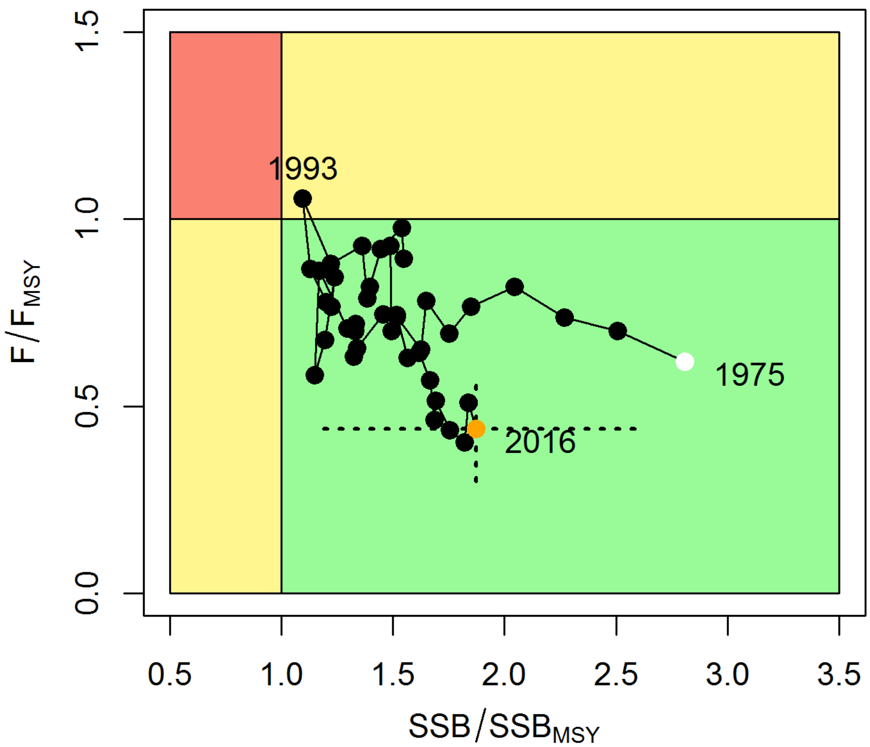


Figure 6-8. Kobe plot of the time series of estimates of relative fishing mortality (average of ages 1-10) and relative spawning stock biomass of WCNPO swordfish (*Xiphias gladius*) during 1975-2016. The white circle denotes the first year (1975) and the yellow circle denotes the last year (2016) of the assessment time horizon. The dashed lines represent the 95% confidence intervals around the 2016 estimate.

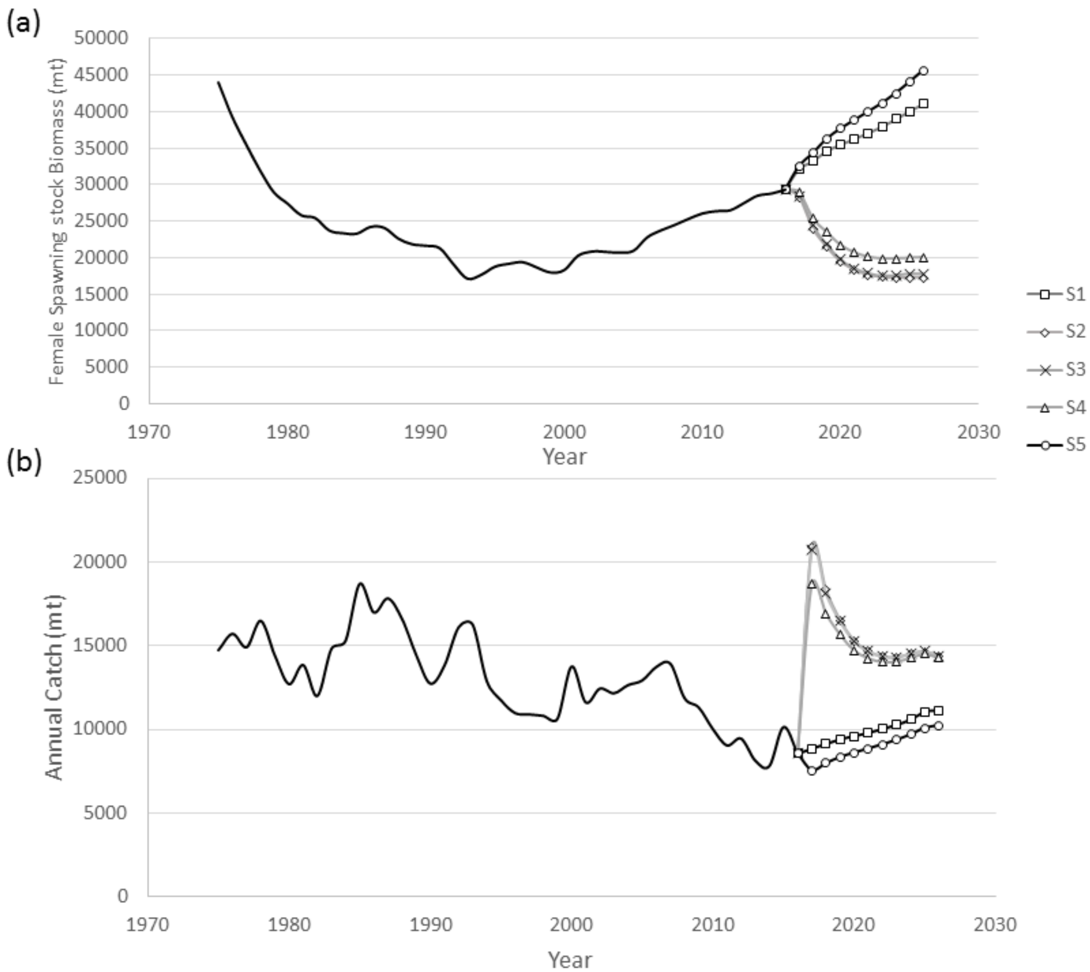


Figure 6-9. Historical and projected trajectories of (a) spawning stock biomass and (b) total catch from the WCNPO swordfish base case model. Stock projection results are shown for S1 = the status quo or average fishing intensity during 2013-2015 ($F_{2013-2015} = F_{43\%}$); S2 = F_{MSY} ($F_{18\%}$); S3 = F to produce 20% of unfished spawning stock biomass or $F_{0.2*SSB(F=0)}$ ($F_{22\%}$); S4 = the highest 3-year average F during 1975-2016 or High F ($F_{20\%}$); S5 = Low F ($F_{50\%}$).

6.5 Eastern Pacific Ocean Swordfish

J. Brodziak, Chair of the BILLWG, noted that the eastern Pacific Ocean (EPO) SWO stock was last assessed in 2014.

Discussion

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC17 (see pp. 45-47 in the ISC17 Plenary Report) unchanged, except for the omission of accompanying figures and tables and slight clarifying modifications.

Stock Status and Conservation Information

Stock Status

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} (exploitable biomass, age-2+). 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.

Based on these findings, the following information on the status of the EPO SWO stock is provided:

1. **No target or limit reference points have been established for the EPO swordfish stock under the auspices of the IATTC**
2. **The Kobe plot shows that overfishing likely occurred (>50%) in a few years relative to MSY-based reference points, but may have occurred (<50%) from 2010 to 2012.**
3. **There was a 55% probability that overfishing occurred in 2012, but there was a less than 1% probability that the stock was overfished relative to MSY-based reference points.**

Conservation Information

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. 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 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. 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.

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. 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.

Based on these findings, the following conservation information is provided:

1. **For the EPO SWO stock, overfishing may have occurred (<50%) 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.**
2. **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.**

6.6 Western and Central North Pacific Striped Marlin

J. Brodziak noted that a WCNPO MLS stock assessment was not conducted by the BILLWG in 2017-2018.

Discussion

The ISC Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC17 for MLS (p. 47-48 ISC17 Plenary Report), except for the omission of accompanying figures and tables and slight clarification modifications if necessary.

Stock Status and Conservation Information

Stock Status

Estimates of population biomass of the WCNPO MLS exhibit a long-term decline. Population biomass (age-1 and older) averaged roughly 20,513 t, or 46% of unfished biomass during 1975-1979, the first five 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). Fishing mortality on the stock (average F on ages 3 and older) is currently high and averaged roughly F = 0.94 during 2010-2012, or 49% above F_{MSY}. The predicted value of the SPR (the predicted spawning output at current F as a fraction of unfished spawning output) is currently $SPR_{2010-2012}$ = 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.

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, except in 2010. Changes in recent size composition data relative to the previous assessment resulted in changes in fishery selectivity estimates and also affected recruitment estimates. These changes, in turn, affected the scaling of biomass and fishing mortality to reference levels.

Based on these findings, the following information on the status of the WCNPO MLS stock is provided:

1. **No target or limit reference points have been established for the WCNPO striped marlin stock under the auspices of the WCPFC.**
2. **When MLS is evaluated relative to MSY-based reference points, the 2013 spawning stock biomass is 61% below SSB_{MSY} (2,819 t). Therefore, the MLS stock is likely overfished.**
3. **The 2010-2012 fishing mortality exceeds F_{MSY} by 49%. Therefore, overfishing is likely occurring relative to MSY-based reference points.**

Conservation Information

The stock has been experiencing overfishing since 1977, except in 1982 and 1983, and fishing appears to be impeding rebuilding, especially if recent (2007-2011) low recruitment levels persist.

Based on these findings, the following conservation information is provided:

1. **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.**
2. **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.**
3. **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.**

6.7 Pacific Blue Marlin

J. Brodziak noted that a BUM stock assessment was not conducted by the BILLWG in 2017-2018.

Discussion

The Plenary reviewed and agreed to forward the stock status and conservation information statements adopted at ISC17 for BUM (see pp. 47-48 in the ISC17 Plenary Report), except for the omission of accompanying figures and tables, and slight clarifications if needed.

Stock Status and Conservation Information

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 five years of the assessment time frame, and has declined by approximately 40% to 78,082 t in 2014. Female spawning biomass was estimated to be 24,809 t in 2014, or about 25% above SSB_{MSY}. 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 SPR of the stock (the predicted spawning output at the current F as a fraction of unfished spawning output) is currently $SPR_{2012\text{-}2014}$ = 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 show a long-term decline in spawning stock biomass and a fluctuating pattern without trend for recruitment. The Kobe plot depicts the stock status relative to MSY-based reference points for the base case model and shows that spawning stock biomass decreased to roughly the MSY level in the mid-2000s, and has increased slightly in recent years.

Based on these findings, the following information on the status of the BUM stock is provided:

1. **No target or limit reference points have been established for the BUM stock;**
2. **The Pacific blue marlin stock is not currently overfished and is not experiencing overfishing relative to MSY-based reference points.**

3. **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 Information

Since the stock is near full exploitation, the ISC recommends that fishing mortality remain at or below the most recent levels estimated in the 2016 assessment (2012-2014).

6.8 Pacific Bluefin Tuna

H. Fukuda reported the results of new stock assessment for PBF (**ISC/18/ANNEX/14**). As the 2018 assessment was an update, the basic model construction is the same as that used for the 2016 assessment. Population dynamics were estimated using a fully integrated age-structured model (Stock Synthesis 3) fitted to catch, size-composition, and CPUE data from 1952 to 2016 (fishing year). Life history parameters included a length-at-age relationship from otolith-derived ages, as well as natural mortality estimates from a tag-recapture study and empirical-life history methods.

Nineteen fleets were defined for use in the stock assessment model based on country/gear/season/region stratification. Quarterly observations of catch and size compositions, when available, were used as inputs to the model to describe the removal processes. Annual estimates of standardized CPUE from the Japanese longline fleets, the Taiwanese longline fleets, and the Japanese troll fleet were used as measures of the relative abundance of the population.

The 2018 base-case model was constructed with minimal modifications relative to the 2016 base-case model. The assessment model was fitted to the input 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. Based on the diagnostic analyses, the WG concluded that the model represents the data sufficiently and results were consistent with the 2016 assessment. The 2018 assessment results are considered the best available scientific information on Pacific bluefin tuna.

The 2018 projection results are more optimistic than the 2016 projections, mainly due to the inclusion of the relatively good recruitment in 2016, which is twice as high as the median of the low recruitment scenario (which occurred during the 1980-1989 period). Based on the performance analyses of the recruitment estimates using an age-structured production model and the retrospective diagnostics, terminal year recruitment estimates were included in the projections. The projection results showed that the probability of achieving the initial rebuilding target under current measures taken by RFMOs was above the level (75% or above in 2024) prescribed in the WCPFC Harvest Strategy (scenario 0 of Table 6-8, Figure 6-14) to provide relevant information for potential increase in catch. Accordingly, the ISC examined some optional scenarios which have higher catch limits. The results of the projections with higher catch limits were also presented.

<u>Discussion</u>

Model diagnostics were explored in the discussion.

It was noted that age-specific mortality fell for ages 3 and below in the recent period (2013-2015), but it increased for ages 4 to 6 during this period.

The PBFWG is using the term "fishing intensity" to denote SPR and it was noted that this use is confusing since this term is used by other WGs to denote the inverse (1-SPR). It was agreed that a clear definition of how the term is being used is necessary for discussions with managers and other scientists, because it differs from how it is used by other WGs.

Characterize rebuilding targets in the WCPFC Harvest Strategy and the uncertainty in achieving those targets were discussed, but remains unresolved at present.

The ISC Plenary endorsed the 2018 PBF update stock assessment as the best available scientific information for management decision-making.

Stock Status and Conservation Information

The base-case model results show that: (1) SSB fluctuated throughout the assessment period, (2) SSB steadily declined from 1996 to 2010; and (3) the slow increase of the stock continues since 2011 including the most recent two years (2015-2016). Based on the model diagnostics, 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 2016 SSB (terminal year) was estimated to be around 21,000 t in the 2018 assessment, which is an increase from 19,000 t in 2014 (Table 6-5 and Figure 6-10).

Historical recruitment estimates have fluctuated since 1952 without an apparent trend. The low recruitment levels estimated in 2010-2014 were a concern in the 2016 assessment. The 2015 recruitment estimate is lower than the historical average while the 2016 recruitment estimate (15.988 million fish) is higher than the historical average (13.402 million fish) (Figure 6-13, Table 6-5). The uncertainty of the 2016 recruitment estimate is higher than in previous years because it occurs in the terminal year of the assessment and is mainly informed by one observation from the troll age-0 CPUE index. The troll CPUE series has been shown to be a good predictor of recruitment, with no apparent retrospective error in the recruitment estimates of the terminal year given the current model construction. As the 2016 recruits grow and are observed by other fleets, the magnitude of this year class will be more precisely estimated in the next stock assessment. The above average recruitment estimated in 2016 had a positive impact on the projection results.

Estimated age-specific fishing mortalities (F) on the stock during the periods 2012-2014 and 2015-2016 compared with 2002-2004 estimates (the base period for the WCPFC Conservation and Management Measure) are presented in Figure 6-11. A substantial decrease in estimated F is observed in ages 0-2 in 2015-2016 from the previous years. Note that stricter management measures in the WCPFC and IATTC have been in place since 2015.

The WCPFC adopted an initial rebuilding biomass target (the median SSB estimated for the period 1952 through 2014) and a second rebuilding biomass target (20%$SSB_{F=0}$ under average recruitment), without specifying a fishing mortality reference level.[4] The 2018 assessment estimated the initial rebuilding biomass target to be 6.7%$SSB_{F=0}$ and the corresponding fishing mortality expressed as SPR of $F_{6.7\%SPR}$ (Table 6-6). SPR is the ratio of the cumulative spawning biomass that an average recruit is expected to produce over its lifetime when the stock is fished at the current intensity to the cumulative spawning biomass that could be produced by an average recruit over its lifetime if the stock was unfished. Because the projections include catch limits, fishing mortality is expected to decline, i.e., $F_{x\%SPR}$ will increase, as biomass increases. The Kobe plot shows that the point estimate of the SSB_{2016} was 3.3%$SSB_{F=0}$ and the 2016 fishing mortality corresponds to $F_{6.7\%SPR}$ (Figure 6-12). Table 6-7 provides an evaluation of stock status against some common reference points. It shows that the PBF stock is overfished relative to biomass-based limit reference points adopted for other species in WCPFC (20%$SSB_{F=0}$) and is subject to overfishing relative to most of the common fishing intensity-based reference points.

Figure 6-13 depicts the historical impacts of the fleets on the PBF stock, showing the estimated biomass when fishing mortality from respective fleets is zero. 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 (ages 0-1), have had a greater impact, and the effect of these fleets in 2016 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, 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.

Stock Status

Based on these findings, the following information on the status of the Pacific bluefin tuna stock is provided:

1. **No biomass-based limit or target reference points have been adopted to evaluate the overfished status for PBF. However, the PBF stock is overfished relative to the potential biomass-based reference points evaluated (SSB_{MED} and 20%$SSB_{F=0}$, Table 6-7 and** Figure 6-12**).**
2. **No fishing intensity-based limit or target reference points have been adopted to evaluate overfishing for PBF. However, the PBF stock is subject to overfishing relative to most of potential fishing intensity-based reference points evaluated (Table 6-7 and** Figure 6-12**).**

Conservation Information

After the steady decline in SSB from 1995 to the historical low level in 2010, the PBF stock appears to have started recovering slowly. The 2016 stock biomass is below the two biomass

[4] The IATTC has adopted the first rebuilding target, the second target is to be discussed at a future IATTC meeting.

rebuilding targets adopted by the WCPFC while the 2015-16 fishing intensity (spawning potential ratio) is at a level corresponding to the initial rebuilding target.

The 2018 base case assessment results are consistent with the 2016 model results. However, the 2018 projection results are more optimistic than the 2016 projections, mainly due to the inclusion of the relatively good recruitment in 2016, which is above the historical average level (119%) and twice as high as the median of the low recruitment scenario (which occurred 1980-1989).

Based on these results, the following conservation information is provided:

1. **The projection based on the base-case model mimicking the current management measures by the WCPFC (CMM 2017-08) and IATTC (C-16-08) under the low recruitment scenario resulted in an estimated 98% probability of achieving the initial biomass rebuilding target (6.7%$SSB_{F=0}$) by 2024. This estimated probability is above the threshold (75% or above in 2024) prescribed by the WCPFC Harvest Strategy (Harvest Strategy 2017-02) (scenario 0 of Table 6-8 to Table 6-10; See also Figure 6-14 and Figure 6-15). The low recruitment scenario is more precautionary than the recent 10 years recruitment scenario.**
2. **The Harvest Strategy specifies that recruitment switches from the low recruitment scenario to the average recruitment scenario beginning in the year after achieving the initial rebuilding target. The estimated probability of achieving the second biomass rebuilding target (20%$SSB_{F=0}$) 10 years after the achievement of the initial rebuilding target or by 2034, whichever is earlier, is 96% (scenario 1 of Tables Table 6-7, Table 6-8, and Table 6-9; Figure 6-14 and Figure 6-15). This estimate is above the threshold (60% or above in 2034) prescribed by the WCPFC Harvest Strategy. However, it should be recognized that these projection results are strongly influenced by the inclusion of the relatively high, but uncertain recruitment estimate for 2016.**

The Harvest Strategy adopted by WCPFC (Harvest Strategy 2017-02) guided projections conducted by ISC to provide catch reduction options if the projection results indicate that the initial rebuilding target will not be achieved or to provide relevant information for potential increase in catch if the probability of achieving the initial rebuilding target exceeds 75%. The projection results showed that the probability of achieving the initial rebuilding target was above the level (75% or above in 2024) prescribed in the WCPFC Harvest Strategy. **Accordingly, the ISC examined some optional scenarios with higher catch limits, which can be found in Appendix 1 of the PBF 2018 stock assessment report (ISC/18/ANNEX/14).**

Research Needs

Given the low SSB, the uncertainty in future recruitment, and the influence of recruitment on stock biomass, monitoring of recruitment and SSB should be strengthened so that the recruitment trends can be understood in a timely manner.

Table 6-5. Total biomass, spawning stock biomass and recruitment of Pacific bluefin tuna (*Thunnus orientalis*) estimated by the base-case model, where coefficient of variation (CV) measures relative variability defined as the ratio of the standard deviation to the mean.

Fishing year	Total biomass (t)	Spawning stock biomass (t)	CV for SSB	Recruitment (x1000 fish)	CV for R
1952	150825	114227	0.51	13352	
1953	146228	107201	0.49	21843	0.17
1954	147385	96239	0.49	34556	0.15
1955	152230	83288	0.50	14106	0.19
1956	169501	76742	0.49	34261	0.11
1957	188830	82975	0.46	12574	0.15
1958	208078	108677	0.41	3436	0.30
1959	214898	147004	0.39	7963	0.22
1960	218055	155183	0.39	7745	0.21
1961	211262	168125	0.39	23323	0.10
1962	197361	151993	0.42	10794	0.18
1963	181329	129755	0.45	27615	0.10
1964	169581	114448	0.45	5827	0.32
1965	159109	100628	0.46	11584	0.35
1966	144866	95839	0.44	8645	0.44
1967	121987	89204	0.44	10803	0.38
1968	107216	83374	0.45	13656	0.24
1969	93223	69074	0.47	6413	0.30
1970	81816	57958	0.48	7120	0.40
1971	71900	49980	0.48	12596	0.34
1972	67819	43035	0.46	22742	0.17
1973	65474	37205	0.44	11058	0.27
1974	65059	29896	0.44	13570	0.17
1975	63515	27733	0.38	11011	0.18
1976	66532	30485	0.30	9171	0.32
1977	64320	36220	0.25	25078	0.17
1978	69199	33382	0.25	15057	0.26
1979	69609	28007	0.29	11509	0.20
1980	71313	30757	0.25	7584	0.27
1981	72109	28867	0.21	11703	0.13
1982	53715	25408	0.21	6965	0.21
1983	31185	15086	0.29	10078	0.15
1984	33147	12813	0.31	9231	0.20
1985	36319	12846	0.28	9601	0.19
1986	35877	15358	0.23	7857	0.19
1987	31609	14632	0.25	6224	0.22
1988	33868	15709	0.25	8796	0.14
1989	38189	15519	0.25	4682	0.28
1990	46388	19468	0.23	18462	0.09
1991	61501	25373	0.21	11803	0.11
1992	70077	32022	0.20	4426	0.17
1993	79910	43691	0.18	4365	0.18
1994	90135	51924	0.19	28350	0.04
1995	103322	67152	0.18	17414	0.09
1996	98854	66841	0.18	17564	0.06
1997	99196	61069	0.19	10919	0.10
1998	95373	60293	0.19	15014	0.08
1999	91963	56113	0.20	23450	0.05
2000	87384	53835	0.21	14335	0.06
2001	76182	50222	0.21	15786	0.05
2002	77727	47992	0.20	13509	0.06
2003	74204	47569	0.19	7769	0.09
2004	68407	40707	0.20	26116	0.04
2005	63042	33820	0.21	14659	0.06
2006	50197	27669	0.23	11645	0.06
2007	43558	22044	0.24	21744	0.04
2008	41169	16754	0.27	20371	0.04
2009	35677	13011	0.27	8810	0.07
2010	33831	12188	0.25	15948	0.05
2011	34983	13261	0.23	13043	0.06
2012	37451	15892	0.20	6284	0.09
2013	39113	18107	0.20	11874	0.06
2014	38918	19031	0.19	3561	0.14
2015	38322	19695	0.20	7765	0.13
2016	41191	21331	0.22	15988	0.21
Average (1952-2016)	89579	53722	0.31	13402	0.17
Median (1952-2014)	71900	43035	0.25	11703	0.16

Table 6-6. Spawning stock biomass and fishing intensity of Pacific bluefin tuna (*Thunnus orientalis*) in 1995 (recent high biomass), 2002-2004 (WCPFC reference year biomass), 2011 (biomass 5 years ago), and 2016 (latest) to those of the adopted WCPFC biomass rebuilding targets. SPR is used as a measure of fishing intensity; the lower the number the higher the fishing intensity that year.

	initial rebuilding target	Second rebuilding target	1995 (recent high)	2002-2004 (reference year)	2011 (5 years ago)	2016 (latest)
Biomass (%SSBF=0)	SSB median1952-2014 = 6.7%	20%	10.4%	7.1%	2.1%	3.3%
SPR	6.7%	20%	5.1%	3.4%	4.9%	6.7%

Table 6-7. Ratios of the estimated fishing intensities mortalities (Fs and 1-SPRs for 2002-04, 2012-14, 2015-16) relative to potential fishing intensity-based reference points, and terminal year SSB (t) for each reference period, and depletion ratios for the terminal year of the reference period for Pacific bluefin tuna (*Thunnus orientalis*).

	F_{max}	F0.1	Fmed	Floss	(1-SPR)/(1-SPRxx%)				Estimated SSB for terminal year of each reference period	Depletion ratio for terminal year of each reference period
					SPR10%	SPR20%	SPR30%	SPR40%		
2002-2004	1.77	2.47	1.04	0.78	1.07	1.21	1.38	1.61	40,707	6.3%
2012-2014	1.47	2.04	0.86	0.65	1.05	1.19	1.36	1.58	19,031	3.0%
2015-2016	1.32	1.85	0.78	0.58	1.02	1.15	1.32	1.54	21,311	3.3%

Table 6-8. Future projection scenarios for Pacific bluefin tuna (*Thunnus orientalis*).

Scenario #	Fishing mortality*1	WPO Catch limit Japan*2 Small	WPO Catch limit Japan*2 Large	WPO Catch limit Korea Small	WPO Catch limit Korea Large	WPO Catch limit Taiwan Large	EPO*3 Catch limit Commercial Small	EPO*3 Catch limit Commercial Large	EPO*3 Sports	Catch limit Increase WPO Small	Catch limit Increase WPO Large	Catch limit Increase EPO Small	Catch limit Increase EPO Large
0*4	F	4,007	4,882	718		1,700	3,300		-	0%		0%	
1	F	4,007	4,882	718		1,700	3,300		−	0%		0%	

*1 F indicates the geometric mean values of quarterly age-specific fishing mortality during 2002-2004.

*2 The Japanese unilateral measure (transferring 250 mt of catch upper limit from that for small PBF to that for large PBF during 2017-2020) would be reflected.

*3 Fishing mortality for the EPO commercial fishery was assumed to be high enough to fulfill its catch upper limit (F multiplied by two). The fishing mortality for the EPO recreational fishery was assumed to be the F2009-11 average level.

*4 In scenario 0, the future recruitment were assumed to be the low recruitment (1980-1989) level forever. In other scenarios, recruitment was switched from low recruitment to average recruitment from the next year of achieving the initial rebuilding target.

Table 6-9. Future projection scenarios for Pacific bluefin tuna (*Thunnus orientalis*) and their probability of achieving various target levels by various time schedules based on the base-case model.

Scenario #	Catch limit Increase WPO Small	Catch limit Increase WPO Large	Catch limit Increase EPO Small	Catch limit Increase EPO Large	Initial rebuilding target: The year expected to achieve the target with >60% probability	Initial rebuilding target: Probability of achiving the target at 2024	Initial rebuilding target: Probability of SSB is below the target at 2024 under the low recruitment	Second rebuilding target: The year expected to achieve the target with >60% probability	Second rebuilding target: Probability of achiving the target at 2034	Median SSB (mt) at 2034
0*1	0%		0%		2020	98%	2%	N/A	3%	74,789
1	0%		0%		2020	99%	2%	2028	96%	263,465

*1 In scenario 0, the future recruitment were assumed to be the low recruitment (1980-1989) level forever. In other scenarios, recruitment was switched from low recruitment to average recruitment from the next year of achieving the initial rebuilding target.

Table 6-10. Expected yield for Pacific bluefin tuna (*Thunnus orientalis*) under various harvesting scenarios based on the base-case model.

Scenario #	Catch limit Increase				Expected annual yield in 2019, by area and size category (mt)				Expected annual yield in 2024, by area and size category (mt)				Expected annual yield in 2034, by area and size category (mt)			
	WPO		EPO		WPO		EPO		WPO		EPO		WPO		EPO	
	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large	Small	Large
0	0%	0%	0%		4,477	4,384	3,530		4,704	6,133	3,457		4,704	6,211	3,451	
1	0%	0%	0%		4,477	4,384	3,530		4,745	6,202	3,665		4,747	6,640	3,703	

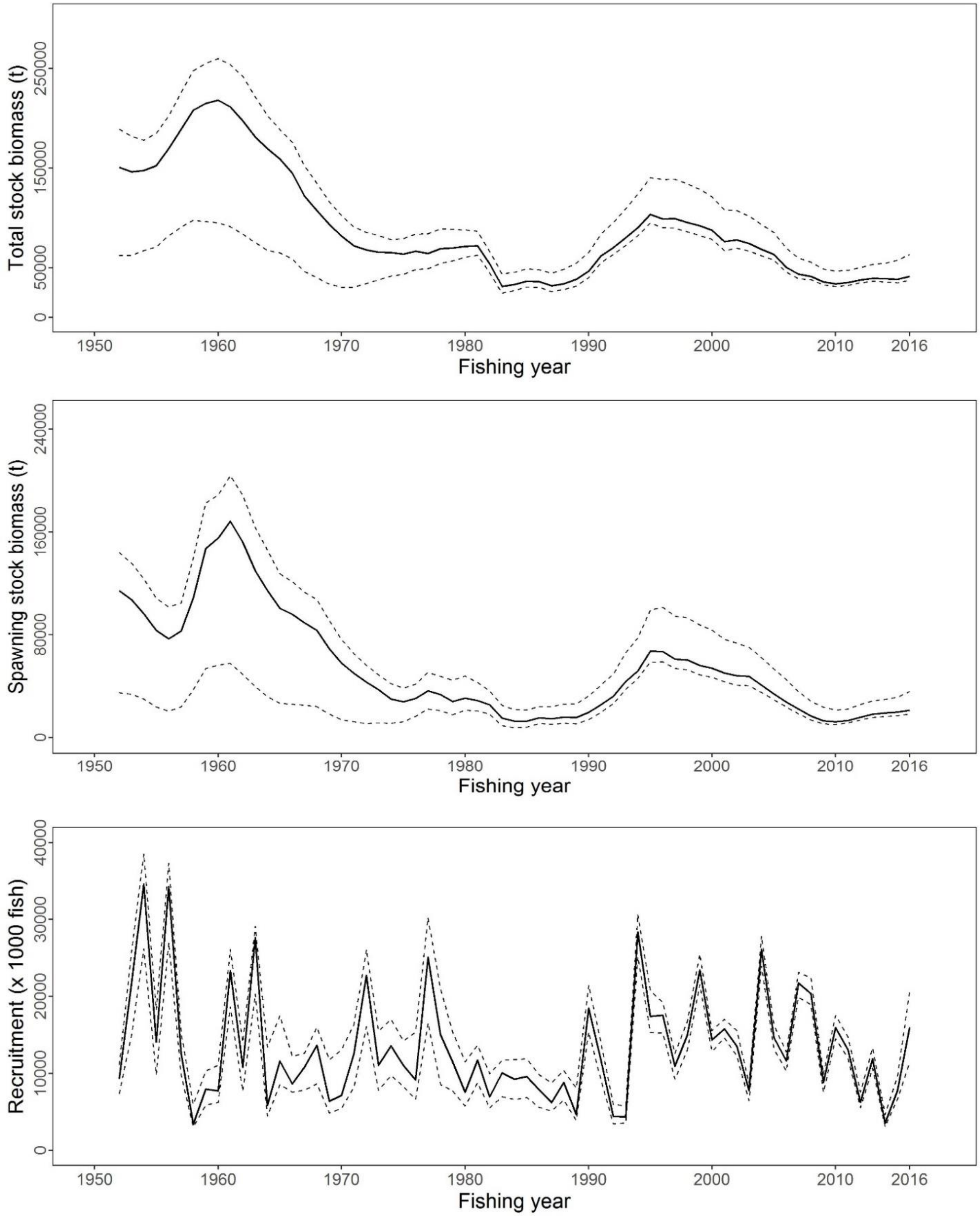


Figure 6-10. Total stock biomass (top), spawning stock biomass (middle) and recruitment (bottom) of Pacific bluefin tuna (*Thunnus orientalis*) from the base-case model. The solid lines indicate point estimates and the dashed lines indicate the 90% confidence intervals.

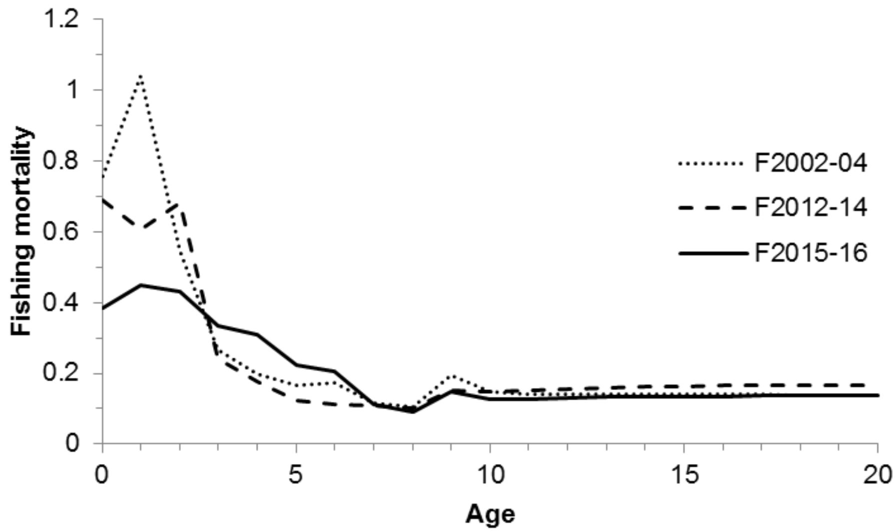


Figure 6-11. Geometric means of annual age-specific fishing mortalities of Pacific bluefin tuna (*Thunnus orientalis*) in 2002-2004 (dotted line), 2012-2014 (dashed line), and 2015-2016 (solid line).

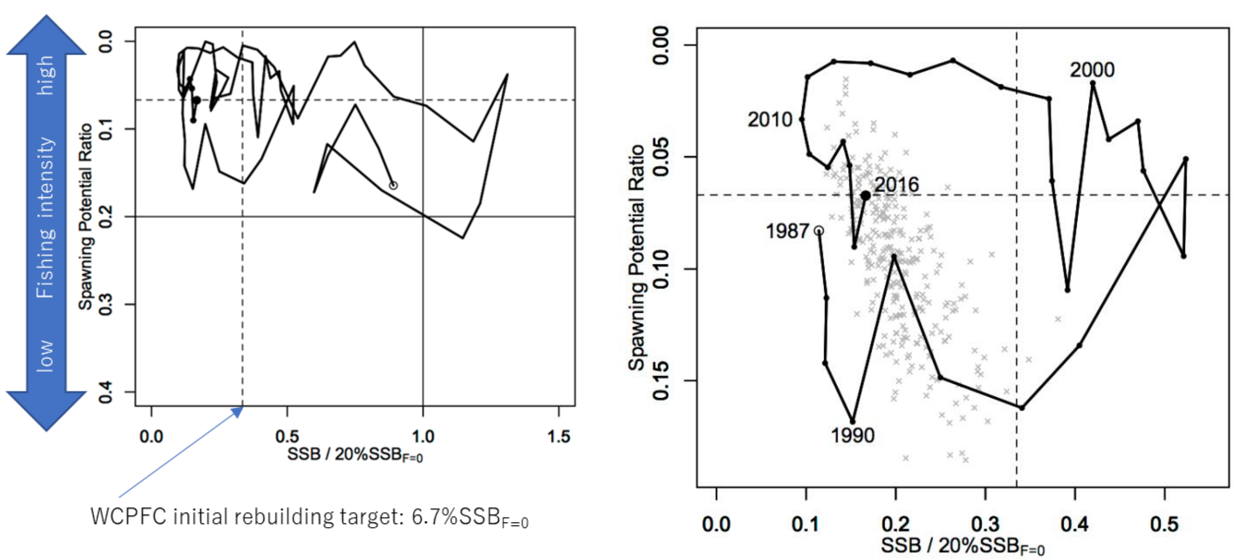


Figure 6-12. Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*). X axis shows the annual SSB relative to 20%$SSB_{F=0}$ and the Y axis shows the spawning potential ratio as a measure of fishing intensity. Solid vertical and horizontal lines in the left figure show 20%$SSB_{F=0}$ (which corresponds to the second biomass rebuilding target) and the corresponding fishing intensity, respectively. Dashed vertical and horizontal lines in both figures show the initial biomass rebuilding target (SSB_{MED} = 6.7%$SSB_{F=0}$) and the corresponding fishing intensity, respectively. SSB_{MED} is calculated as the median of estimated SSB over 1952-2014. The left figure shows the historical trajectory, where the open circle indicates the first year of the assessment (1952) while solid circles indicate the last five years of the assessment (2012-2016). The right figure shows the trajectory of the last 30 years, where grey dots indicate the uncertainty of the terminal year.

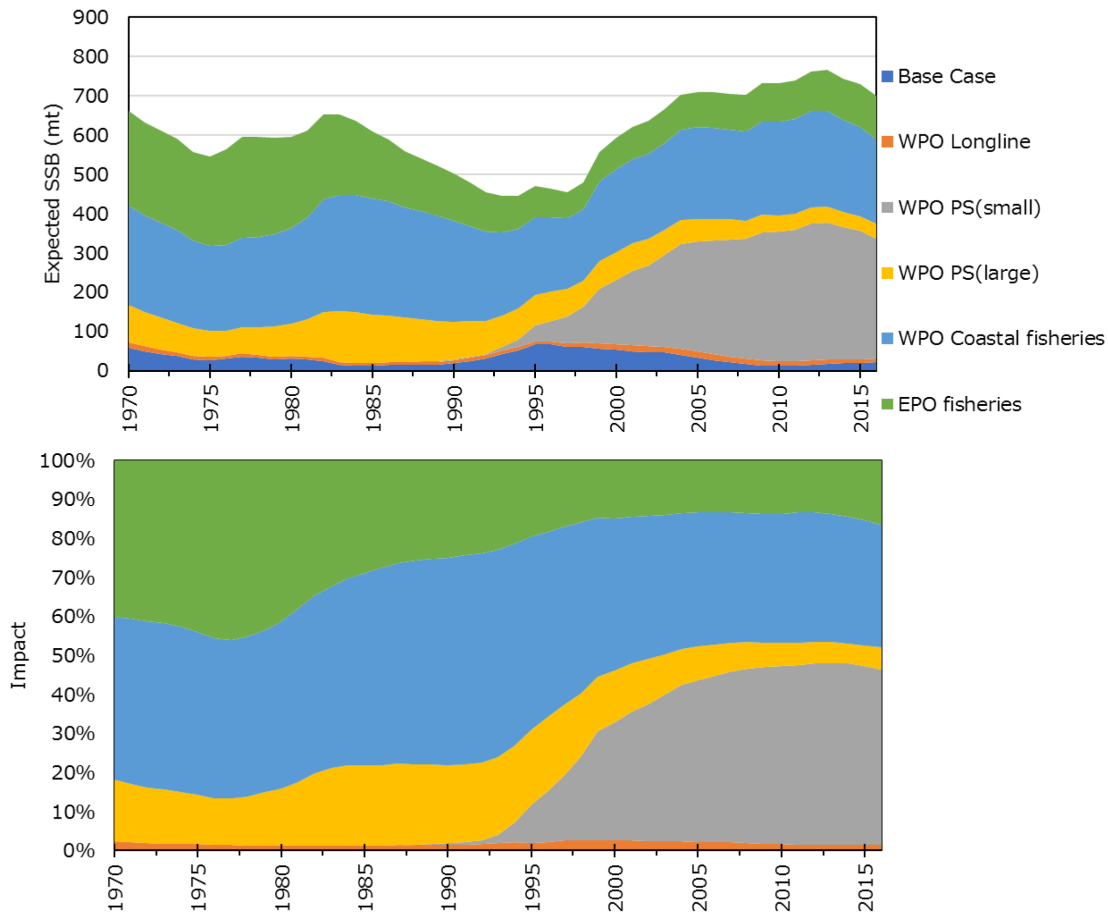


Figure 6-13. Trajectory of the spawning stock biomass of a simulated population of Pacific bluefin tuna (*Thunnus orientalis*) when zero fishing mortality is assumed, estimated by the base-case model. (top: absolute impact, bottom: relative impact). Fleet definition; WPO longline: F1, F12, F17. WPO purse seine for small fish: F2, F3, F18. WPO purse seine: F4, F5. WPO coastal fisheries: F6-11, F16, F19. EPO fisheries: F13, F14, F15.

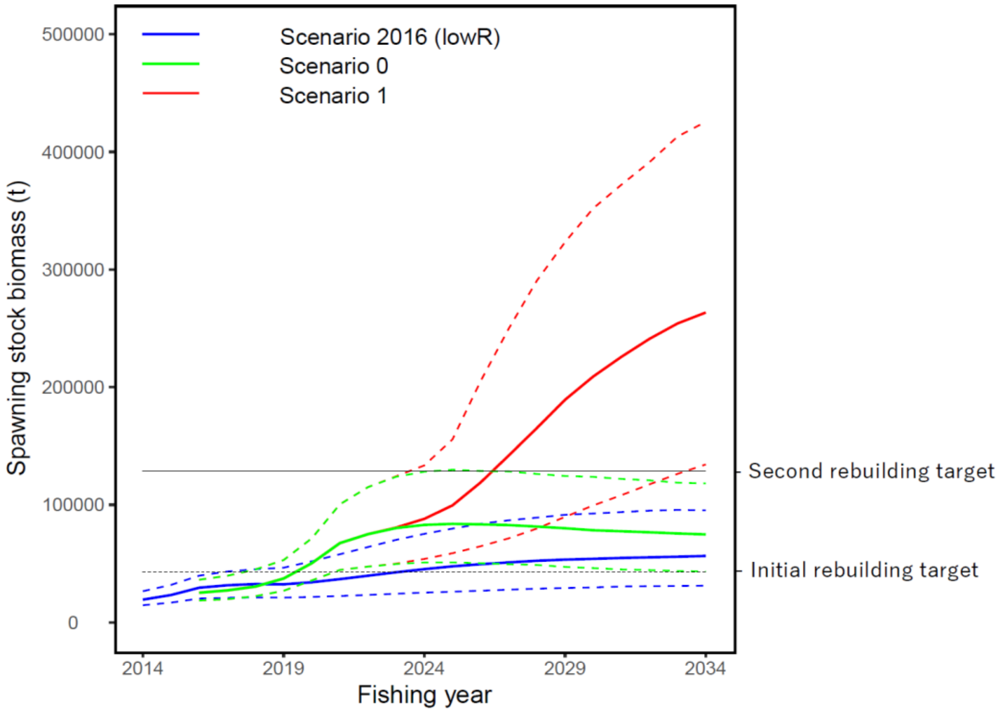


Figure 6-14. Comparison of future SSB of Pacific bluefin tuna (*Thunnus orientalis*) under the current management measures assuming low recruitement using the 2016 assessment (scenario 2016 lowR), assuming low recruitment using the 2018 assessment (scenario 0), and assuming a shift of the recruitment scenario from low to average after achieving the initial rebuilding target using the 2018 assessment (scenario 1).

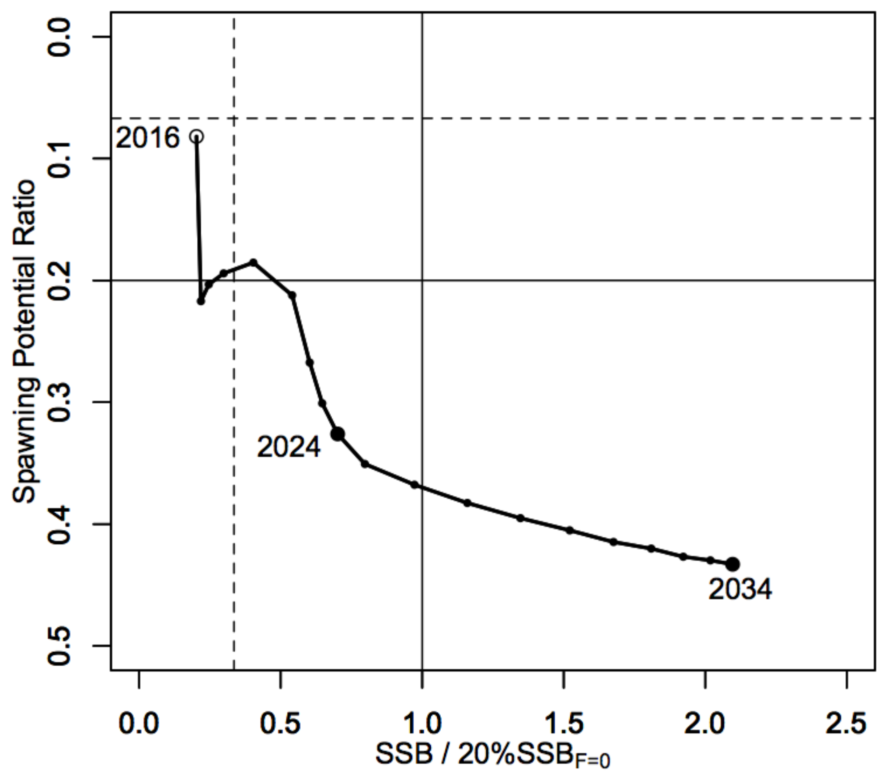


Figure 6-15. A projection result (scenario 1 from Table 4) for Pacific bluefin tuna (*Thunnus orientalis*) in a form of Kobe plot. The X axis shows the SSB value relative to 20%$SSB_{F=0}$ (second rebuilding target) and the Y axis shows the spawning potential ratio as a measure of fishing intensity. Vertical and horizontal solid lines indicate the second rebuilding target (20%$SSB_{F=0}$) and the corresponding fishing intensity, respectively, while vertical and horizontal dashed lines indicate the initial rebuilding target (SSB_{MED} = 6.7%$SSB_{F=0}$) and the corresponding fishing intensity, respectively.

7 REVIEW OF STOCK STATUS OF SECONDARY STOCKS

7.1 WCPFC

A. Beeching gave a brief overview of tuna production by gear and species, and value in the WCPO, noting that the 2016 catch was the second highest on record. He then reported on the stock assessments and management advice for bigeye and yellowfin tuna, and swordfish. Risk assessments of Pacific bigeye thresher and porbeagle sharks were also briefly presented. The presentation focused on the background of the outcomes in the bigeye assessment, which indicates that the stock is now likely to be above the limit reference point (LRP). The major influences in the new assessment were detailed, especially new biological information which impacted age at maturity and reorganization of the regions used in the model, recognizing that there was greater fishing pressure in tropical areas and the likely impact on biomass distribution. It was noted that throughout, the WCPFC Scientific Committee (SC) encouraged the Commission to agree to target reference points (TRPs) for stocks of interest, so that advice could be developed with the intention to move the stock closer to a TRP rather than away from an LRP.

8 INTERACTIONS WITH REGIONAL ORGANIZATIONS

8.1 WCPFC

A. Beeching presented reviews of ISC stock assessments presented to the WCPFC 13th Scientific Committee Meeting. Two stock assessments were presented, one for NPALB, and the other for BSH. It was noted that there were no data issues between the ISC and WCPFC. Outcomes from WCPFC14 were presented, especially in relation to adopted Harvest Strategy approaches for PBF and NPALB. Papers developed following withdrawal of samples from the WCPFC Tuna Tissue Bank were listed and finally website development and upcoming commission meetings were presented. Attention was drawn to the repositioning of a Harvest Strategy Page and a new item "Current Stock Status for Species of interest to the WCPFC" under the "Key Documents" drop-down menu.

Discussion

It was noted that the new stock status page will be very useful, but it will take a lot of effort to maintain.

8.2 PICES

G. DiNardo provided an update on activities of the Joint PICES / ISC Working Group on Ocean Conditions and the Distribution and Productivity of Highly Migratory Fish (PICES WG-34). The WG was established in October 2015 and is scheduled to conclude in October 2019. The goal of the WG is to achieve a greater understanding of pelagic ecosystem structure and variability, and its effect on the dynamics and production of Pacific pelagic fish populations and associated fisheries. Improvements in our understanding will advance population modeling and stock assessment research, as well as our ability to investigate mechanisms regulating productivity of Pacific pelagic fish populations resulting from large-scale climate events. The WG convened workshops associated with the PICES 2016 and PICES 2017 Annual Meetings. The WG is scheduled to convene Topic Session 12 (S12) "Applying ecosystem considerations in science advice for managing highly migratory species" and a business meeting at the PICES 2018 Annual Meeting. To cap off the PICES-ISC relationship, the WG will consider convening an international workshop on the impacts of climate variability on pelagic fish populations. It was also noted ISC received an invitation from Robin Brown, PICES Executive Secretary, to participate in the PICES 2018 Annual Meeting. Outside of the PICES WG-34, the ISC has historically participated in the poster session. If the ISC agrees to participate in the poster session at the PICES 2018 Annual Meeting, then the recent ISC poster updated in April 2018 for the PICES International Symposium could be used. The ISC Chair will need to inform PICES of our decision immediately.

Discussion

It was agreed that M. Seki will represent the ISC and present a poster at the next PICES annual meeting.

8.3 IATTC Scientific Advisory Committee Participation

J. Holmes, ISC Chair, introduced this topic and noted that the there is a mismatch between the timing of the ISC Plenary meeting and the IATTC Scientific Advisory Committee (SAC) meeting that results in a delay of about one year between the approval of stock assessment stock status advice and conservation information by the ISC and its entry into the IATTC management decision-making cycle. Based on previous ISC Plenary discussions, WGs that have completed stock assessments have provided an executive summary (ES), with approval by the ISC Chair, as a draft document to the SAC to get advice to the IATTC in a timely manner. However, there were some difficulties with that process this year.

It was noted that to date the ALB and PBF WGs have followed this procedure for providing stock assessment results to the IATTC. In 2018, the SHARKWG provided the ES of the SMA assessment following this procedure.

A practical procedure is needed to provide ISC advice to the IATTC SAC in a timely manner. It was noted that the assessment itself does not change between completion by the WG and approval by the ISC Plenary, but the text of stock status and conservation information may be changed by the ISC Plenary. Some options for the ISC were discussed and the ISC Plenary agreed to clarify the current procedure, particularly the timelines, and include this clarified procedure in the Operations Manual when it is revised.

The process agreed to by the ISC Plenary is as follows: WGs that complete a stock assessment and wish to provide stock assessment results and science advice to the IATTC SAC meeting will forward the ES of their assessment to the ISC Chair for review no later than one (1) month prior to the SAC meeting. The ISC Chair will forward the draft ES to the Heads of Delegation and will provide comments back to the WG as soon as possible. Once the ISC Chair and the WG agree on the revised text of the ES, the ISC Chair will provide approval and the ES will be forwarded to the IATTC. This approval will be given no later than two weeks prior to the SAC meeting to allow time for posting. Only the ES will be forwarded to the IATTC SAC and the ES will be clearly marked as “Draft, Subject to Change by the ISC Plenary.”

The Plenary discussed how frequently WGs are expected to contribute ES’s to the IATTC SAC meeting and agreed that this procedure would be followed for both update and benchmark stock assessments. The IATTC will be informed of this process.

This clarified procedure will be incorporated into the ISC Operations Manual during the intersessional period and forwarded to the Heads of Delegation for review.

9 REVIEW OF STATISTICS AND DATABASE ISSUES

9.1 STATWG Report

R. Wu, the STATWG Chair, provided a summary of STATWG activities since ISC17 (**ISC/18/ANNEX/17**). The STATWG Steering Group held a technical meeting in Taipei on 17-18 December 2017 and an intercessional meeting in Shimizu, Japan, on 14-15 March 2018 (**ISC/18/ANNEX/10**). A meeting of the entire STATWG was held in Yeosu, Korea on 6-7 July 2018, prior to ISC18; seven Information Papers and one Working Paper were submitted for this meeting (**ISC/18/ANNEX/17**).

The STATWG also welcomed new members Mi Kyung Lee, who replaces Youjung Kwon as the Data Correspondent for Korea; Sung Il Lee for Korea; Hiromu Fukuda, who replaces Osamu Sakai for Japan; and Russell Ito, who will replace Darryl Tagami for the United States.

Kirara Nishikawa continues in the roles of ISC Database Administrator (DA) and Webmaster.

It was reported that seven of eight items of the 2017 STATWG Work Plan were completed since ISC17; the outstanding item, updating member metadata, was completed by 7 July at ISC18.

At the STATWG meeting in 6-7July 2018 the following topics were presented and discussed:

1. Status of the 2017 STATWG Work Plan;
2. Member submission of their 2017 data;
3. Process for publishing Category II data in the public domain;
4. Establishing data checking protocols;
5. Review of the ISC catch tables;
6. Data Revision Reports from Japan and Mexico;
7. E-Reporting systems of member countries;
8. Improvements to the ISC website;
9. Improvements to the ISC researcher's website;
10. STATWG work plans for 2018-19 and recommendations to ISC18; and
11. Elections for Chair and Vice Chair of the STATWG for 2018-2021

Accomplishments of the STATWG since ISC17 include:

1. Annual publishing of ISC data inventories on the ISC website by October;
2. Annual archiving of stock assessment files from the species Working Groups (2014-2017);
3. Annual review and updating of member metadata;
4. Annual review and resolution of discrepancies between ISC catch tables and catch tables in National Reports of Members;
5. Accepted the Data Revision Reports of Japan and Mexico;
6. Reviewed draft protocols for data checking and Category II data publishing; further work is scheduled;
7. Reviewed E-Reporting system of member countries;
8. Continued with improvements to the online data submission system and the ISC database, including updating the User's Manual for members; and
9. Improved the ISC researcher's website and drafted a new User's Manual for the researcher's website

The 2018 Work Plan for the STATWG was developed, as well as recommendations to the ISC18 Plenary. The recommendations were:

1. The STATWG recommends that the Plenary provide clear guidelines for the publishing of ISC Category II data in the public domain, including the definition of Category II public domain data; and
2. The STATWG recommends scheduling a one-and-a-half day meeting prior to the ISC19 Plenary in July 2019.

The current national contacts list for the STATWG was also provided, as well as the 2018 Member Report Card (**ISC/18/ANNEX/17**).

The ISC Chair, J. Holmes, presided over the elections of Chair and Vice Chair for the STATWG; the current Chair, Ren-Fen Wu, and Vice Chair, Darryl Tagami, have completed eight years of service and are not eligible for additional terms. There were no nominations for the Chair and Vice Chair of the STATWG.

The STATWG Steering Group will schedule their next meeting in Shimizu, Japan, on 29-30 January 2019, and requested the scheduling of a one-and-a-half-day STATWG meeting in July 2019 prior to the ISC19 Plenary.

Discussion

After discussing the Category II public domain data request from the STATWG, the ISC Plenary decided not to move forward with making Category II data publicly available, because these data may be obtained from the IATTC and WCPFC. Category II metadata will still be published on the ISC website. The Operations Manual will be revised to reflect this decision.

The Plenary agreed that the ISC Chair and Vice Chair will serve as interim Chair and Vice Chair of the STATWG until ISC19. The outgoing STATWG Chair will provide the ISC Chair with a list of upcoming tasks.

The STATWG Chair recommended removing links on the ISC website to all but the most recent stock status and conservation information. The ISC Plenary agreed that only links to the most recent stock status and conservation information should be published on the ISC website. (Currently, both current and past recommendations are available on the website.) The ISC Plenary also agreed that the species WG chairs are responsible for reviewing the contents of species pages in ISC website and making necessary updates regularly in consultation with the ISC webmaster.

It was noted that the data revisions from Japan and Mexico followed the ISC procedure and were reviewed and approved by the SHARKWG prior to submission to the STATWG.

9.2 Total catch tables

K. Nishikawa, the DA, presented the annual catch tables for ISC Member countries for 2016-2017. The catch tables were prepared for the following ISC species of interest: ALB, PBF, SWO, MSL, BUM, BSH, and SMA. The catch tables were generated from the ISC database, and are based on Category I data (retained catch and released catch, when available) submitted by Data Correspondents for the major fisheries in the North Pacific Ocean of the member countries. Graphs of the historical catch by country were also presented for each species. Statistics for mean, minimum and maximum catch were also presented for each species for the

latest 5 years. The complete catch tables will be included in the ISC Plenary Report (Table 15-1 through

Catch disposition	Year	TWN		USA						Total
		Longline	TWN Total	Drift gill-net	Longline	Troll	Others	Sport	USA Total	
Retain catch	1985			0			1		1	**1**
	1986			1			1		2	**2**
	1987			1			1		2	**2**
	1988			0			3		3	**3**
	1989						6		6	**6**
	1990			0			20		20	**20**
	1991			0			1		1	**1**
	1992			1			1		2	**2**
	1993			0			0		0	**0**
	1994			0			12		12	**20,074**
	1995			0			5		5	**18,432**
	1996			0			0		0	**21,251**
	1997			0			0		0	**26,105**
	1998			0			1		1	**23,989**
	1999			0			0		0	**26,541**
	2000			0			0		0	**27,511**
	2001						0		+	**28,126**
	2002						0		+	**26,345**
	2003			0			0		0	**26,278**
	2004						0		+	**22,470**
	2005						0		+	**21,887**
	2006						0		+	**19,063**
	2007			9	8		0		17	**17,280**
	2008				7				7	**25,311**
	2009	11,541	11,541	1	9		1		11	**37,354**
	2010	7,670	7,670	0	7		0		7	**36,664**
	2011	13,117	13,117		13		0		13	**36,948**
	2012	10,606	10,606		16		0		16	**29,705**
	2013	6,321	6,321		1	+	0		1	**29,210**
	2014	8,151	8,151		0		0	+	0	**31,070**
	2015	8,551	8,551				1	+	1	**21,795**
	2016	8,563	8,563		+		0	+	0	**18,137**
	2017	11,121	11,121				(1)	+	1	**(20,704)**
Retain catch total		**85,641**	**85,641**	**13**	**61**	**0**	**55**	**0**	**129**	**(687,509)**
Release	2015									**0**
	2016									**8**
	2017									**11**
Release total										**8**
Total		**(85641)**	**(85641)**	**13**	**61**	**0**	**55.2**	**0**	**129**	**(687517)**

Parenthetic numbers are provisional.

Table 15-7) and serve as the official ISC catch tables.

Discussion

In response to a question, the DA confirmed that data from Canada has been updated but she needed to check on the status of data from the Korean driftnet fishery.

The Chair and Vice Chair thanked the Database Administrator, Webmaster, and STATWG Chair and Vice Chair for their leadership in improving database procedures and the functionality of the ISC website over the past eight years.

The Plenary discussed the sources and status of the data in ISC catch tables. These data represent reported catch from ISC members only. In cases where a member does not submit data directly to the ISC, data are obtained from WCPFC and IATTC. It was suggested that cases where data are lacking due to non-submission should be noted when reporting total catch.

10 REPORT OF SEMINAR

D.N. Kim opened and provided an overview of the ISC18 Seminar on the topic, "Ecosystem-based Fisheries Assessment and Management," and four internal experts gave presentations on this issue.

Z.G. Kim, National Institute of Fisheries Science, Korea, made a presentation on "Review of Progress on implementation of EAFM in tRFMO" which included a summary of the report of the Joint Meeting of tuna RFMOs on the implementation of the Ecosystem Approach to Fisheries Management. This project was initiated by ICCAT and organized by FAO Common Oceans ABNJ Tuna Project and funded by the GEF. He summarized that tRFMOs have made considerable progress on monitoring the impacts of fisheries on target species, however, moderate progress on bycatch species and little progress for ecosystem, trophic relationships and habitats properties. All tRFMOs share the same challenge of developing a formal mechanism to better integrate ecosystem science and advice into management decisions. Finally, he suggested that the ISC might need to incorporate the precautionary and ecosystem approach in its text and structure and strengthen cooperation with PICES.

S.Y. Hyun, Pukyong National University, made a presentation on "A recent trend in fish stock assessments: two examples." He introduced two recent stock assessments models, age-structured and length-based models using case studies of US Gulf of Maine-Georges Bank Acadian redfish (*Sebastes fasciatus*) and Korean chub mackerel (*Scomber japonius*) stocks. A state-space, age-structured model is one of the most sophisticated methods, which allows population sizes over time to be random effect parameters. He noted that when data about fish ages are not available, a size- (fish length or weight) based model could be an alternative option.

C.K. Kang, Gwangju Institute of Science and Technology, presented on "Patterning multitrophic community and trophic network in a temperate, low-turbidity estuarine bay of Korea," which was used to characterize longitudinal and seasonal patterns in multitrophic community and trophic structure of the main water channel across a riverine-estuarine-coastal continuum in Gwangyang Bay of Korea. Typological characteristics showed the importance of longitudinal as well as seasonal patterns in the occurrence of planktonic assemblages in association with variations in environmental conditions. Also, the prevalent longitudinal pattern was also observed in the nektonic community. He noted that conceptual food web models, based on a combination of community patterns and isotopic determination, may provide a more realistic framework than an empirical determinant of compartments constituting a trophic network.

C.I. Zhang, Pukyong National University, presented on "Ecosystem-based Fisheries Assessment and Management in Korea." He introduced a comprehensive ecosystem-based approach, which is required to assess and manage fisheries resources and their associated habitat ecosystems. In this approach, four management objectives (sustainability, biodiversity, habitat quality, and socio-economic benefits) were considered and a two-tier analytical method was employed. A total of about 20 indicators were developed for assessment of ecosystem status; both target and limit reference points were chosen for each to assess the status of species, fisheries, and ecosystems. The Integrated Fisheries Risk Analysis Method for Ecosystems (IFRAME) framework, which is an extension of this ecosystem-based approach, also has been developed. He noted that this approach could be used to compare the status of species, fisheries, and ecosystems spatially and temporally using an ecosystem perspective.

11 REVIEW OF MEETING SCHEDULE

11.1 Future Plenary Schedules

The Chair presented a proposal to shorten the length of the ISC Plenary meeting. Eliminating the half day WG meetings will reduce the length by two days. Furthermore, the agenda can be compressed into three full working days by discontinuing the seminar and combining the half-day agenda on Friday with the half-day on Saturday. This proposal means there would be a one-and-a-half day STATWG meeting, plus a half day for the Heads of Delegation and Working Group Chairs meetings, followed by a 5-day Plenary schedule commencing on a Thursday and finishing on the following Monday with a Sunday recess to compile the draft meeting report. WGs would need to complete any tasks supporting the Plenary, including finalizing reports and reviewing catch data, at their intersessional meetings. It was noted that this proposal is designed to be adaptable and the ISC Plenary session can be lengthened or shortened, depending on the number of new assessments to be reviewed and the need to provide adequate time to review and develop scientific information and advice.

The ISC Plenary endorsed the Chair's proposal and agreed to implement it for ISC19.

11.2 Time and Place of ISC19

Chinese Taipei offered to host ISC19. The proposed dates are 9-15 July 2019. The invitation was accepted by the Plenary

11.3 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.

Year	Month	ALB	BILL	PBF	SHARK	STAT	PLENARY	OTHER
2018	August							WCPFC SC Aug 8-16; Busan, Korea
	September		Data Prep Conference Call					WCPFC NC Sept 3-7; Fukuoka, Japan
	October		Data Prep Conference Call	Close-kin Meeting Dates: TBD La Jolla, USA				Pices AGM Oct 25-Nov 4 Yokohama, Japan
	Novemeber		Data Prep Conference Call		Shark Workshop Nov 6-12 Kaohsiung, Taiwan			
	December		MLS Data Prep Workshop Honolulu, USA	Tagging Meeting Dec 9-14 Honolulu, USA				WCPFC15 Dec 9-14 Honolulu, USA
2019	January		MLS Assessment Modeling Conference Call			Steering Group Jan 29-30 Shimizu, Japan		
	February	Workshop Feb 26-Mar 4 Shimizu, Japan	MLS Assessment Modeling Conference Call	Workshop Feb or Mar Busan, Korea				
	March	MSE Workshop March 5-7 Yokohama, Japan	MLS Assessment Modeling Conference Call	Workshop Feb or Mar Busan, Korea				
	April		MLS Assess Workshop La Paz, Mexico?					
	May			PBF MSE Workshop; Dates and Location TBD				IATTC SAC May 13-17 La Jolla, USA
	June							
	July						ISC19 July 9-15 Taiwan	

12 ADMINISTRATIVE MATTERS

12.1 Template for stock status and conservation information

M. Seki presented the U.S.A. proposed template for WGs to present information on stock status and conservation information (**ISC/18/PLENARY/12**) in order to produce greater consistency and facilitate ISC Plenary deliberations, which ISC15 agreed to develop.

ISC17 reviewed a draft template proposal from the U.S.A.. Although not formally adopted, WGs were encouraged to consult the draft template when formulating stock status and conservation information in future stock assessment reports. In addition, all ISC member countries were encouraged to solicit feedback from their respective managers so that ISC18 could revisit the proposed template.

<u>Discussion</u>

Guidelines for when the quadrants in Kobe plots should be colored were discussed. The template recommends not using colors when RFMOs have not adopted biological reference points for the stock. This practice may be different than that of the RFMOs. This difference in practice should not be a problem as long as the ISC applies it in a clear and consistent manner. It was noted that the template provides flexibility to consider BRPs in addition to targets and limits. The ISC Plenary agreed to adopt the template for use in presenting stock status and conservation advice beginning with ISC19. It will be attached to the Operations Manual.

12.2 Status of Peer Review of Function and Process and Stock Assessments

H. Matsuda briefed the Plenary on his preliminary conclusions on a peer review process for ISC assessments.

Discussion

The Plenary thanked Dr. Matsuda for his update and looks forward to receipt of the final report in October 2018.

It was noted that most assessments are only reviewed by plenary but ALB and PBF assessments have been subject to desktop reviews in 2011 and 2012, respectively, by the Center for Independent Experts in the United States.

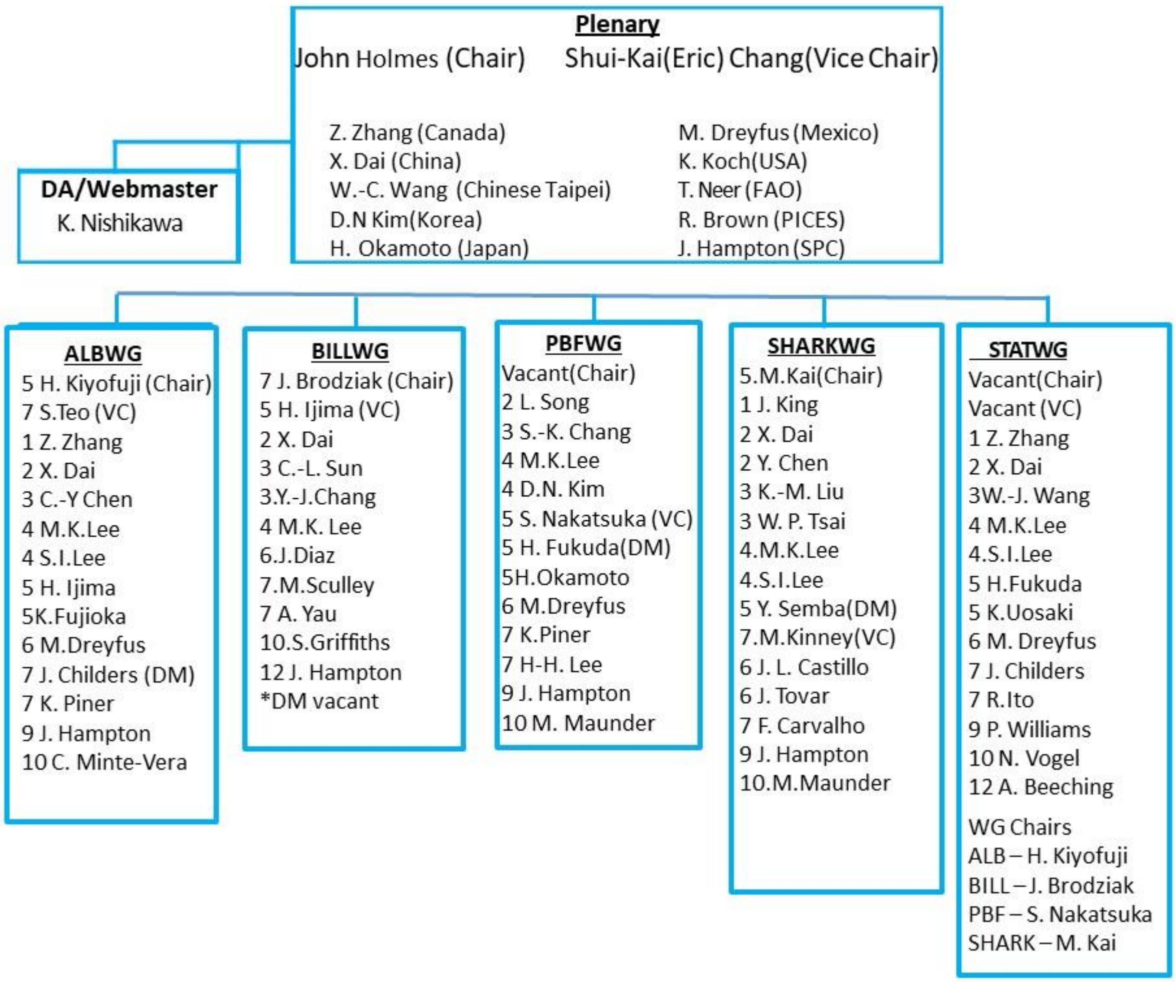
12.3 Status of Formalization of ISC

The U.S.A. has taken the lead on developing a memorandum of understanding (MOU) among members to formalize ISC structure and function (see **ISC/17/PLENARY/13**). The previous Chair confirmed that all members have identified points of contact for this process. With the change in Administration in the U.S.A. the diplomatic process for finalizing the MOU was interrupted but is now back on track.

12.4 Updated ISC Organization Chart

The ISC organizational chart was reviewed for completeness. It was noted that species WG Chairs and Vice chairs are members of the STATWG and should be shown as members on the organizational chart The updated chart is reproduced below, representing personnel going forward from ISC18. U.S.A. committed to providing a Data Manager for the BILLWG.

ISC Organizational Chart (July 2018)



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 Upcoming Chair/Vice Chair Elections

The BILLWG Chair is on his second term so a new Chair will need to be elected at the expiration of his term prior to ISC19. The PBFWG Chair is currently vacant and an election is scheduled during the next workshop. Both the STATWG Chair and Vice Chair seats are vacant, but these roles will be fulfilled by the ISC Chair and Vice-Chair, respectively, until ISC19.

12.6 Pacific Bluefin Tuna Tagging Ad Hoc Working Group

G. DiNardo summarized activities to form an Ad-hoc Working Group to explore the development of a coordinated PBF tagging program under auspices of ISC. Working Group activities are separated into two phases spanning two years. Phase 1 includes an inventory and description of existing tagging programs for PBF in the Pacific, scheduled to be presented and reviewed at ISC18. Phase 2 includes development of a framework for a multinational ISC tagging program, scheduled presentation and review at ISC19. The Ad-hoc Working Group was scheduled to meet prior to ISC18 to complete Phase 1, but due to travel issues and complications impacting members of the Working Group, the meeting was postponed. Updated dates for completing both tasks were proposed. Phase 1 would be presented and reviewed at ISC19 and Phase 2 presented and reviewed at ISC20. A recent overture by Baja Aqua Farms to allow PBF tagging associated with operations in 2019, at the conclusion of Mexico's fishing season, was presented. Expected benefits from advancing with PBF tagging in 2019 were then presented.

Discussion

The Plenary agreed to the revised schedule for the Ad Hoc Working Group meetings. Possible venues for the first Ad Hoc Working Group meeting were discussed. The Plenary endorsed the proposal to hold it in conjunction with WCPFC15 in Hawaii. The objectives of the tagging project and possible funding sources will be discussed at the upcoming meeting.

12.7 Other Business

The practice of footnoting ISC documents to prohibit citation without express permission was brought up. Under current practice any ISC document published on the ISC website has been cleared for dissemination so this footnote is no longer necessary. The ISC Chair will ensure that it is removed from documents produced at this meeting and going forward.

It was agreed that only electronic documents will be provided at future ISC Plenary meetings; thus, at future meetings hard copy briefing books will no longer be distributed to participants. However, the draft ISC Plenary report will continue to be printed for review by Members.

It was reiterated that all requests to the ISC from other RFMOs need to be submitted in writing to the ISC Chair. RFMOs have not been consistent in following this guidance. The ISC Chair will write to remind them of this practice.

The ALBWG requested guidance on how to proceed with presenting the preliminary results of the MSE to managers and stakeholders in March 2019. It was agreed that the preliminary results of the ALB MSE, which will be presented prior to ISC19, will be submitted to the Chair for review in consultation with ISC Members. It was noted that MSE results are not tactical management advice so thorough vetting by the Plenary may be unnecessary.

It was noted that a PBF close-kin workshop has been scheduled for October 2018 in La Jolla. U.S.A. plans to bring geneticists together and develop a work plan for analysis of samples that have been collected by ISC member countries participating in the project.

13 ADOPTION OF REPORT

The draft report of the Meeting was adopted. The ISC Chair will finalize the Plenary report for posting on the ISC website and forward it to the WCPFC-SC.

14 CLOSE OF MEETING

J. Holmes thanked the ISC Membership for their support and commitment over the past year. The scientific structure and competency of the ISC have increased substantially because of the ongoing dedication and support of its scientists. The meeting was closed at 11:40 AM 16 July 2018.

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. "+"; Bellow 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	129	129													
	1940	2	2													
	1941	35	35													
	1942															
	1943	13	13													
	1944	210	210													
	1945	648	648													
	1946	196	196													
	1947	36	36													
	1948	984	984													
	1949	1,012	1,012													
	1950	961	961													
	1951	86	86													
	1952	71	71	55	-	26,687	41,787	-	237	154	68,920			-	-	-
	1953	5	5	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			23	-	14,341	42,810	-	57	-	57,231			-	-	-
	1957			13	-	21,053	49,500	-	151	83	70,800			-	-	-
	1958	17	17	38	-	18,432	22,175	-	124	8	40,777			-	-	-
	1959	8	8	48	-	15,802	14,252	-	67	-	30,169			-	-	-
	1960	74	74	23	-	17,369	25,156	-	76	-	42,624			-	-	-
	1961	212	212	111	-	17,437	18,639	-	268	7	36,462			39	2	41
	1962	141	141	20	-	15,764	8,729	-	191	53	24,757			0	0	0
	1963	4	4	4	-	13,464	26,420	-	218	59	40,165			0	31	31
	1964	1	1	50	-	15,458	23,858	-	319	128	39,813			-	0	-
	1965	5	5	70	-	13,701	41,491	-	121	11	55,394			-	0	-
	1966	3	3	64	-	25,050	22,830	-	585	111	48,640			-	0	-
	1967	15	15	43	-	28,869	30,481	-	520	89	60,002			-	-	-
	1968	44	44	58	-	23,961	16,597	-	1,109	267	41,992			-	-	-
	1969	161	161	34	-	18,006	31,912	-	925	521	51,398			-	0	-
	1970	1,028	1,028	19	-	16,222	24,263	-	498	317	41,319			-	0	-
	1971	1,365	1,365	5	-	11,473	52,957	-	354	902	65,691	0	0	-	0	-
	1972	390	390	6	1	13,022	60,569	-	638	277	74,513	0	0	0	100	100
	1973	1,746	1,746	44	39	16,760	68,767	-	486	1,353	87,449	4	4	-	0	-
	1974	3,921	3,921	13	224	13,384	73,564	-	891	161	88,237	91	91	0	1	1
	1975	1,400	1,400	13	166	10,303	52,152	-	230	159	63,023	7,050	7,050	0	1	1
	1976	1,331	1,331	15	1,070	15,812	85,336	-	270	1,109	103,612	2,212	2,212	5	36	41
	1977	111	111	5	688	15,681	31,934	-	365	669	49,342	500	500	0	3	3
	1978	278	278	21	4,029	13,007	59,877	-	2,073	1,115	80,122	669	669	0	1	1
	1979	53	53	16	2,856	14,186	44,662	-	1,139	125	62,984	0	0	0	1	1
	1980	23	23	10	2,986	14,681	46,742	-	1,177	329	65,925	592	592	0	31	31
	1981	521	521	8	10,348	17,878	27,426	-	699	252	56,611	0	0	0	8	8
	1982	212	212	11	12,511	16,714	29,614	-	482	561	59,893	4,874	4,874	0	0	0
	1983	200	200	22	6,852	15,094	21,098	-	99	350	43,515	366	366	0	0	0
	1984	104	104	24	8,988	15,053	26,013	-	494	3,380	53,952	1,925	1,925	6	107	113
	1985	225	225	68	11,204	14,249	20,714	-	339	1,533	48,107	2,789	2,789	35	14	49
	1986	50	50	15	7,813	12,899	16,096	-	640	1,542	39,005	3,833	3,833	0	3	3
	1987	56	56	16	6,698	14,668	19,082	-	173	1,205	41,842	1,624	1,624	0	7	7
	1988	30	30	7	9,074	14,688	6,216	-	170	1,208	31,363	799	799	0	15	15
	1989	104	104	33	7,437	13,031	8,629	-	433	2,521	32,084	561	561	0	2	2
	1990	155	155	5	6,064	15,785	8,532	-	248	1,995	32,629	29	29	0	2	2
	1991	140	140	4	3,401	17,039	7,103	-	395	2,652	30,594	4	4	0	2	2
	1992	302	302	12	2,721	19,042	13,888	-	1,522	4,104	41,289	1	1	0	10	10
	1993	139	139	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

Table 15 1. Continued.

	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	0	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	4,391	4,391	17	138	21,058	21,294	239	170	1,072	43,988	38	38		0	0
	2016	2,842	2,842	25	19	16,549	14,442	148	128	3,679	34,990	56	56		0	0
	2017	1,831	1,831	25	19	16,312	14,442	148	128	3,679	34,753	202	202		0	0
Retain catch total		**126,163**	**126,163**	**2,429**	**110,219**	**1,304,467**	**1,972,591**	**14,157**	**23,135**	**87,285**	**3,514,283**	**31,346**	**31,346**	**193**	**913**	**1,106**
Release	2013	1	1													
	2014	7	7													
	2015	14	14													
	2016	2	2													
	2017	2	2													
Release total		**26**	**26**													
Total		**126,189**	**126,189**	**2,429**	**110,219**	**1,304,467**	**1,972,591**	**14,157**	**23,135**	**87,285**	**3,514,283**	**31,346**	**31,346**	**193**	**913**	**1,106**

Table 15-1. Continued.

Catch disposition	Year	TWN Set-net	TWN Gill-net (not specified)	TWN Longline	TWN Others	TWN Purse seine	TWN Total	USA Drift gill-net	USA Handline	USA Longline	USA Pole and line	USA Troll	USA Others	USA Purse seine	USA Sport	USA Total	Total
Retain ca	1936											442				442	**442**
	1937											1,681				1,681	**1,681**
	1938											8,594				8,594	**8,594**
	1939											8,586				8,586	**8,715**
	1940											6,603				6,603	**6,605**
	1941											5,412				5,412	**5,447**
	1942											10,678				10,678	**10,678**
	1943											17,071				17,071	**17,084**
	1944											23,957				23,957	**24,167**
	1945											17,886				17,886	**18,534**
	1946											10,955				10,955	**11,151**
	1947											12,235				12,235	**12,271**
	1948									45		22,457				22,502	**23,486**
	1949									33		24,901				24,934	**25,946**
	1950									27		32,746				32,773	**33,734**
	1951									24		15,629				15,653	**15,739**
	1952									46		23,843			1,373	25,262	**94,253**
	1953									23		15,740			171	15,934	**76,895**
	1954									13		12,246			147	12,406	**61,500**
	1955									9		13,264			577	13,850	**54,535**
	1956									6		18,751			482	19,239	**76,470**
	1957									4		21,165			304	21,473	**92,273**
	1958									7		14,855			48	14,910	**55,704**
	1959									5		20,990			+	20,995	**51,172**
	1960									4		20,100			557	20,661	**63,359**
	1961									5	2,837	12,055	1		1,355	16,253	**52,968**
	1962									7	1,085	19,752	1		1,681	22,526	**47,424**
	1963									7	2,432	25,140			1,161	28,740	**68,940**
	1964									4	3,411	18,388			824	22,627	**62,441**
	1965									3	417	16,542	1		731	17,694	**73,093**
	1966									8	1,600	15,333			588	17,529	**66,172**
	1967	-	-	330	189		519			12	4,113	17,814			707	22,646	**83,182**
	1968	-	-	216	283		499			11	4,906	20,434			951	26,302	**68,837**
	1969	-	-	65	423		488			14	2,996	18,827			358	22,195	**74,242**
	1970	-	-	34	59		93			9	4,416	21,032			822	26,279	**68,719**
	1971	-	-	20	52		72			11	2,071	20,526			1,175	23,783	**90,911**
	1972	-	-	187	-		187			8	3,750	23,600			637	27,995	**103,185**
	1973	-	-	-	-		-			14	2,236	15,653			84	17,987	**107,186**
	1974	-	-	486	-		486			9	4,777	20,178			94	25,058	**117,794**
	1975	-	-	1,240	-		1,240			33	3,243	18,932	10		640	22,858	**95,572**
	1976	-	-	686	-		686			23	2,700	15,905	4		713	19,345	**127,227**
	1977	-	-	572	-		572			37	1,497	9,969			537	12,040	**62,568**
	1978	-	-	6	-		6			54	950	16,613	15		810	18,442	**99,518**
	1979	-	-	81	-		81				303	6,781			74	7,158	**70,277**
	1980	-	1	249	20		270				382	7,556			168	8,106	**74,947**
	1981	1	-	143	12		156			25	748	12,637			195	13,605	**70,901**
	1982	-	-	38	9		47			105	425	6,609	21		257	7,417	**72,443**
	1983	-	-	8	1		9			6	607	9,359			87	10,059	**54,149**
	1984	-	1	-	-		1			2	1,030	9,304		3,728	1,427	15,491	**71,586**
	1985	1	-	-	2		3	2				6,422	118	26	1,176	7,744	**58,917**
	1986	-	-	-	-		-	3				4,713	66	47	196	5,025	**47,916**
	1987	2	2,514	-	-		2,516	5		150		2,772	139	1	74	3,141	**49,186**
	1988	6	7,389	-	-		7,395	15		307		4,221	76	17	64	4,700	**44,302**
	1989	-	8,350	40	-		8,390	4		248		1,896	10	1	160	2,319	**43,460**
	1990	-	16,701	4	39		16,744	29		177		2,733	20	71	24	3,054	**52,613**
	1991	-	3,398	12	-		3,410	17		312		1,917	20		6	2,272	**36,422**
	1992	-	7,866	-	-		7,866			334		4,626	40		2	5,002	**54,470**
	1993	-	-	5	-		5			438		6,325	194		25	6,982	**53,945**
	1994	-	-	83	-		83	38		544		11,068	66		106	11,822	**72,988**
	1995	-	-	4,280	-		4,280	52		882		8,302	4		102	9,342	**67,853**
	1996	-	-	7,596	-	-	7,596	83		1,185		17,150	10	11	88	18,527	**84,016**
	1997	-	-	9,456	-	-	9,456	60		1,653		14,458	12	2	1,018	17,203	**103,606**
	1998	-	-	8,810	-	-	8,810	80		1,120		14,577	15	33	1,208	17,033	**92,029**
	1999	-	-	8,393	-	-	8,393	149		1,542		10,451	61	48	3,621	15,872	**119,066**
	2000	-	-	8,842	-	-	8,842	55		940		9,834	24	4	1,798	12,655	**81,033**

Table 15-1. Continued.

	2001	-	1	8,684	+	-	8,685	94		1,295		11,543	39	51	1,635	14,657	**88,522**
	2002	-	-	7,965	-	-	7,965	30		525		11,003	13	4	2,357	13,932	**104,070**
	2003	-	-	7,166	-	-	7,166	16		524		14,246	8	44	2,214	17,052	**90,090**
	2004	-	-	4,988	-	-	4,988	12		361		13,630	3	1	1,506	15,513	**86,252**
	2005	-	-	4,472	-	-	4,472	20		296		8,654	1		1,719	10,690	**59,008**
	2006	-	-	4,317	-	-	4,317	3		270		12,642	+		385	13,300	**61,403**
	2007	-	+	2,916	-	-	2,916	4	94	250		11,911	+	77	461	12,797	**88,579**
	2008	-	-	3,069	-	-	3,069	1	28	354		11,762	+		418	12,563	**62,698**
	2009	-	-	2,378	-	-	2,378	4	97	203		12,343	+	31	944	13,622	**77,683**
	2010	+	-	2,818	-	-	2,818	5	53	421		11,691	0		862	13,032	**64,258**
	2011	+	1	3,434	2	0	3,437	5	84	708		10,147	0		421	11,365	**67,988**
	2012	2	2	2,643	0	0	2,647	8	253	660		14,152	2		1,212	16,287	**83,150**
	2013	1	+	4,427	0	0	4,428	5	46	317		12,312	0		839	13,519	**79,166**
	2014	1	1	2,617	+	0	2,619	0	49	208		13,369			1,045	14,671	**74,027**
	2015	1	2	3,020	4	0	3,027	0.5	62	243		11,560	2		926	12,794	**64,238**
	2016	+	+	3,406	0	0	3,406	0.8	24	248		10,797	0		675	11,746	**53,040**
	2017	(+)	(+)	(4333)	(0)	(0)	(4333)		34	95		7,216	0		372	7,717	**48,836**
Retain catch total		**15**	**46,227**	**124,535**	**1,095**	**0**	**171,872**	**800**	**824**	**17,463**	**52,932**	**1,080,169**	**997**	**4,197**	**47,394**	**1,204,776**	**5,049,546**
Release	2013																**1**
	2014																**7**
	2015																**14**
	2016																**2**
	2017																**2**
Release total																	**26**
Total		**(15)**	**(46,226)**	**(124,535)**	**(1,091)**	**-**	**(171,872)**	**800**	**824**	**17,463**	**52,932**	**1,080,169**	**997**	**4,197**	**47,394**	**1,204,776**	**5,049,572**

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

Catch disposition	Year	JPN							KOR						MEX		
		Set-net	Longline[1]	Pole and line	Troll[2]	Others	Purse seine	JPN Total	Set-net	Longline	Purse seine	Trawl	Troll	KOR Total [3]	Others	Purse seine	MEX Total
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							32	171	203
	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							-	130	130
	1962	2,545	5,769	747	1,683	293	10,657	21,694							-	294	294
	1963	2,797	6,077	1,256	2,542	294	9,786	22,752							-	412	412
	1964	1,475	3,140	1,037	2,784	1,884	8,973	19,293							-	131	131
	1965	2,121	2,569	831	1,963	1,106	11,496	20,086							-	289	289
	1966	1,261	1,370	613	1,614	129	10,082	15,069							-	435	435
	1967	2,603	878	1,210	3,273	302	6,462	14,728							-	371	371
	1968	3,058	500	983	1,568	217	9,268	15,594							-	195	195
	1969	2,187	878	721	2,219	195	3,236	9,436							-	260	260
	1970	1,779	607	723	1,198	224	2,907	7,438							-	92	92
	1971	1,555	697	938	1,492	317	3,721	8,720		0				0	-	555	555
	1972	1,107	512	944	842	197	4,212	7,814		0				0	-	1,646	1,646
	1973	2,351	838	526	2,108	636	2,266	8,725		0				0	-	1,084	1,084
	1974	6,019	1,177	1,192	1,656	754	4,106	14,904		0				0	-	344	344
	1975	2,433	1,061	1,401	1,031	808	4,491	11,225		3				3	-	2,145	2,145
	1976	2,996	320	1,082	830	1,237	2,148	8,613		5				5	-	1,968	1,968
	1977	2,257	338	2,256	2,166	1,052	5,110	13,179		0				0	-	2,186	2,186
	1978	2,546	648	1,154	4,517	2,276	10,427	21,568		3				3	-	545	545
	1979	4,558	729	1,250	2,655	2,429	13,881	25,502		0				0	-	213	213
	1980	2,521	811	1,392	1,531	1,953	11,327	19,535		0				0	-	582	582
	1981	2,129	590	754	1,777	2,653	25,422	33,325		0				0	-	218	218
	1982	1,667	718	1,777	864	1,709	19,234	25,969		0	31			31	-	506	506
	1983	972	217	356	2,028	1,117	14,774	19,464		0	13			13	-	214	214
	1984	2,234	142	587	1,874	868	4,433	10,138		1	4			5	-	166	166
	1985	2,562	105	1,817	1,850	1,175	4,154	11,663		0	1			1	-	676	676
	1986	2,914	102	1,086	1,467	719	7,412	13,700		0	344			344	-	189	189
	1987	2,198	211	1,565	880	445	8,653	13,952		13	89			102	-	119	119
	1988	843	157	907	1,124	498	3,605	7,134		0	32			32	1	447	448
	1989	748	209	754	903	283	6,190	9,087		0	71			71	-	57	57
	1990	716	309	536	1,250	455	2,989	6,255		0	132			132	-	50	50
	1991	1,485	218	286	2,069	650	9,808	14,516		0	265			265	-	9	9
	1992	1,208	513	166	915	1,081	7,162	11,045		0	288			288	-	0	0
	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	2	63	65
	1995	1,859	678	270	4,778	586	18,909	27,080		0	821			821	-	11	11
	1996	1,149	901	94	3,640	570	7,644	13,998		0	102			102	-	3,700	3,700
	1997	803	1,300	34	2,740	811	13,152	18,840		0	1,054			1,054	-	367	367
	1998	874	1,255	85	2,876	700	5,391	11,181		0	188			188	0	1	1
	1999	1,097	1,157	35	3,440	709	16,173	22,611		0	256			256	35	2,369	2,404
	2000	1,125	953	102	5,217	689	16,486	24,572		0	2,401	0		2,401	99	3,019	3,118

Table 15-2. Continued.

	2001	1,366		791		180	3,466	782	7,620	14,205		0	1,176	10		1,186	-	863	863
	2002	1,100		841		99	2,607	631	8,903	14,181		0	932	1		933	2	1,708	1,710
	2003	839		1,237		44	2,060	446	5,768	10,394		0	2,601	0		2,601	43	3,211	3,254
	2004	896		1,847		132	2,445	514	8,257	14,091		0	773	0		773	14	8,880	8,894
	2005	2,182		1,925		549	3,633	548	12,817	21,654		0	1,318	9		1,327	-	4,542	4,542
	2006	1,421		1,121		108	1,860	777	8,880	14,167		0	1,012	3		1,015	-	9,806	9,806
	2007	1,503		1,762		236	2,823	657	6,840	13,821		0	1,281	4		1,285	-	4,147	4,147
	2008	2,358		1,390		64	2,377	770	10,221	17,180		0	1,866	10		1,876	15	4,407	4,422
	2009	2,236		1,080		50	2,003	575	8,077	14,021		0	936	4		940	-	3,019	3,019
	2010	1,603		890		83	1,583	495	3,742	8,396		0	1,196	16		1,212	-	7,746	7,746
	2011	1,651		837		63	1,820	283	8,340	12,994		0	670	14	+	684	1	2,731	2,732
	2012	1,932		673		113	570	343	2,462	6,093		0	1,421	2		1,423	1	6,668	6,669
	2013	1,415	[4]	784		8	904	529	2,771	6,411	1	0	604	+	+	605		3,154	3,154
	2014	1,907		683		5	1,023	499	5,456	9,573	6	0	1,305	+	0	1,311		4,862	4,862
	2015	1,242		618		8	413	432	3,645	6,357	1	0	676	+	0	677		3,082	3,082
	2016	1,227		688		44	778	508	5,095	8,341	3	0	1,025	2	0	1,030		2,709	2,709
	2017	2,255		(887)	[5]	86	603	665	4,540	9,035	3	0	734	6	0	743		3,643	3,643
Retain catch total		**131,702**	[4]	**91,084**	[5]	**54,804**	**129,756**	**47,665**	**564,316**	**(1,019,327)**	**14**	**25**	**25,708**	**81**	**0**	**25,829**	**245**	**101,407**	**101,652**
Total		**131,702**		**(91,084)**		**54,804**	**129,756**	**47,665**	**564,316**	**(1,019,327)**	**14**	**25**	**25,708**	**81**	**0**	**25,829**	**245**	**101,407**	**101,652**

Table 15-2. Continued.

Catch disposition	Year	TWN							USA									Total
		Set-net	Gill-net (not specified)	Drift gill-net	Longline	Others	Purse seine	TWN Total	Drift gill-net	Longline	Pole and line	Troll	Hook and Line	Others	Purse seine	Sport	USA Total [6]	
Retain catch	1952														2,076	2	2,078	**19,162**
	1953														4,433	48	4,481	**20,110**
	1954														9,537	11	9,548	**28,547**
	1955														6,173	93	6,266	**31,988**
	1956														5,727	388	6,115	**40,144**
	1957														9,215	73	9,288	**36,543**
	1958														13,934	10	13,944	**28,584**
	1959										56				3,506	13	3,575	**19,974**
	1960										+				4,547	1	4,548	**25,885**
	1961										16				7,989	23	8,028	**30,810**
	1962										+				10,769	25	10,794	**32,782**
	1963										28				11,832	7	11,867	**35,031**
	1964										39				9,047	7	9,093	**28,517**
	1965				54			54			11	+		66	6,523	1	6,601	**27,030**
	1966				-			-			12				15,450	20	15,482	**30,986**
	1967				53			53			+				5,517	32	5,549	**20,701**
	1968				33			33			8				5,773	12	5,793	**21,615**
	1969				23			23			9				6,657	15	6,681	**16,400**
	1970				-			-			+				3,873	19	3,892	**11,422**
	1971				1			1			+				7,804	8	7,812	**17,088**
	1972				14			14			3			42	11,656	15	11,716	**21,190**
	1973				33			33			5	+		20	9,639	54	9,718	**19,560**
	1974				47	15		62			+	+		30	5,243	58	5,331	**20,641**
	1975				61	5		66			83			1	7,353	34	7,471	**20,910**
	1976				17	2		19			22	+		3	8,652	21	8,698	**19,303**
	1977				131	2		133			10			3	3,259	19	3,291	**18,789**
	1978				66	2		68			4			2	4,663	5	4,674	**26,858**
	1979				58	-		58			5			1	5,889	11	5,906	**31,679**
	1980				114	5		119			+			24	2,327	7	2,358	**22,594**
	1981				179	-		179	4		+	10		+	867	9	890	**34,612**
	1982			2	207	-		209	9		1			+	2,639	11	2,660	**29,375**
	1983			2	175	-	9	186	31		59			2	629	33	754	**20,631**
	1984			-	477	8	5	490	6	1	5			18	673	49	752	**11,551**
	1985			11	210	-	80	301	8					20	3,320	89	3,437	**16,078**
	1986			13	70	-	16	99	16					41	4,851	12	4,920	**19,252**
	1987			14	365	-	21	400	2					18	861	34	915	**15,488**
	1988			37	108	25	197	367	4					46	923	6	979	**8,960**
	1989			51	205	3	259	518	3					18	1,046	112	1,179	**10,912**
	1990			299	189	16	149	653	11					81	1,380	65	1,537	**8,627**
	1991			107	342	12	-	461	4	2				+	410	92	508	**15,759**
	1992			3	464	5	73	545	9	38				14	1,928	110	2,099	**13,977**
	1993				471	3	1	475	32	42				29	580	283	966	**10,781**
	1994				559	-		559	28	30				1	906	86	1,051	**16,891**
	1995				335	2		337	20	29				+	657	245	951	**29,200**
	1996	-	-		956	-	-	956	43	25		2		+	4,639	40	4,749	**23,505**
	1997	-	-		1,814	-	-	1,814	58	26		1		48	2,240	131	2,504	**24,579**
	1998	-	-		1,910	-	-	1,910	40	54		128		59	1,771	422	2,474	**15,754**
	1999	-	-		3,089	-	-	3,089	22	54		20		88	184	408	776	**29,136**
	2000	-	1		2,780	1	-	2,782	30	19		1		11	693	319	1,073	**33,946**
	2001	-	2		1,839	2	-	1,843	35	6		6		1	292	344	684	**18,781**
	2002	-	3		1,523	1	-	1,527	7	2		1		2	50	613	675	**19,026**
	2003	-	10		1,863	11	-	1,884	14	1				3	22	355	395	**18,528**
	2004	-	1		1,714	2	-	1,717	10	1				+		50	61	**25,536**
	2005	1	-		1,368	1	-	1,370	5	1				1	201	73	281	**29,174**
	2006	1	-		1,149	-	-	1,150	1	1				+		94	96	**26,234**
	2007	2	8		1,401	-	-	1,411	2	+				+	42	12	56	**20,720**
	2008	1	1		979	-	-	981	1	+				+		63	64	**24,523**
	2009	1	10		877	-	-	888	3	1		0		2	410	156	572	**19,440**
	2010	29	7		373	-	-	409	1	0				0		88	89	**17,852**
	2011	16	7		292	1	0	316	18	0		0		100		225	343	**17,069**
	2012	2	0		210	2	-	214	4	0		0		38		400	442	**14,841**
	2013	2	1		331	0	0	334	7	1		0		3		809	820	**11,324**
	2014	38	4		483	0	0	525	5	+		0		2	401	436	844	**17,115**
	2015	25	1		552	0	0	578	4	+			26	0	68	382	481	**11,174**
	2016	0	+		454	0	0	454	9	+			30		316	286	641	**13,175**
	2017	(0)	(+)		415	(0)	0	415	1	1			18		466	369	855	**14,691**
Retain catch total		**118**	**56**	**539**	**31,433**	**126**	**810**	**33,082**	**508**	**335**	**376**	**169**	**73**	**838**	**242,528**	**8,343**	**252,316**	**(1,433,061)**
Total		**118**	**56**	**539**	**31,433**	**126**	**810**	**33,082**	**508**	**335**	**376**	**169**	**73**	**838**	**242,528**	**8,343**	**252,316**	**(1,433,061)**

Parenthetic numbers 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 2017 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 15-3. 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. "+"; Bellow 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN						KOR		MEX		
		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

Table 15-3. Continued.

	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	6,242	662	662	222	-	222
	2011	2	193	4,019	12	233	4,459	962	962	-	-	-
	2012	8	371	4,030	63	288	4,760	856	856	0	0	0
	2013	13	290	4,243	168	291	5,005	1,071	1,071	0	0	0
	2014	7	269	4,360	2	291	4,929	829	829	0	0	0
	2015	3	277	5,101	205	281	5,867	776	776	-	-	-
	2016	2	303	5,496	171	256	6,228	582	582	-	-	-
	2017	(2)	(303)	(4,222)	(171)	(256)	4,954	583	583	-	-	-
Retain catch total		**(932)**	**(44,067)**	**(581,602)**	**(41,459)**	**(6,569)**	**674,629**	**11,756**	**11,756**	**3,430**	**0**	**3,430**
Release	2010											
	2011											
Release total												
Total		**(0,934)**	**(43,756)**	**(575,961)**	**(41,085)**	**(6,323)**	**(674,629)**	**11,174**	**11,174**	**3,430**	**-**	**3,430**

Table 15-3. Continued.

Catch disposition	Year	TWN							USA										Total
		Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Drift gill-net	Harpoon	Handline	Longline	Hook and line	Troll	Others	Purse seine	Sport	USA Total	
Retain catch	1951																		**11,678**
	1952																		**11,691**
	1953				-			-											**12,408**
	1954				-			-											**13,611**
	1955				-			-											**14,111**
	1956				-			-											**15,486**
	1957				-			-											**15,251**
	1958				-			-											**19,734**
	1959				427			427											**18,694**
	1960				520			520											**21,919**
	1961				318			318											**21,466**
	1962				494			494											**12,609**
	1963				343			343											**11,586**
	1964				358			358											**9,210**
	1965				331			331											**11,322**
	1966				489			489											**12,252**
	1967	-	-	5	646	30		681											**12,689**
	1968	-	8	3	763	1		775											**12,424**
	1969	-	1	6	843	-		850											**12,186**
	1970	-	1	5	904	-		910		612		5						617	**11,074**
	1971	-	-	3	992	-		995		99		1						100	**9,041**
	1972	-	-	12	862	-		874		171								171	**8,732**
	1973	-	-	113	860	6		979		399								399	**9,845**
	1974	-	-	98	881	38		1,017		406								406	**9,631**
	1975	-	-	152	928	1		1,081		557								557	**12,270**
	1976	-	-	159	636	35		830		42								42	**13,714**
	1977	-	2	139	578	-		719		318		17						335	**12,980**
	1978	-	3	10	546	-		559		1,699		9						1,708	**14,074**
	1979	-	5	24	668	4		701		329		7						336	**11,937**
	1980	-	4	72	613	1		690	160	566		5						731	**10,643**
	1981	-	3	18	658	4		683	473	271		3	2					749	**11,320**
	1982	-	3	46	856	-		905	945	156		5	3	6	1			1,116	**10,703**
	1983	-	3	164	783	-		950	1,693	58		5	2	3	1	1		1,763	**12,752**
	1984	43	5	259	733	-		1,040	2,647	104		15	49			26		2,841	**13,600**
	1985	3	29	166	566	61		825	2,990	305	4	2			104			3,405	**16,032**
	1986	3	1	201	456	6		667	2,069	291	4	2			109			2,475	**14,418**
	1987	-	-	187	1,331	3		1,521	1,529	235	4	24			31			1,823	**14,999**
	1988	-	1	80	777	183		1,041	1,376	198	6	24			64			1,668	**13,487**
	1989	3	2	61	1,541	35		1,642	1,243	62	7	218			56			1,586	**12,716**
	1990	4	2	118	1,452	88		1,664	1,131	64	5	2,437			43			3,680	**13,207**
	1991	4	2	205	1,430	56		1,697	944	20	6	4,535			44			5,549	**13,649**
	1992	12	1	287	1,494	33		1,827	1,356	75	1	5,762			47			7,241	**18,895**
	1993	13	3	194	1,228	100		1,538	1,412	168	4	5,936			161			7,681	**19,672**
	1994	12	3	211	1,155	9		1,390	792	157	4	3,807			24			4,784	**15,671**
	1995	6	2	14	1,185	203		1,410	771	97	6	2,981			29			3,884	**14,137**
	1996	10	2	19	710	1	-	742	761	81	5	2,848			15			3,710	**13,524**
	1997	8	1	27	1,397	1	-	1,434	708	84	7	3,393			11			4,203	**14,730**
	1998	15	9	17	1,198	-	-	1,239	931	48	7	3,681			19			4,686	**14,518**
	1999	5	5	51	1,455	+	-	1,516	606	81	9	4,329			27			5,052	**14,497**
	2000	5	6	74	3,716	-	-	3,801	649	90		4,834			33			5,606	**18,871**

Table 15-3. Continued.

	2001	8	18	64	4,853	-	-	4,943	375	52		1,969			19			2,415	**17,159**
	2002	16	8	1	5,400	1	-	5,426	302	90		1,524			3			1,919	**16,598**
	2003	8	3	-	4,771	-	-	4,782	216	107	10	1,958			11			2,302	**15,519**
	2004	7	6	1	4,248	2	-	4,264	182	69	7	1,185			44			1,487	**14,658**
	2005	5	3	16	3,964	2	-	3,990	220	77	5	1,622			5			1,929	**14,692**
	2006	7	2	49	4,382	3	-	4,443	443	71	4	1,211			5			1,734	**16,048**
	2007	2	2	20	4,099	2	-	4,125	490	59	5	1,735		1				2,290	**16,486**
	2008	3	6	39	3,745	+	-	3,793	405	48	6	2,014			19			2,492	**14,683**
	2009	83	7	31	3,550	-	-	3,671	253	50	5	1,817		0	0			2,125	**14,363**
	2010	6	4	42	2,844	-	-	2,896	62	37	3	1,676			18			1,796	**11,818**
	2011	8	17	52	3,577	1	+	3,655	119	24	5	1,623			90			1,861	**10,937**
	2012	3	15	30	3,746	0	0	3,794	118	5	6	1,395		1	1			1,526	10,936
	2013	2	8	0	2,846	1	0	2,857	95	6	6	1,270		1	7			1,385	10,318
	2014	4	4	0	2,817	+	+	2,825	124	5	7	1,665		1	0			1,802	10,385
	2015	4	4	0	3,199	0	0	3,207	97	5	5	1,516	1	+	14			1,639	11,489
	2016	2	4	+	2,054	1	0	2,061	193	26	4	1,092	1		33			1,348	10,219
	2017	(2)	(4)	(+)	(2,197)	(1)	+	2,204	176	25	6	1,617	3		44			1,870	9,611
Retain catch total		**(314)**	**(218)**	**(3545)**	**(98216)**	**(912)**	**(0)**	**(103,205)**	**28,880**	**8,574**	**157**	**70,157**	**59**	**13**	**1,088**	**27**	**+**	**(108,954)**	**(901,974)**
Release	2010															0		0	**0**
	2011															0		0	**0**
Release total																**0**		**0**	**0**
Total		**(312)**	**(214)**	**(3,545)**	**(96,162)**	**(911)**	**(0)**	**(101,144)**	**28,656**	**8,548**	**153**	**69,064**	**56**	**14**	**1,042**	**27**	**+**	**107,560**	**(901,974)**

Parenthetic numbers are provisional.

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. "+"; Bellow 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN						KOR			MEX	
		Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	Purse seine	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	-	-

Table 15.4. Continued.

	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	1,307	62	34	2,052	33		33	-	-
	2013	39	336	1,463	52	34	1,924	65		65	-	-
	2014	35	173	1,107	35	22	1,372	82		82	-	-
	2015	37	287	1,331	80	27	1,762	44		44	-	-
	2016	(25)	(308)	(994)	(74)	(32)	1433	61		61	-	-
	2017	(25)	(308)	(809)	(74)	(32)	1248	81		81	-	-
Retain catch total		**(4,985)**	**(80,943)**	**(315,039)**	**(49,652)**	**(6,491)**	**(457,110)**	**6,327**		**6,327**	-	-
Release	2010											
	2011											
	2016								0	0		
Release total									**0**	**0**		
Total		**(4,985)**	**(80,943)**	**(315,039)**	**(49,652)**	**(6,491)**	**(454,166)**	**6,327**	**0**	**6,327**		

Table 15-4. Continued.

Catch disposition	Year	TWN							USA							Total
		Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Handline	Longline	Troll	Others	Purse seine	Sport	USA Total	
Retain catch	1951															**4,447**
	1952													23	23	**5,210**
	1953					-		-						5	5	**3,145**
	1954					-		-						16	16	**4,223**
	1955					-		-						5	5	**4,153**
	1956					-		-						34	34	**5,818**
	1957					-		-						42	42	**5,809**
	1958				543	387		930						59	59	**8,288**
	1959				391	354		745						65	65	**8,312**
	1960				398	350		748						30	30	**6,682**
	1961				306	342		648						24	24	**7,060**
	1962				332	211		543						5	5	**8,317**
	1963				560	199		759						68	68	**8,953**
	1964				392	175		567						58	58	**17,317**
	1965				355	157		512						23	23	**14,951**
	1966				370	180		550						36	36	**10,689**
	1967	-	-	141	387	63		591						49	49	**14,019**
	1968	-	40	134	333	34		541						51	51	**17,778**
	1969	-	5	159	573	28		765						30	30	**12,613**
	1970	-	8	175	495	6		684						18	18	**15,604**
	1971	-	16	101	449	18		584						17	17	**14,544**
	1972	-	1	124	389	1		515						21	21	**9,760**
	1973	-	4	115	569	20		708						9	9	**11,791**
	1974	-	7	53	674	58		792						55	55	**11,810**
	1975	-	7	86	796	3		892						27	27	**13,744**
	1976	-	9	61	379	70		519						31	31	**10,110**
	1977	-	9	207	541	3		760						41	41	**9,062**
	1978	-	7	70	618	1		696						37	37	**11,099**
	1979	2	18	104	458	-		582						36	36	**9,624**
	1980	-	39	92	284	1		416						33	33	**11,515**
	1981	-	25	70	508	-		603						60	60	**9,448**
	1982	-	26	112	404	-		542						41	41	**9,358**
	1983	-	31	144	555	39		769						39	39	**7,603**
	1984	-	16	314	965	-		1,295						36	36	**8,323**
	1985	1	6	152	513	23		695			18			42	60	**8,496**
	1986	-	13	119	179	16		327			19			19	38	**11,876**
	1987	1	2	132	414	16		565	1	272	29			28	330	**12,042**
	1988	7	12	70	464	80		633		504	54			30	588	**11,146**
	1989	-	23	124	192	10		349	+	612	24			52	688	**9,096**
	1990	12	16	207	139	21		395	+	538	27			23	588	**6,970**
	1991	-	81	173	290	32		576	+	663	41			12	716	**7,180**
	1992	-	11	163	220	24		418	1	459	37			25	522	**6,712**
	1993	3	7	132	226	-		368	1	471	67			11	550	**8,222**
	1994	4	5	176	138	11		334	+	326	35			17	378	**7,290**
	1995	4	5	67	110	6		192	+	543	52			14	609	**7,698**
	1996	3	8	30	188	6	-	235	1	418	53			20	492	**5,802**
	1997	3	9	33	351	-	-	396	1	352	37			21	411	**6,323**
	1998	6	16	19	304	-	-	345	+	378	26			23	427	**6,564**
	1999	5	8	26	197	-	-	236	1	364	27			12	404	**5,546**
	2000	6	18	29	315	1	-	369		200	15			10	225	**4,758**

Table 15-4. Continued.

	2001	5	16	30	250	-	-	301		351	44			+	395	**4,585**
	2002	8	15	6	477	-	-	506	+	226	30			+	256	**4,068**
	2003	5	27	11	922	+	-	965	+	538	29			+	567	**4,862**
	2004	5	10	7	522	2	-	546	2	376	31			+	409	**4,160**
	2005	9	9	5	783	9	-	815	+	511	20			+	531	**4,025**
	2006	-	30	117	741	+	-	888	+	611	21			+	632	**4,022**
	2007	-	29	141	301	-	-	471		276	13			+	289	**3,026**
	2008	-	43	168	270	2	-	483		427	14				441	**3,361**
	2009	-	46	92	262	-	-	400		258	10				268	**2,410**
	2010	-	42	131	253	3	-	429		165	19		1		185	**2,688**
	2011	1	27	95	343	4	0	470		362	16		0		378	**2,637**
	2012	+	34	114	443	1	+	592		282	11				293	**2,970**
	2013	+	24	197	372	+	+	593		398	8				406	**2,988**
	2014	+	5	64	140	+	1	210		426	12			1	439	**2,103**
	2015	1	4	28	228	+	0	261		493	11	0			504	**2,571**
	2016	0	3	21	214	+	1	239		390	12				402	**2,135**
	2017	(0)	(3)	(21)	(389)	+	(0)	413		411	6				417	**2,159**
Retain catch total		**(91)**	**(875)**	**(5,162)**	**(24,174)**	**(2,967)**	**(2)**	**(33,271)**	**8**	**12,601**	**868**	**0**	**1**	**1,484**	**14,962**	**496,744**
Release	2010												1		1	**1**
	2011												0		0	**0**
	2016						1	1								**1**
Release total							**1**	**1**					**1**		**1**	**2**
Total		**(90)**	**(870)**	**(6,454)**	**(24,174)**	**(2,967)**	**(3)**	**(32,655)**	**8**	**12,601**	**868**	**0**	**2**	**1,484**	**14,963**	**(496,746)**

Parenthetic numbers are provisional.

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. "+"; Bellow 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN		KOR			MEX	
		Longline	JPN Total	Longline	Purse seine	KOR Total	Sport	MEX Total
Retain catch	1953							
	1954							
	1955							
	1956							
	1957							
	1958							
	1959							
	1960							
	1961							
	1962							
	1963							
	1964							
	1965							
	1966							
	1967							
	1968							
	1969							
	1970							
	1971	5,461	5,461	0		0		
	1972	6,772	6,772	0		0		
	1973	6,453	6,453	0		0		
	1974	6,545	6,545	0		0		
	1975	4,374	4,374	0		0		
	1976	5,018	5,018	0		0		
	1977	4,780	4,780	0		0		
	1978	5,900	5,900	0		0		
	1979	5,949	5,949	0		0		
	1980	5,613	5,613	155		155		
	1981	5,518	5,518	0		0		
	1982	6,051	6,051	351		351		
	1983	4,796	4,796	82		82		
	1984	6,248	6,248	155		155		
	1985	5,164	5,164	45		45		
	1986	5,922	5,922	86		86		
	1987	5,370	5,370	89		89		
	1988	5,054	5,054	133		133		
	1989	5,117	5,117	50		50		
	1990	4,116	4,116	44		44	-	-
	1991	4,094	4,094	75		75	-	-
	1992	3,721	3,721	60		60	-	-
	1993	4,600	4,600	36		36	-	-
	1994	5,832	5,832	2		2	-	-
	1995	5,907	5,907	0		0	-	-

Table 15-5. Continued.

	1996	3,260	3,260	10		10	-	-
	1997	3,697	3,697	145		145	-	-
	1998	3,438	3,438	335		335	-	-
	1999	3,751	3,751	164		164	-	-
	2000	3,606	3,606	96		96	-	-
	2001	3,594	3,594	166		166	-	-
	2002	2,976	2,976	152		152	-	-
	2003	2,836	2,836	158		158	-	-
	2004	2,977	2,977	226		226	-	-
	2005	2,506	2,506	303		303	-	-
	2006	2,414	2,414	217		217	-	-
	2007	2,016	2,016	120		120	-	-
	2008	2,096	2,096	219		219	-	-
	2009	1,840	1,840	224		224	-	-
	2010	2,457	2,457	257		257	-	-
	2011	2,343	2,343	684		684	-	-
	2012	2,019	2,019	587		587	-	-
	2013	2,179	2,179	963		963	-	-
	2014	1,903	1,903	801		801	-	-
	2015	1,622	1,622	531		531	-	-
	2016	1,582	1,582	1,116		1,116	-	-
	2017	(1,426)	(1,426)	1,453		1,453	-	-
Retain catch total		**(190,913)**	**(190,913)**	**8,837**		**10,290**	**-**	**-**
Release	2010							
	2011							
	2013							
	2015				0	0		
	2016				1	1		
	2017							
Release total					**1**	**1**		
Total		**(190,913)**	**(190,913)**	**8,837**	**1**	**10,291**	**-**	**-**

Table 15-5. Continued.

Catch disposition	Year	TWN							USA						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				0			0							-
	1954				0			0							-
	1955				0			0							-
	1956				0			0							-
	1957				0			0							-
	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	0	0	317	898	167		1,382							**1,382**
	1968	0	30	649	1,433	120		2,232							**2,232**
	1969	0	58	465	1,232	103		1,858							**1,858**
	1970	1	21	604	1,385	70		2,081							**2,081**
	1971	0	13	473	1,331	118		1,935							**7,396**
	1972	0	14	490	1,205	50		1,759							**8,531**
	1973	0	12	275	1,650	265		2,202							**8,655**
	1974	1	6	355	2,144	146		2,652							**9,197**
	1975	0	3	421	2,638	207		3,269							**7,643**
	1976	0	9	511	1,315	162		1,997							**7,015**
	1977	0	11	391	1,183	110		1,695							**6,475**
	1978	1	15	364	1,633	7		2,020							**7,920**
	1979	3	19	362	1,646	164		2,194							**8,143**
	1980	0	35	444	1,185	170		1,834							**7,602**
	1981	0	35	313	1,840	69		2,257							**7,775**
	1982	0	7	306	2,139	120		2,572							**8,974**
	1983	0	26	741	2,122	127		3,016							**7,894**
	1984	0	22	960	1,789	111		2,882							**9,285**
	1985	9	11	747	1,187	43		1,997			145			145	**7,351**
	1986	4	90	839	1,723	107		2,763			220			220	**8,991**
	1987	12	9	973	4,627	1		5,622		51	261			312	**11,393**
	1988	20	8	658	2,822	589		4,097		102	266			368	**9,652**
	1989	10	14	640	2,691	9		3,364		356	326			682	**9,213**
	1990	3	24	427	1,749	143		2,346		378	295			673	**7,179**
	1991	4	50	338	2,288	152		2,832		297	346			643	**7,644**
	1992	25	40	432	3,786	110		4,393		347	260			607	**8,781**
	1993	44	41	400	4,135	82		4,702		339	311			650	**9,988**
	1994	12	30	206	3,007	7		3,262		362	298			660	**9,756**
	1995	15	36	895	3,896	5		4,847		570	315			885	**11,639**

Table 15-5. Continued.

	1996	13	35	270	3,337	10	0	3,665		467	409			876	**7,811**
	1997	5	48	194	3,683	0	0	3,930		487	378			865	**8,637**
	1998	8	59	91	3,624	1	0	3,783		395	242			637	**8,193**
	1999	21	32	135	3,417	0	0	3,605		357	293			650	**8,170**
	2000	24	40	186	4,131	2	0	4,383		314	235			549	**8,634**
	2001	18	57	229	4,733	0	0	5,037		399	291			690	**9,487**
	2002	13	63	32	4,448	6	0	4,562		264	225	1		490	**8,180**
	2003	20	107	52	7,685	4	0	7,868		363	210			573	**11,435**
	2004	14	93	36	6,672	9	0	6,824		283	188	5		476	**10,503**
	2005	8	65	48	7,630	16	0	7,767		337	187			524	**11,100**
	2006	12	15	30	5,729	0	0	5,786		409	160			569	**8,986**
	2007	3	17	20	5,117	0	0	5,157	1	262	127			390	**7,683**
	2008	10	16	15	5,477	1	0	5,519	1	349	198			548	**8,382**
	2009	9	12	9	4,638	1	0	4,669	1	360	15			376	**7,109**
	2010	5	27	15	4,959	1	0	5,007	2	306	148			456	**8,177**
	2011	3	18	17	4,625	9	2	4,674	2	373	199			574	**8,275**
	2012	6	13	16	4,097	+	12	4,144	2	298	141			441	**7,191**
	2013	2	6	16	4,607	+	9	4,640	3	406	137			546	**8,328**
	2014	4	11	124	4,861	5	7	5,012	4	535	159			698	**8,414**
	2015	3	14	177	4,306	+	3	4,503	3	631	196			830	**7,486**
	2016	3	23	158	3,398	3	4	3,589	2	554	161			717	**7,004**
	2017	(3)	(23)	(158)	(3,977)	(3)	(6)	4,170	4	684	153		3	844	**7,893**
Retain catch total		**(368)**	**(1,460)**	**(16,866)**	**(169,398)**	**(3,602)**	**(37)**	**(195,901)**	**21**	**10,951**	**7,342**	**6**		**19,164**	**(416,268)**
Release	2010												1	1	**1**
	2011												6	6	**6**
	2013						5	5							**5**
	2015						3	3							**3**
	2016						4	4							**5**
	2017						6								
Release total							**12**	**12**					**7**	**7**	**20**
Total		**(368)**	**(1,460)**	**(16,866)**	**(169,398)**	**(3,602)**	**(49)**	**(195,913)**	**21**	**10,951**	**7,342**	**6**	**7**	**19,171**	**(416,288)**

Parenthetic numbers 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. "+"; Bellow 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN						KOR		MEX	
		Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	KOR Total	Others	MEX Total
Retain catch	1985										
	1986										
	1987										
	1988										
	1989										
	1990										
	1991										
	1992										
	1993										
	1994	9	600	30,545	537	4	31,695				
	1995	7	503	35,392	503	4	36,409				
	1996	6	493	26,449	314	4	27,266				
	1997	8	622	29,716	164	6	30,517				
	1998	7	636	29,187	264	4	30,098				
	1999	7	861	25,473	162	2	26,506				
	2000	7	759	26,424	483	1	27,675				
	2001	7	760	28,831	215	2	29,816			0	0
	2002	6	768	23,464	315	1	24,554			0	0
	2003	7	1,350	24,661	368	2	26,387			0	0
	2004	7	1,202	24,037	258	3	25,507			0	0
	2005	0	1,321	28,654	654	2	30,631			2,721	2,721
	2006	5	1,204	24,549	615	2	26,375			2,765	2,765
	2007	5	1,323	24,273	810	2	26,413			3,324	3,324
	2008	0	944	18,704	875	1	20,524			4,355	4,355
	2009	0	1,208	19,401	769	1	21,379			4,423	4,423
	2010	4	962	22,718	833	1	24,518			4,469	4,469
	2011	8	795	18,433	860	3	20,099			3,719	3,719
	2012	2	1,120	12,494	762	3	14,380			4,108	4,108
	2013	6	1,103	12,385	626	2	14,124	75	75	4,494	4,494
	2014	4	1,060	12,691	598	2	14,354	100	100	5,502	5,502
	2015	21	697	12,140	387	2	13,247	53	53	-	-
	2016	26	1,832	7,487	226	2	9,574	0	0	-	-
	2017	(26)	(1832)	(7,487)	(226)	(2)	(9,574)	8	8	-	-
Retain catch total		**186**	**23,957**	**525,597**	**11,823**	**59**	**561,622**	**236**	**236**	**39,880**	**39,880**
Release	2015							0	0		
	2016							8	8		
	2017							11	11		
Release total								**19**	**19**		
Total		**186**	**23,957**	**525,597**	**11,823**	**59**	**561,622**	**255**	**255**	**39,880**	**39,880**

Table 15-6. Continued.

Catch disposition	Year	TWN		USA						Total
		Longline	TWN Total	Drift gill-net	Longline	Troll	Others	Sport	USA Total	
Retain catch	1985			0			1		1	**1**
	1986			1			1		2	**2**
	1987			1			1		2	**2**
	1988			0			3		3	**3**
	1989						6		6	**6**
	1990			0			20		20	**20**
	1991			0			1		1	**1**
	1992			1			1		2	**2**
	1993			0			0		0	**0**
	1994			0			12		12	**20,074**
	1995			0			5		5	**18,432**
	1996			0			0		0	**21,251**
	1997			0			0		0	**26,105**
	1998			0			1		1	**23,989**
	1999			0			0		0	**26,541**
	2000			0			0		0	**27,511**
	2001						0		+	**28,126**
	2002						0		+	**26,345**
	2003			0			0		0	**26,278**
	2004						0		+	**22,470**
	2005						0		+	**21,887**
	2006						0		+	**19,063**
	2007			9	8		0		17	**17,280**
	2008				7				7	**25,311**
	2009	11,541	11,541	1	9		1		11	**37,354**
	2010	7,670	7,670	0	7		0		7	**36,664**
	2011	13,117	13,117		13		0		13	**36,948**
	2012	10,606	10,606		16		0		16	**29,705**
	2013	6,321	6,321		1	+	0		1	**29,210**
	2014	8,151	8,151		0		0	+	0	**31,070**
	2015	8,551	8,551				1	+	1	**21,795**
	2016	8,563	8,563		+		0	+	0	**18,137**
	2017	11,121	11,121				(1)	+	1	**(20,704)**
Retain catch total		**85,641**	**85,641**	**13**	**61**	**0**	**55**	**0**	**129**	**(687,509)**
Release	2015									**0**
	2016									**8**
	2017									**11**
Release total										**8**
Total		**(85641)**	**(85641)**	**13**	**61**	**0**	**55.2**	**0**	**129**	**(687517)**

Parenthetic numbers are provisional.

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. "+"; Bellow 499kg catch. "-"; Unreported catch or catch information not available. *: Data from the most recent years are provisional.

Catch disposition	Year	JPN						KOR		MEX	
		Setnet	Drift gill-net	Longline	Others	Not Specified	JPN Total	Longline	KOR Total	Others	MEX Total
Retain catch	1985									43	43
	1986									84	84
	1987									197	197
	1988									248	248
	1989									135	135
	1990									288	288
	1991									228	228
	1992									376	376
	1993									442	442
	1994	14	123	727	24	0	889			336	336
	1995	11	103	961	26	0	1,102			333	333
	1996	10	101	1,026	130	0	1,267			413	413
	1997	14	127	818	61	0	1,020			401	401
	1998	11	130	662	6	0	809			386	386
	1999	12	176	999	54	0	1,241			439	439
	2000	12	156	992	30	0	1,189			539	539
	2001	12	156	1,084	49	0	1,301			491	491
	2002	4	122	775	29	0	930			488	488
	2003	5	229	844	5	0	1,083			471	471
	2004	0	134	914	6	0	1,054			865	865
	2005	42	155	925	14	0	1,135			609	609
	2006	5	178	994	2	0	1,180			641	641
	2007	12	244	1,031	12	0	1,299			689	689
	2008	12	212	935	34	0	1,194	-	-	609	609
	2009	1	294	1,106	95	0	1,496	-	-	653	653
	2010	18	272	864	54	0	1,208	-	-	760	760
	2011	11	163	604	45	0	823	-	-	758	758
	2012	1	229	712	5	0	948	0	0	715	715
	2013	7	345	700	2	0	1,054	8	8	711	711
	2014	3	263	784	0	0	1,051	8	8	1,867	1,867
	2015	11	334	553	0	0	898			1,653	1,653
	2016	26	448	412	0	0	886	0	0	660	660
	2017	(26)	(448)	(412)	(0)	(0)	(886)	0	0	-	-
Retain catch total		**282**	**5143**	**19788**	**731**	**0**	**25,944**	**16**	**16**	**17,528**	**17,528**
Release	2011										
	2012										
	2016							1	1		
Release total								**1**	**1**		
Total								**17**	**17**	**17,528**	**17,528**

Table 15-7. Continued.

Catch disposition	Year	TWN Longline	TWN Purse seine	TWN Total	USA Drift gill-net	USA Harpoon	USA Troll	USA Hook and	USA Others	USA Purse seine	USA Sport	USA Total	Total
Retain catch	1985				129	1			19			149	**192**
	1986				250	1			59			310	**394**
	1987				208	3			188			399	**596**
	1988				106	3			214			323	**571**
	1989				117	1			137			255	**390**
	1990				229	3			141			373	**661**
	1991				125	1			91			217	**445**
	1992				118	3			19			140	**516**
	1993				87	1			32			120	**562**
	1994				80	1			46			127	**463**
	1995				79	1			14			94	**427**
	1996				85	1			9			95	**508**
	1997				118	3			11			132	**533**
	1998				85	1			12			98	**484**
	1999				52	+			9			61	**500**
	2000				64	+			12			76	**615**
	2001				30	1			10			41	**532**
	2002				69	+			12			81	**569**
	2003				57	+			9			66	**537**
	2004				38	1			13			52	**917**
	2005				25	1			8			34	**643**
	2006				38	+			7			45	**686**
	2007				37	+			6			43	**732**
	2008				27	1			5			33	**642**
	2009	78		78	21	1	0		7			29	**760**
	2010	54		54	10	0			10			20	**834**
	2011	208		208	8	0			8			16	**982**
	2012	74		74	9	0	0		11			20	**809**
	2013	107		107	16	0			12			28	**854**
	2014	119		119	7	0			9		4	20	**1,081**
	2015	322		322	7			1	4		2	15	**1,192**
	2016	220		220	12	0	0	1	4		0	18	**1,303**
	2017	187		187	12	0	0	1	5			19	**1,081**
Retain catch total		**1,369**		**1,369**	**2,343**	**29**	**0**	**2**	**1,149**		**6**	**166**	**19,079**
Release	2011									0		0	**0**
	2012		0	0									**0**
	2016												**1**
Release total			**0**	**0**						**0**		**0**	**1**
Total		**1,369**	**0**	**1,369**	**2,343**	**29**	**0**	**2**	**1,149**	**0**	**6**	**166**	**19,080**

Parenthetic numbers are provisional.

Sharks catch is all retained, and no discard data.

1) USA data provided mako shark data as MAK (shortfin mako and longfin mako shark).