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

PLENARY SESSION

15-20 July 2020
Virtual Meeting

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ACRONYMS AND ABBREVIATIONS

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

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

ISC Working Groups

Acronym	Name	Chair
ALBWG	Albacore Working Group	Hidetada Kiyofuji (Japan)
BILLWG	Billfish Working Group	Hirotaka Ijima (Japan)
PBFWG	Pacific Bluefin Working Group	Shuya Nakatsuka (Japan)
SHARKWG	Shark Working Group	Mikihiko Kai (Japan)
STATWG	Statistics Working Group	Vacant

Common Abbreviations and Acronyms Used by the ISC

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 Programme, Secretariat of the Pacific Community
SPR	Spawning potential ratio, spawner per recruit
SSB	Spawning stock biomass
$SSB_{F=0}$	Spawning stock biomass at a hypothetical unfished level
$SSB_{CURRENT}$	Current spawning stock biomass
SSB_{MSY}	Spawning stock biomass at maximum sustainable yield
STLL	Small-scale tuna longline

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 ISC20 Plenary Meeting

The 20[th] ISC Plenary was held virtually July 15-20, 2020, was attended by Members from Canada, Chinese Taipei, Japan, Korea, Mexico, and the United States as well as the Western and Central Pacific Fisheries Commission. Observers from American Fisheries Research Foundation, Monterey Bay Aquarium, Pew Charitable Trusts, the Western Pacific Fisheries Management Council, and World Wildlife Fund Japan also attended. The Plenary endorsed the North Pacific Albacore (ALB) and Pacific Bluefin Tuna (PBF) stock assessments and considers them to be the best available scientific information on these stocks. The ALB stock is likely not overfished relative to the limit reference point (20%$SSB_{current,\ F=0}$) adopted by the Western and Central Pacific Fisheries Commission (WCPFC) and current fishing intensity ($F_{2015-2017}$) is likely at or below seven potential F-based reference points for the stock. Although no biomass-based or fishing mortality-based limit or target reference points have been adopted for PBF, the Plenary notes that the PBF stock is overfished relative to the potential biomass-based reference points (SSB_{MED} and 20%$SSB_{F=0}$) adopted for other tuna species by the Inter-American Tropical Tuna Commission (IATTC) and the WCPFC and that recent fishing mortality is above the level producing 20%SPR. An updated Blue Shark (BSH) stock assessment was presented, but the Plenary concluded that no change in stock status or conservation information presented at ISC19 was warranted. The Plenary accepted a recommendation from the BILLWG that the short-term recruitment scenario (2010-2016) was most appropriate for projections of the Western and Central Pacific Ocean Striped Marlin (MLS) stock and updated its conservation information, noting that catches must be reduced to 60% of the WCPFC catch quota from CMM 2010-01 (3,397 t) to 1,359 t in order to achieve a 60% probability of rebuilding to 20%SSB_0=3,610 t by 2022 if the stock continues to experience recruitment consistent with the short term recruitment scenario. The Plenary re-iterated stock status and conservation information provided at ISC19 for North Pacific Shortfin Mako Shark (SMA), WCNPO Swordfish (SWO), Eastern Pacific Ocean Swordfish (EPO SWO) and Pacific Blue Marlin (BUM). The ISC work plan for 2020-21 includes a benchmark stock assessment of BUM and indicator analysis of SMA, advancing biological sampling for ALB and shark species, continuing the MSE process for ALB and enhancing database and website management. Shui-kai Chang (TWN) and Sung Il Lee (KOR) were elected as the Vice-Chairs of the PBFWG and STATWG, respectively, Hidetada Kiyofuji (JPN) and Steve Teo (USA) were relected as the Chair and Vice-Chair of the ALBWG and John Holmes (CAN) and Shui-kai Chang (TWN) were relected as Chair and Vice-Chair of the ISC. The next ISC Plenary will be hosted by the United States of America in Kona, Hawai’i, July 14-19, 2021.

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

The ISC provides scientific advice on the stocks and fisheries of tuna and tuna-like species in the NPO to the Member governments and regional fisheries management organizations. Fishery data tabulated by ISC Members and peer-reviewed by the species and statistics Working Groups (WGs) form the basis for research conducted by the ISC. Although some data for the most recent years are incomplete and provisional, the total catch of highly migratory species (HMS) by ISC Members estimated from available information is in excess of 500,000 metric tons (t) annually and dominated by the tropical tuna species. Catches of priority species monitored by ISC Member countries in 2019 were 51,688 t of NPO albacore (ALB, *Thunnus alalunga*), 10,940 t of Pacific bluefin tuna (PBF, *T. orientalis*), 8,635 t of NPO swordfish (SWO, *Xiphias gladius*), 2,685 t of NPO striped marlin (MLS, *Kajikia audax*), 6,686 t of Pacific blue marlin (BUM, *Makaira nigicans*), 1,175 t of NPO shortfin mako shark (SMA, *Isurus oxyrinchus*) and 30,377 t of NPO blue shark (BSH, *Prionace glauca*). The total estimated catch of these seven species is 112,186 t or approximately 102% of the 2018 total estimated catch of 109,475 t. Annual catches of priority stocks throughout their ranges reported by ISC Members are shown in Table 10 through Table 16.

As consequence of the coronavirus pandemic and COVID-19 transmission, the in-person ISC20 Plenary meeting scheduled for July 15-20, 2020, in Kona, Hawai'i was postponed. In its place, a virtual meeting using the Microsoft Teams platform was organized for the same dates. In order to accommodate the participation of scientists and observers on both sides of the Pacific Ocean, the meeting was scheduled for 3-hours on each day[1] and the agenda was pared to its essence, focusing on the activities of the ISC Working Groups and generating stock status and conservation information for the Inter-American Tropical Tuna Commission (IATTC) and the Northern Committee of the Western and Central Pacific Fisheries Commission (WCPFC-NC).

[1] The starting times for the sessions were: 18:00 Pacific Daylight Time (UTC -7), 09:00 China Standard Time (UTC +8), 10:00 Japan/Korea Standard Time (UTC +9), and 15:00 Hawai'i Standard Time (UTC -10).

Although National Reports are part of the meeting document package (**ISC/20/PLENARY/04, 05, 06, 07, 08, 09**), they were not formally presented nor reviewed by meeting participants.

The ISC intends to resume the in-person Plenary meeting when conditions with respect to the coronavirus pandemic and COVID-19 transmission are appropriate and Public Health authorities deem it safe to permit travel and large group gatherings. To that end, ISC21 will be hosted by the USA and is currently planned as an in-person meeting in July 2021. However, the final decision on the ISC21 Plenary meeting will be based on minimizing the risk to the safety and health of all participants.

1.2 Opening of the Meeting

The Twentieth Plenary session of the ISC (ISC20) was convened as a virtual meeting, at 18:00 on 15 July 2020 by the ISC Chairman, J. Holmes. A roll call confirmed the presence of delegates from Canada, Chinese-Taipei, Japan, Republic of Korea, Mexico, and USA (**ISC/20/ANNEX/01**). A representative from the WCPFC was also present. The American Fisheries Research Foundation, Monterey Bay Aquarium, Pew Charitable Trusts, the Western Pacific Fisheries Management Council, and World Wildlife Fund-Japan were present as observers.

ISC Member China, as well as the non-voting Members the Secretariat of the Pacific Community (SPC), the Food and Agriculture Organization of the United Nations (FAO), North Pacific Marine Science Organization (PICES), and the IATTC, while extended an invitation, did not participate in the Plenary.

2 ADOPTION OF AGENDA

The proposed agenda for the session (**ISC/20/ANNEX/02**) was considered and adopted. C. Dahl was assigned lead rapporteur duties. A list of meeting documents is contained in **ISC/20/ANNEX/03**.

3 REPORT OF SPECIES WORKING GROUPS AND STOCK STATUS AND CONSERVATION INFORMATION

3.1 North Pacific Albacore

3.1.1 Working Group Report and Review of Assignments

H. Kiyofuji, the chair of ALBWG, reported on the activities of the ALBWG over the past year (**ISC/20/ANNEX/04, 09**). A data preparation workshop was held 12 - 18 November 2019, in Shimizu, Shizuoka, Japan to (1) review input data series for the upcoming stock assessment; (2) assess catch-per-unit-of-effort (CPUE) indices (adult and juvenile by the JPN LL); (3) review model parameterization, assumptions, and diagnostic tools for the base case model and future projection software and (4) review the timeline and work plan for the MSE process. The ALBWG agreed with the recommendations about the timeline and workplan made by the management strategy evaluation (MSE) analyst. The stock assessment workshop was scheduled for 16 – 23 March 2020 at the Southwest Fisheries Science Center (SWFSC), La Jolla, CA, USA. However, the WG decided that it would not be possible to conduct the workshop in-person due to the coronavirus pandemic. The workshop was changed to an electronic meeting that was rescheduled for 5 – 14 and 20 April 2020 (eastern Pacific time) and 6 – 15 and 21 April 2020 (western Pacific time). The objectives of this workshop were to: (1) complete a new assessment of the North Pacific albacore tuna stock, and (2) to provide scientific information on current stock status, future trends and research needs of North Pacific albacore tuna.

The WG Chair briefly reported progress on the MSE and the biological sampling program for age and growth parameter estimation. The WG is considering a WG webinar in August 2020 to review the ongoing work on MSE and expects a complete report in December 2020, which will be reviewed through another WG webinar. The WG recommends that a 5th MSE workshop be held in person rather than by webinar because it is difficult to explain MSE results virtually. The timing of this workshop should be in February or March 2021, contingent on resolution of current travel issues. The WG supports developing a basin wide sampling program and agreed that there should be coordination between the sampling and model development as well as coordination among different countries.

The WG Chair reported the results of the election for a new WG chair and vice chair. The current WG Chair (Hidetada Kiyofuji, Japan) and Vice-Chair (Steve Teo; USA) were both re-elected for another three-year term (2020 – 2023).

The WG Chair also noted the status of the peer review for the assessment, which has not occurred yet. An in-person meeting is recommended and it is essential for the WG chair, the lead modeler, and lead index modeler to attend. It should be noted that the peer review workshop must fit into the WG schedule and consider COVID-19 restrictions.

Discussion

The stock assessment peer review process was discussed, noting that at ISC19, a model in which reviewers are embedded in the ALBWG data preparation and stock assessment workshop meetings was developed. However, implementing this approach was not possible due to logistical reasons and as an alternative, a retrospective in-person meeting was proposed as the most feasible approach for receiving feedback to improve the stock assessment in the future. Further discussion on obtaining feedback on ISC stock assessments occurred under Agenda Item 6.1.

Concern was expressed about the feasibility of conducting the 5th MSE workshop as a in-person meeting in February-March 2021 because restrictions on travel and public gatherings related to COVID-19 still may be in force at that time. However, it was recognized that the in-person format is essential to facilitate stakeholder involvement. At the same time, members expressed the desire for the timely completion of the MSE process. One option would be to conduct several national workshops, which would obviate the need for international travel, but the feasibility of this option is dependent on the recommendations of Public Health authorities in each country at the time the meetings are scheduled. As far as completing the MSE, it was noted that the results are relevant to WCPFC–NC deliberations so a final report of the 5th workshop would not be due until just prior to the September 2021 WCPFC-NC meeting. This deadline offers some flexibility in the timing of the 5th workshop.

3.1.2 Albacore Stock Assessment Report

S. Teo, lead modeler of the ALBWG, gave a presentation of the benchmark ALB stock assessment (**ISC/20/ANNEX/12**). There were three important changes to the base case model in this assessment compared to the previous assessment in 2017. These changes were: 1) Input sample sizes of the size composition data were allowed to vary between fisheries and over time, depending on the sampling that occurred, because of improvements in data preparation; 2) The primary Japan pole-and-line fisheries were subdivided into seasonal fisheries, and the selectivity of the two most important Japanese pole-and-line fisheries were allowed to vary annually; and 3) The Japan longline fisheries that caught albacore in the main spawning area were also subdivided into seasonal fisheries with separate selectivity patterns.

All available fishery data for NPO ALB from the 1994-2018 period were used in the stock assessment. Catch and size composition data from ISC member (Canada, China, Chinese Taipei, Japan, Korea, and USA) and non-member countries were compiled and assigned to 35 fisheries defined for this assessment (based on flag, gear, area, and season). Catches during the modeling period (1994-2018) reached a peak of about 119,000 t in 1999 and then declined in the early 2000s, followed by a recovery in later years. However, catches have dropped to low levels during the last three years of the time series (2016 – 2018), with catches fluctuating between about 52,000 and 57,000 t. Seven relative abundance indices (standardized catch-per-unit-effort) were provided by Japan and Chinese Taipei but only one abundance index, the Japanese longline index (F09 index) from the main spawning area, was fitted in the base case model.

The NPO ALB stock was assessed using a length-based, age-, and sex-structured Stock Synthesis (SS Version 3.30.14.08) model over the 1994-2018 period and it was assumed that there is instantaneous mixing of albacore on a quarterly basis. Biological parameters including growth, natural mortality (M) and stock-recruitment steepness, were the same as for the 2017 assessment. The base case model was fitted to the F09 index (1996-2018) and all representative size composition data in a likelihood-based statistical framework. All fisheries were assumed to have dome-shaped length selectivity curves, and age-based selectivity for ages 1-5 were also estimated for surface fisheries (troll and pole-and-line) to address age-based changes in juvenile albacore availability and movement. Selectivity curves were also assumed to vary over time for several fleets. Maximum likelihood estimates of model parameters, derived outputs, and their uncertainties were used to characterize stock status. Several sensitivity analyses were conducted to evaluate model performance or the range of uncertainty resulting from changes in model parameters, including natural mortality, stock-recruitment steepness, growth, starting year, selectivity patterns, and weighting of size composition data.

An age-structured production model (ASPM) diagnostic analysis, showed that the estimated catch-at-age and fixed productivity parameters (growth, mortality and stock-recruitment relationship without annual recruitment deviates) were able to explain trends in the F09 index. Based on these findings, the ALBWG concluded that the base case model was able to estimate the stock production function and the effect of fishing on the abundance of the NPO ALB stock. Similar to the 2017 assessment, the link between catch-at-age and the F09 index adds confidence to the data used and the results of the assessment. Due to the moderate exploitation levels relative to stock productivity, the production function was weakly informative about NPO ALB stock size, resulting in asymmetric uncertainty in the stock's absolute scale, with more uncertainty in the upper limit of the stock than the lower limit. It is important to note that the primary aim of estimating the female spawning biomass (SSB) in this assessment was to determine whether the estimated SSB was lower than the limit reference point, LRP (i.e., determine whether the stock is in an overfished condition). Since the lower bound is better defined, it adds confidence to the evaluation of stock condition relative to the LRP.

Two 10-yr projection scenarios were conducted externally to the base case model to evaluate impacts on future female SSB: 1) F constant at the $F_{2015\text{-}2017}$ level, and 2) constant catch at the average of 2013-2017 (69,354 t). Projections started in 2019 and continued for 10 years through 2028. Future recruitment was based on the expected recruitment variability ($\sigma_R = 0.3$) of the recruitment time series (1994 – 2018) in the base case model. The overall sex-specific F-at-age was estimated from the base case model and used (scaled to the appropriate catch in the constant catch scenario) to remove ALB from the appropriate age and sex in the projected populations. There are two main sources of uncertainty in the projections: 1) uncertainty in the estimates of numbers-at-age in the terminal year; and 2) uncertainty in future recruitment. It should be noted that the projections, especially the constant $F_{2015\text{-}2017}$ scenario, appear to underestimate the uncertainty due to a fixed F-at-age over time and a relatively low recruitment variability. Therefore, it is advisable to use the estimated future probabilities of breaching the LRP in a qualitative manner for management purposes until the projection software is improved. It also should be noted that the constant catch scenario is inconsistent with current management approaches for NPO ALB adopted by the IATTC and the WCPFC.

Discussion

The rationale for beginning the assessment time series in the 1990s was discussed. This shift of the start year from 1966 to 1994 was first implemented in the 2017 stock assessment because data and biological parameters from prior years were considered unreliable. The ALBWG is recommending additional work on catch reconstruction of high seas drift net fisheries for these earlier years.

The ISC Plenary had a fulsome discussion about characterizing uncertainty of the two stock projection scenarios (constant fishing intensity and constant catch). It was noted that the uncertainties in the projections are reduced over time, especially the constant F scenario, because the future F is fixed in the constant F scenario and the only sources of uncertainty or variability in the projections are future recruitment uncertainty and the uncertainty in the estimated initial N-at-age at the end of the assessment period. Over time, the influence of the initial N-at-age uncertainty is reduced and the uncertainty at the end of the projections is dominated by the recruitment uncertainty. This artifact of the uncertainty declining over time in this projection scenario is at odds with what would otherwise be expected. Because of these issues, the Plenary decided not to incorporate numerical probability estimates into the conservation information. Nonetheless, as noted above, in either scenario the probability of breaching the LRP is small.

The ISC Plenary endorsed the North Pacific ALB stock assessment and considers it to be the best available scientific information on the stock.

Stock Status and Conservation Information

Stock Status

Estimated total stock biomass (males and female at age-1+) declines at the beginning of the time series until 2000, after which biomass becomes relatively stable (Figure 1). Estimated female SSB exhibits a similar population trend, with an initial decline until 2003 followed by fluctuations without a clear trend through 2018 (Figure 1). However, estimated recruitment reached historical lows in 2014 (~125 million fish; 95% CI: 69 – 180 million fish) and 2015 (~113 million fish; 95% CI: 56 – 170 million fish) (Figure 1, which may have contributed to relatively low catches of fisheries catching juvenile albacore in recent years. It is currently unclear whether recruitment improved after 2015 because recruitment during the terminal years of the assessment (2016 – 2018) have large uncertainties (Figure 1).

The estimated average SPR (spawners per recruit relative to the unfished population) during 2015 – 2017 is 0.50 (95% CI: 0.36 – 0.64), which corresponds to a moderate fishing intensity (i.e., 1-SPR = 0.50). Instantaneous fishing mortality at age (F-at-age) is similar in both sexes through age-5, peaking at age-4 and declining to a low at age-6, after which males experience higher F-at-age than females up to age 12. Juvenile albacore aged 2 to 4 years comprised approximately 70% of the annual catch between 1994 and 2018. The dominance of juveniles is also reflected in the larger impact of surface fisheries (primarily troll, pole-and-line), which remove juvenile fish, relative to longline fisheries, which primarily remove adult fish (Figure 2).

The WCPFC -NC, which manages this stock together with the IATTC, adopted a biomass-based LRP in 2014 of 20% of the current spawning stock biomass when F=0 (20%$SSB_{current,\ F=0}$). The 20%$SSB_{current,\ F=0}$ LRP is based on dynamic biomass and fluctuates depending on changes in recruitment. This LRP is calculated for NPO ALB as 20% of the unfished dynamic female spawning biomass in the terminal year of this assessment (i.e., 2018) (WCPFC-NC13 Summary Report). However, neither the IATTC nor the WCFPC have adopted F-based limit reference points for the NPO ALB stock.

Stock status is depicted in relation to the LRP (20%$SSB_{current,\ F=0}$) for the stock and the equivalent fishing intensity ($F_{20\%}$; calculated as 1-$SPR_{20\%}$) (Figure 3). Fishing intensity (F, calculated as 1-SPR) is a measure of fishing mortality expressed as the decline in the proportion of the spawning biomass produced by each recruit relative to the unfished state. For example, a fishing intensity of 0.8 will result in an SSB of approximately 20% of SSB_0 over the long run. Fishing intensity is considered a proxy of fishing mortality.

The Kobe plot shows that the estimated female SSB has never fallen below the LRP since 1994, albeit with large uncertainty in the terminal year (2018) estimates (Figure 3). Even when alternative hypotheses about key model uncertainties such as growth were evaluated, the point estimate of female SSB in 2018 (SSB_{2018}) did not fall below the LRP, although the risk increases with this more extreme assumption (Figure 3). The SSB_{2018} was estimated to be 58,858 t (95% CI: 27,751 – 89,966 t) and 2.30 (95% CI: 1.49 – 3.11) times greater than the estimated LRP threshold of 25,573 t (95% CI: 19,150 – 31,997 t) (Table 1). Current fishing intensity, $F_{2015-2017}$ (0.50; 95% CI: 0.36 – 0.64; calculated as 1- $SPR_{2015-2017}$) , was at or lower than all seven potential F-based reference points identified for the NPO ALB stock (Table 1)

Based on these findings, 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 ($F_{2015-2017}$) is likely at or below all seven potential reference points (see ratios in Table 1).**

Conservation Information

Two harvest scenarios were projected to evaluate impacts on future female SSB: F constant at the 2015-2017 rate over 10 years ($F_{2015-2017}$) and constant catch[2] (average of 2013-2017 = 69,354 t) over 10 years. Median female SSB is expected to increase to 62,873 t (95% CI: 45,123 - 80,622 t) by 2028, with a low probability of being below the LRP by 2028, if fishing intensity remains at the 2015-2017 level (Figure 4). If future catch is held constant at 69,354 t, then the female SSB is expected to increase to 66,313 t (95% CI: 33,463 - 99,164 t) by 2028 and the probability that female SSB will be below the LRP by 2028 is slightly higher than the constant F scenario (Figure 5). Although the projections appear to underestimate the future uncertainty in female SSB trends, the probability of breaching the LRP in the future is likely small if the future fishing intensity is around current levels.

Based on these findings, the following information is provided:

1. **If a constant fishing intensity ($F_{2015-2017}$) is applied to the stock, then median female spawning biomass is expected to increase to 62,873 t and there will be a low probability of falling below the limit reference point established by the WCPFC by 2028.**

2. **If a constant average catch ($C_{2013-2017}$ = 69,354 t) is removed from the stock in the future, then the median female spawning biomass is also expected to increase to 66,313 t and the probability that SSB falls below the LRP by 2028 will be slightly higher than the constant fishing intensity scenario.**

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2 It should be noted that the constant catch scenario is inconsistent with current management approaches for north Pacific albacore tuna adopted by the Inter-American Tropical Tuna Commission (IATTC) and the Western and Central Pacific Fisheries Commission (WCPFC).

Research Needs

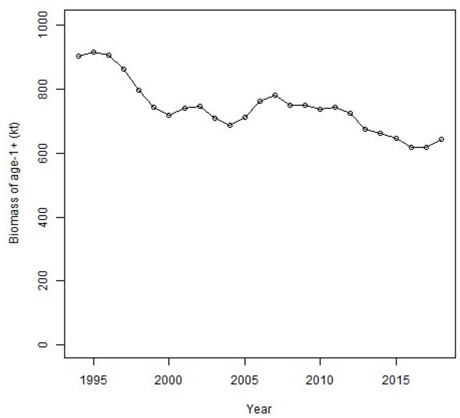
1. Further investigation of the F01 fishery (JPLL_A13_Q1) because there appears to be a mixture of two fisheries one on juveniles and one adults in this fishery;
2. Evaluate adult indices from the Japanese longline fisheries in southern areas (Areas 2 and 4), especially with respect to incorporating size data into the standardization process using a spatiotemporal process and/or data from alternative seasons;
3. Evaluate potential juvenile indices from the Japanese longline fisheries in northern areas (Areas 1, 3 and 5), the Japanese pole-and-line and/or EPO surface fisheries;
4. Collect sex-specific age-length samples using a coordinated biological sampling plan to improve current growth curves, and examine regional and temporal differences in length-at-age;
5. Collect sex ratio data by fishery using a coordinated biological sampling plan; and
6. Evaluate and document historical high seas drift gillnet catch by member countries.

Table 1. Estimates of maximum sustainable yield (MSY), female spawning biomass (SSB), and fishing intensity (F) based reference point ratios for north Pacific albacore tuna for: 1) the base case model; 2) an important sensitivity model due to uncertainty in growth parameters; and 3) a model representing an update of the 2017 base case model to 2020 data. SSB_0 and SSB_{MSY} are the unfished biomass of mature female fish and at MSY, respectively. The Fs in this table are indicators of fishing intensity based on SPR and calculated as 1-SPR so that the Fs reflect changes in fishing mortality. SPR is the equilibrium SSB per recruit that would result from the current year's pattern and intensity of fishing mortality. Current fishing intensity is based on the average fishing intensity during 2015-2017 ($F_{2015-2017}$). $20\%SSB_{current, F=0}$ is 20% of the current unfished dynamic female spawning biomass, where current refers to the terminal year of this assessment (i.e., 2018). The model representing an update of the 2017 base case model is highly similar to but not identical to the 2017 base case model due to changes in data preparation and model structure.

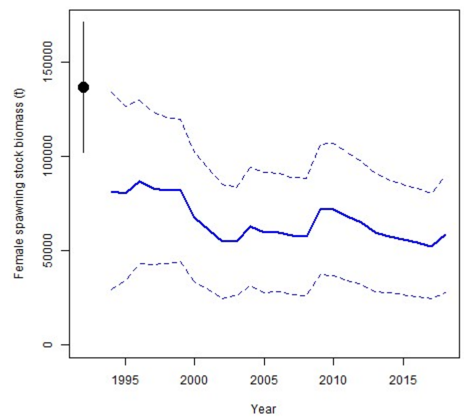
Quantity	Base Case	Growth CV = 0.06 for L_{inf}	Update of 2017 base case model to 2020 data
MSY (t) [A]	102,236	84,385	113,522
SSB_{MSY} (t) [B]	19,535	16,404	21,431
SSB_0 (t) [B]	136,833	113,331	152,301
SSB_{2018} (t) [B]	58,858	34,872	77,077
$SSB_{2018}/20\%SSB_{current, F=0}$ [B]	2.30	1.63	2.63
$F_{2015-2017}$	0.50	0.64	0.43
$F_{2015-2017}/F_{MSY}$	0.60	0.77	0.52
$F_{2015-2017}/F_{0.1}$	0.57	0.75	0.49
$F_{2015-2017}/F_{10\%}$	0.55	0.71	0.48
$F_{2015-2017}/F_{20\%}$	0.62	0.80	0.54
$F_{2015-2017}/F_{30\%}$	0.71	0.91	0.62
$F_{2015-2017}/F_{40\%}$	0.83	1.06	0.72
$F_{2015-2017}/F_{50\%}$	1.00	1.27	0.86

A – MSY includes male and female juvenile and adult fish
B – Spawning stock biomass (SSB) in this assessment refers to mature female biomass only.

A.



B.



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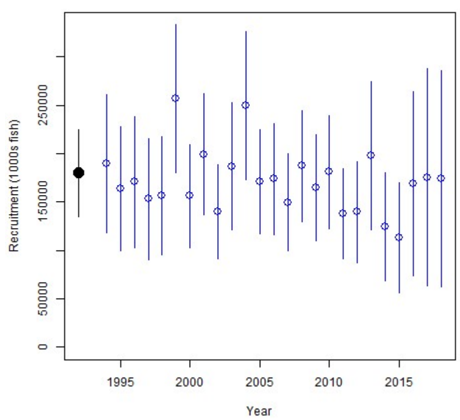

Figure 1. Maximum likelihood estimates of (A) total age-1+ biomass (B), female spawning biomass (SSB) (solid blue line), and (C) age-0 recruitment (open circles) of north Pacific albacore tuna (*Thunnus alalunga*). Dashed lines (B) and vertical bars (C) indicate 95% confidence intervals of the female SSB and recruitment estimates respectively. Closed black circle and error bars in (B) are the maximum likelihood estimate and 95% confidence intervals of unfished female spawning biomass, SSB_0. Estimates of total biomass (A) are based on estimates from Quarter 1 of each year. Estimates of female SSB (B) and age-0 recruitment (C) are based on estimates from Quarter 2 of each year.

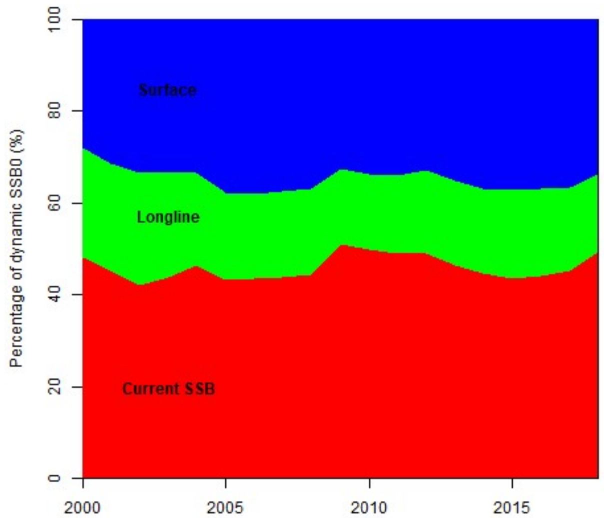

Figure 2. Fishery impact analysis on north Pacific albacore (*Thunnus alalunga*) showing female spawning biomass (SSB) (red) estimated by the 2020 base case model as a percentage of dynamic unfished female SSB (SSB_0). Colored areas show the relative proportion of fishing impact attributed to longline (USA, Japan, Chinese-Taipei, Korea, China, Vanuatu and others) (green) and surface (USA, Canada, and Japan) (blue) fisheries (primarily troll and pole-and-line gear, but including all other gears except longline).

A B

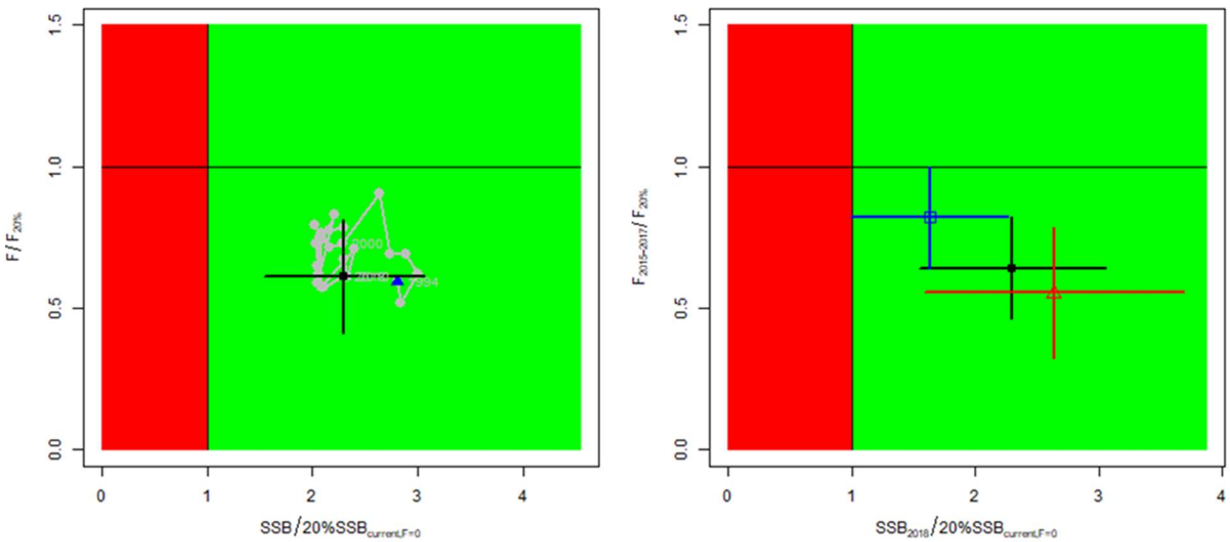

Figure 3. (A) **Kobe plot showing the status of the north Pacific albacore (*Thunnus alalunga*) stock relative to the 20%$SSB_{current,\ F=0}$ biomass-based limit reference point, and equivalent fishing intensity ($F_{20\%}$; calculated as 1-$SPR_{20\%}$) over the base case modeling period (1994-2018). The blue triangle is the start year (1994) and the black circle with 95% confidence intervals is the terminal year (2018).** (B) **Kobe plot showing current stock status and 95% confidence intervals of the base case model (black; closed circle), an important sensitivity run of CV = 0.06 for L_{inf} in the growth model (blue; open square), and a model representing an update of the 2017 base case model to 2020 data (red; open triangle). The coefficients of variation of the SSB/20%$SSB_{current,\ F=0}$ ratios are assumed to be the same as for the SSB/20%SSB_0 ratios. Fs in this figure are not based on instantaneous fishing mortality. Instead, the Fs are indicators of fishing intensity based on SPR and calculated as 1-SPR so that the Fs reflects changes in fishing mortality. SPR is the equilibrium SSB per recruit that would result from the current year's pattern and intensity of fishing mortality. Current fishing intensity is calculated as the average fishing intensity during 2015-2017 ($F_{2015-2017}$), while current female spawning biomass refers to the terminal year of this assessment (i.e., 2018). The model representing an update of the 2017 base case model is highly similar to but not identical to the 2017 base case model due to changes in data preparation and model structure. In accordance with Plenary agreement during ISC18, only two colours are used in these plots as only one reference point, 20%$SSB_{current,\ F=0}$, has been adopted by Regional Fisheries Management Organizations for this stock.**

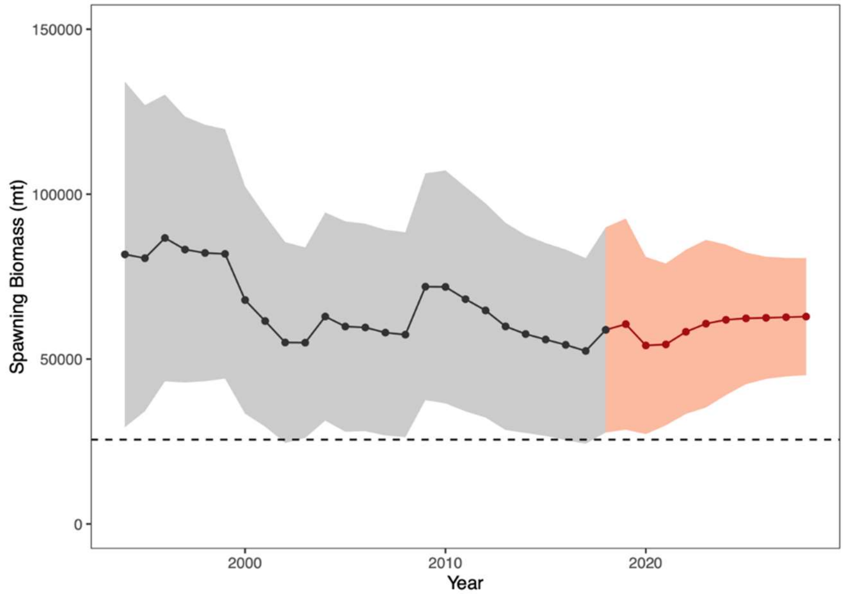

Figure 4. Historical and future trajectory of north Pacific albacore (*Thunnus alalunga*) female spawning biomass (SSB) under a constant fishing intensity ($F_{2015\text{-}2017}$) harvest scenario. Future recruitment is based on the expected recruitment variability. Black line and gray area indicates maximum likelihood estimates and 95% confidence intervals (CI), respectively, of historical female SSB, which includes parameter uncertainty. Red line and red area indicates mean value and 95% CI of projected female SSB, which only includes future recruitment variability and SSB uncertainty in the terminal year. Dashed black line indicates the 20%$SSB_{current\ F=0}$ limit reference point for 2018 (25,573 t).

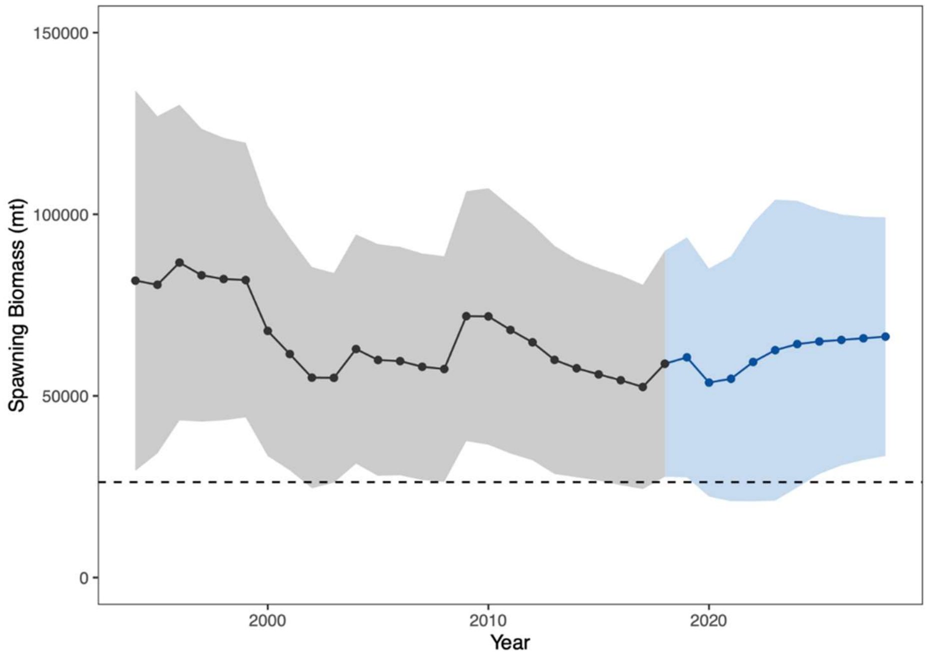

Figure 5. Historical and future trajectory of north Pacific albacore (*Thunnus alalunga*) female spawning biomass (SSB) under a constant catch (average 2013-2017 = 69,354 t) harvest scenario. Future recruitment is based on the expected recruitment variability. Black line and grey area indicates maximum likelihood estimates and 95% confidence intervals (CI), respectively, of historical female SSB, which includes parameter uncertainty. Blue line and blue area indicates mean value and 95% CI of projected female SSB, which only includes future recruitment variability and SSB uncertainty in the terminal year. Dashed black line is the 20%$SSB_{current\ F=0}$ limit reference point for 2018 (25,573 t).

3.2 Pacific Bluefin Tuna

3.2.1 PBFWG Report and Review of Assignments

S. Nakatsuka, Chair of the PBFWG, reported on the activities of the PBFWG over the past year **(ISC/20/ANNEX/05, 08**). The PBFWG held two workshops during 2019 and 2020 to complete the benchmark assessment. The first meeting was the data preparation workshop in November 2019 in La, Jolla, USA and the second meeting was the stock assessment workshop in March 2020 in Shimizu, Japan. Due to the outbreak of COVID-19, all participants chose online participation for the stock assessment workshop. The PBFWG completed the PBF benchmark assessment and projections based on the new assessment results during these workshops. In addition, the PBFWG prepared a response to requests to the ISC from regional fishery management organizations (RFMOs) responsible for PBF management.

The benchmark assessment includes several improvements relative to the 2018 assessment including converting the assessment model to the newer version of Stock Synthesis, applying spatio-temporal standardization to the main adult CPUE indices, refining fishery definitions, and an estimate of discard mortality. The new base-case model is consistent with the last assessment model in terms of stock biomass with improvements in the model and data. The PBFWG concluded that this assessment represents the best available scientific information for PBF and prepared draft stock status and conservation information based on the results.

The PBFWG also prepared responses to a request from the WCPFC NC-IATTC Joint Working Group (JWG). The Joint Meeting requested that the ISC provide a matrix of conversion values across the catch of age classes. The conversion factors are intended to facilitate discussions by the WCPFC-NC-IATTC joint meeting regarding the transfer of catch limits from small fish (< 30 kg) to the large fish catch limit. These conversion values are presented in Table 2, which is based on the comparison of expected asymptotic SSB that one unit weight of PBF at respective ages will produce based on the biological assumptions in the stock assessment.

Table 2. Relative impact of catching a unit weight of certain age of PBF.

Age	Body weight at half of age (kg)	Relative fishing Impact to Age 6
0	1.42	8.8
1	9.3	3.6
2	24.5	1.9
3	46.0	1.3
4	71.6	1.1
5	99	1.0
6	126	1.0

Shui-Kai (Eric) Chang was newly elected as Vice-Chair of the PBFWG. The PBFWG's proposed schedule for 2020/21 is as follows:

Meeting	Dates	Location	Goals
WCPFC SC16	Aug	TBD	Present benchmark assessment results.
NC-IATTC JWG	TBD	TBD	Present benchmark assessment results.
WCPFC NC16	Sep	TBD	Present benchmark assessment results.
WG Workshop	Feb-Mar, 2021	TBD	To check indices and develop MSE.

Discussion

The Plenary discussed work associated with the PBF MSE as described by the PBFWG. The WG Chair clarified that the proposed early 2021 WG workshop is not intended as a stakeholder workshop for the MSE but a regular work session of the PBFWG. Some tasks associated with MSE development, such as initial development of the operating model, overlap with other WG objectives associated with improving future stock assessments. The ISC Chair noted that although the WCPFC-NC-IATTC JWG is discussing an MSE for PBF by 2024, no formal request has been made to the ISC and the actual process of PBF MSE remains unclear at present.

The Plenary reviewed the table on relative impact of catching different ages of PBF on the stock and endorsed the provision of this response to the WCPFC-IATTC JWG.

3.2.2 Pacific Bluefin Tuna Stock Assessment Report

H. Fukuda, the lead modeler for the PBFWG, made a detailed report on the benchmark stock assessment for PBF conducted in March 2020 (**ISC/20/ANNEX/11**). As this assessment was a benchmark assessment, all of the aspects of assessment, including data, biological information, and assumptions were re-considered in the data preparation and assessment workshops. After those re-considerations, the WG acknowledged that several modifications such as the spatio-temporal modeling for CPUE standardization, more detailed modeling of fisheries, inclusion of newly available size data and discard information, and correction of bias between the bootstrap replicates and point estimates of the base-case for projections would contribute to the improvement of the PBF stock assessment.

Population dynamics during 1952-2018 were modeled in the assessment model using quarterly observations of catch and size compositions, when available, as well as the annual estimates of standardized CPUE-based abundance indices. The assessment model was fitted to the input data in a likelihood-based statistical framework. Based on the diagnostic analysis, the WG concluded that the new base-case model represents the data sufficiently and there is an internal consistency among the assumptions of the assessment model and input data. The new base-case model also showed consistent results with the 2016 and 2018 assessments. The WG considered the 2020 assessment results as the best available scientific information on Pacific bluefin tuna.

The base-case results show that: (1) SSB has fluctuated throughout the assessment period; (2) SSB steadily declined from 1996 to 2010; (3) there has been a slow increase of the stock biomass since 2011; (4) total biomass in 2018 exceeded the historical median with an increase in immature fish; and (5) fishing mortality ($F_{\%SPR}$) declined from a level producing about 1% of SPR in 2004-2009 to a level producing 14% of SPR in 2016-2018.

The stock projections were developed based on the bootstrap replicates of the base-case model and the future harvesting scenarios, which were requested by the WCPFC and IATTC. For the sake of precaution in light of the current low level of the SSB and the possible future low recruitment produced thereby, future recruitment were resampled from a relatively low recruitment period (1980-1989) until the stock recovered to the initial rebuilding target. For the following years, future recruitment was randomly resampled from the whole stock assessment period.

The projection results showed that the probability of achieving the initial rebuilding target by 2024 ($SSB_{MED,\ 1952\text{-}2014}$) under the all tested scenarios exceeded 60% as prescribed in the WCPFC Harvest Strategy even if low recruitment were to continue (WCPFC Harvest Strategy for Pacific bluefin tuna fisheries HS-2017-02). The projection results also showed that the probability of achieving the second rebuilding target (20% $SSB_{F=0}$) for all of the tested scenarios was greater than 60% within 10 years after reaching the initial rebuilding target, which is above the level prescribed in WCPFC HS-2017-02.

<u>Discussion</u>

The issue of over-parameterization in the stock assessment model was discussed. The current assessment has 415 parameters, an increase from 316 in the previous assessment (2018). Despite the high number of parameters, the PBFWG does not believe the model is overparameterized since the model converge on a global minimum rather than a local minimum of the likelihood surface. However, the PBFWG recognizes that there is the potential for convergence issues to arise in the future if the number of parameters continues to increase. The WG has tried to reduce the number of parameters by combining selectivity patterns of similar fisheries, for example, but has only been able to do this in a few cases. The issue of paramterization will be further investigated by the PBFWG in future assessment.

The use of lower steepness parameters in model sensitivity testing was raised. Model convergence was unsuccessful with steepness values below 0.99. This issue is outstanding for the PBF assessments and will be further investigated by the PBFWG in future.

Information sources for estimating discard mortality, which was incorporated into this stock assessment, were discussed. Some estimates tend to be based on anecdotal information and the Plenary emphasized the need for Members to improve data collection on discard amounts and discard mortality. Absent these improvements, the total removals will remain unknown and the risks of future assessment uncertainty will rise.

The characteristics of the age-structured production model with recruitment forced to fit the recruitment index (ASPM-R) were discussed. The ASPM-R was used in the model diagnostics process. It was noted that the ASPM and ASPM-R supplement evidence about internal consistency of information on stock scale.

In considering the statements about stock status, evidence for trends in recent recruitment was discussed. It was noted that the 2017 recruitment index value was estimated (second last year of the assessment) but it was not included in the assessment model. This index value had greater uncertainty than usual, because the data used to estimate the index value was incomplete in that year.

The ISC Plenary endorsed the PBF stock assessment and considers it to be the best available scientific information on the stock.

Stock Status and Conservation Information

The base-case model results show that: (1) spawning stock biomass (SSB) fluctuated throughout the assessment period (fishing years 1952-2018); (2) the SSB steadily declined from 1996 to 2010; (3) there has been a slow increase of the stock biomass continues since 2011; (4) total biomass in 2018 exceeded the historical median with an increase in immature fish; and (5) fishing mortality ($F_{\%SPR}$) declined from a level producing about 1% of SPR[3] in 2004-2009 to a level producing 14% of SPR in 2016- 2018 (Table 3, Figure 6). 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. The SSB in 2018 was estimated to be around 28,000 t (Table 3, Figure 6), which is a 3,000 t increase from 2016 according to the base-case model. An increase of young fish (0-2 years old) was observed in 2016-2018 (Figure 7), likely resulting from low fishing mortality on those fish (Figure 8) and is expected to accelerate the recovery of SSB in the future.

Historical recruitment estimates have fluctuated since 1952 without an apparent trend. Relatively low recruitment levels estimated in 2010-2014 were of concern in the 2016 assessment. The 2015 recruitment estimate is lower than the historical average while the 2016 recruitment estimate (about 17 million fish) is higher than the historical average (Table 3, Figure 6). The recruitment estimates for 2017 and 2018, which are based on fewer observations and more uncertain, are below the historical average.

Estimated age-specific fishing mortalities (F) on the stock during the periods of 2011-2013 and 2016-2018 compared with 2002-2004 estimates (the reference period for the WCPFC Conservation and Management Measure (CMM)) are presented in Figure 8. A substantial decrease in estimated F is observed in ages 0-2 in 2016-2018 relative to the previous years. Note that stricter management measures in the WCPFC and IATTC have been in place since 2015.

Figure 9 depicts the historical impacts of the fleets on the PBF stock, showing the estimated biomass when fishing mortality from the respective fleets is zero. Historically, the WPO coastal fisheries have had the greatest impact on the PBF stock, but since about the early 1990s the

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[3] SPR (spawning potential ratio) 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 fishing level to the cumulative spawning biomass that could be produced by an average recruit over its lifetime if the stock was unfished. $F_{\%SPR}$: F that produces % of the spawning potential ratio.

WPO purse seine fishery targeting small fish (ages 0-1) has had a greater impact and the effect in 2018 was greater than any of the other fishery. The impact of the EPO fisheries was large before the mid-1980s, decreasing significantly thereafter. The WPO longline fisheries 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 (see the conversion factors in Table 2). There is greater uncertainty regarding discards than other fishery impacts because the impact of discarding is not based on observed data.

Stock Status

The WCPFC and IATTC adopted an initial rebuilding biomass target (the median SSB estimated for the period from 1952 through 2014) and a second rebuilding biomass target (20%$SSB_{F=0}$ under average recruitment), without specifying a fishing mortality reference level. The 2020 assessment estimated the initial rebuilding biomass target ($SSB_{MED1952-2014}$) to be 6.4%$SSB_{F=0}$ and the corresponding fishing mortality expressed as $F_{6.4\%SPR}$. The Kobe plot shows that the point estimate of the SSB_{2018} was 4.5%$SSB_{F=0}$ and the recent (2016-2018) fishing mortality corresponds to $F_{14\%SPR}$ (Table 3, Figure 10). Although no reference points have been adopted to evaluate the status of PBF, an evaluation of stock status against some common reference points (Table 4) shows that the stock is overfished relative to biomass-based limit reference points adopted for other species in WCPFC (20%$SSB_{F=0}$) and fishing mortality has declined but not reached the level corresponding to that reference point ($F_{20\%SPR}$).

The PBF spawning stock biomass (SSB) has gradually increased in the last 8 years (2011-2018). Young fish (age 0-2) shows a more rapid increase in recent years (Figure 6, Figure 7). These changes in biomass coincide with a decline in fishing mortality over the last decade (Figure 8). Based on these findings, the following information on the status of the Pacific bluefin tuna stock is provided:

1. **The latest (2018) SSB is estimated to be 4.5% of $SSB_{F=0}$, which is an increase from 4.0% estimated for 2016 (Figure 10 and Table 3; the terminal year in the previous assessment). No biomass-based limit or target reference points have been adopted for PBF. However, the PBF stock is overfished relative to the potential biomass-based reference points (SSB_{MED} and 20%$SSB_{F=0}$) adopted for other tuna species by the IATTC and WCPFC.**
2. **The recent (2016-2018) $F_{\%SPR}$ is estimated to produce 14%SPR (Figure 10 and Table 4). Although no fishing mortality-based limit or target reference points have been adopted for PBF by the IATTC and WCPFC, recent fishing mortality is above the level producing 20%SPR. However, the stock is subject to rebuilding measures including catch limits and the capacity of the stock to rebuild is not compromised, as shown by the projection results.**

Conservation Information

After the steady decline in SSB from 1995 to the historically low level in 2010, the PBF stock has started recovering slowly, consistent with the management measures implemented in 2014-2015. The spawning stock biomass in 2018 was below the two biomass rebuilding targets adopted by the WCPFC while the 2016-18 fishing mortality ($F_{\%SPR}$) has reduced to a level producing 14%SPR.

The projection results based on the base-case model under several harvest and recruitment scenarios and time schedules requested by the RFMOs are shown in Table 4 and Table 5 and Figures 11 and 12. The projection results show that PBF SSB recovers to the biomass-based rebuilding targets due to reduced fishing mortality by applying catch limits as the stock increases (Figure 11). In most of the scenarios, the SSB biomass is projected to recover to the initial rebuilding target (SSB_{MED}) in the fishing year 2020 (April of 2021) with a probability above the 60% level prescribed in the WCPFC CMM 2019-02 (Table 6).

A Kobe chart and impacts by fleets estimated from future projections under the current management scheme are provided for information (Figure 11 and Figure 12, respectively). Because the projections include catch limits, fishing mortality ($F_{x\%SPR}$) is expected to decline, i.e., SPR will increase, as biomass increases. Further stratification of future impacts is possible if the allocation of increased catch limits among fleets/countries is specified.

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

1. **Under all examined scenarios the initial goal of WCPFC and IATTC, rebuilding to SSB_{MED} by 2024 with at least 60% probability, is reached and the risk of SSB falling below historical lowest observed SSB at least once in 10 years is negligible (Table 5, and Table 6).**
2. **The projection results assume that the CMMs are fully implemented and are based on certain biological and other assumptions. For example, these future projection results do not contain assumptions about discard mortality. Although the impact of discards on SSB is small compared to other fisheries (Figure 9), discards should be considered in the harvest scenarios.**
3. **Given the low SSB, the uncertainty in future recruitment, and the influence recruitment has on stock biomass, monitoring recruitment and SSB should continue so that the recruitment level can be understood in a timely manner.**

Table 3. Total biomass, spawning stock biomass, recruitment, and spawning potential ratio of Pacific bluefin tuna (*Thunnus orientalis*) estimated by the base-case model, 1952-2018.

Fishing Year	Total Biomass (t)	Spawning Stock Biomass (t)	Recruitment (1,000 fish)	Spawning Potential Ratio	Depletion Ratio
1952	134,751	103,502	4,857	11.4%	16.4%
1953	136,428	97,941	20,954	12.7%	15.5%
1954	146,741	87,974	34,813	7.8%	13.9%
1955	156,398	75,360	13,442	11.4%	11.9%
1956	175,824	67,700	33,582	16.1%	10.7%
1957	193,597	76,817	11,690	10.7%	12.1%
1958	201,937	100,683	3,195	19.2%	15.9%
1959	209,300	136,430	7,758	23.2%	21.6%
1960	202,121	144,411	7,731	17.4%	22.8%
1961	193,546	156,302	23,339	3.4%	24.7%
1962	176,618	141,277	10,737	10.8%	22.3%
1963	165,892	120,244	28,112	6.8%	19.0%
1964	154,192	105,870	5,696	6.6%	16.7%
1965	142,548	93,222	10,710	3.0%	14.7%
1966	119,683	89,236	8,680	0.1%	14.1%
1967	105,084	83,208	10,897	1.3%	13.2%
1968	91,408	77,466	14,535	1.2%	12.2%
1969	80,523	64,299	6,484	8.5%	10.2%
1970	74,222	53,961	7,027	3.1%	8.5%
1971	66,114	46,839	12,420	1.0%	7.4%
1972	64,114	40,447	23,552	0.3%	6.4%
1973	63,023	35,273	10,968	5.6%	5.6%
1974	64,885	28,502	13,322	6.3%	4.5%
1975	65,074	26,410	11,252	8.0%	4.2%
1976	64,512	29,274	9,253	2.9%	4.6%
1977	74,670	35,105	25,601	3.7%	5.6%
1978	76,601	32,219	14,037	5.6%	5.1%
1979	73,615	27,093	12,650	7.9%	4.3%
1980	72,809	29,657	6,910	5.2%	4.7%
1981	57,482	27,928	13,340	0.3%	4.4%
1982	40,398	24,240	6,512	0.0%	3.8%
1983	33,210	14,456	10,133	6.1%	2.3%
1984	37,464	12,651	9,184	5.1%	2.0%
1985	39,591	12,817	9,676	2.8%	2.0%
1986	34,349	15,147	8,181	1.1%	2.4%
1987	32,008	13,958	6,026	8.1%	2.2%
1988	38,086	14,931	9,304	11.0%	2.4%
1989	41,849	14,839	4,409	14.4%	2.3%
1990	58,122	18,953	18,096	18.2%	3.0%
1991	69,351	25,294	10,392	9.8%	4.0%
1992	76,228	32,252	3,958	14.8%	5.1%
1993	83,624	43,639	4,450	16.4%	6.9%
1994	97,731	50,277	29,314	13.7%	7.9%
1995	94,279	62,784	16,533	4.8%	9.9%
1996	96,463	61,826	17,787	8.9%	9.8%
1997	90,349	56,393	11,259	5.9%	8.9%
1998	95,977	55,888	16,018	4.0%	8.8%
1999	92,232	51,705	22,842	3.7%	8.2%
2000	76,795	48,936	14,383	1.7%	7.7%
2001	78,052	46,408	17,384	9.7%	7.3%
2002	76,110	44,492	13,761	5.7%	7.0%
2003	68,707	43,806	7,110	2.3%	6.9%
2004	66,433	36,701	27,930	1.4%	5.8%
2005	55,778	30,004	15,256	0.6%	4.7%
2006	43,912	24,089	13,660	1.1%	3.8%
2007	43,765	19,061	23,146	0.4%	3.0%
2008	39,646	14,805	21,265	0.8%	2.3%
2009	35,135	11,422	8,002	1.3%	1.8%
2010	38,053	10,837	18,230	2.4%	1.7%
2011	38,901	12,096	12,574	4.9%	1.9%
2012	41,058	14,578	6,845	7.4%	2.3%
2013	49,383	16,703	12,798	4.7%	2.6%
2014	47,864	18,503	3,783	8.9%	2.9%
2015	52,725	21,014	8,778	10.4%	3.3%
2016	62,069	25,009	16,504	10.5%	4.0%
2017	71,228	25,632	6,663	16.5%	4.1%
2018	82,212	28,228	4,658	15.4%	4.5%
Median (1952-2018)	73,615	35,273	11,259	5.9%	5.6%
Average(1952-2018)	86,908	49,388	13,199	7.1%	7.8%

Table 4. Ratios of the estimated fishing mortalities (Fs and 1-SPRs for 2002-04, 2011-13, 2016-18) relative to potential fishing mortality-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*) from the base-case model. F_{max}: Fishing mortality (F) that maximizes equilibrium yield per recruit (Y/R). $F_{0.1}$: F at which the slope of the Y/R curve is 10% of the value at its origin. F_{med}: F corresponding to the inverse of the median of the observed R/SSB ratio. $F_{xx\%SPR}$: F that produces given % of the unfished spawning potential (biomass) under equilibrium condition.

Reference period	F_{max}	$F_{0.1}$	F_{med}	(1-SPR)/(1-SPRxx%)				Estimated SSB for terminal year of each period (ton)	Depletion rate for terminal year of each period (%)
				SPR10%	SPR20%	SPR30%	SPR40%		
2002-2004	1.92	2.84	1.14	1.08	1.21	1.38	1.61	36,701	5.80
2011-2013	1.54	2.26	0.89	1.05	1.18	1.35	1.57	16,703	2.64
2016-2018	1.14	1.65	0.57	0.95	1.07	1.23	1.43	28,228	4.46

Table 5. 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 #	Upper Limit increase				Probability of SSB is below the Initial rebuilding target at 2024 in case the low recruitment continue	The fishing year expected to achieve the initial rebuilding target with >60% probability	The fishing year expected to achieve the 2nd rebuilding target with >60% probability	Probability of achiving the initial rebuilding target at 2024	Probability of achiving the second rebuilding target at 2034	Probability of SSB falling below the historical lowest at any time during the projection period.	Probability of Catch falling below the historical lowest at any time during the projection period.	Median SSB at 2024	Median SSB at 2034
	WCPO		EPO										
	Small	Large	Small	Large									
1	0%				0%	2020	2026	100%	99%	0%	100%	107,098	286,958
2	0%				0%	2020	2026	100%	99%	0%	100%	104,973	287,020
3	5%				0%	2020	2027	100%	98%	0%	100%	99,968	272,814
4	10%				0%	2020	2027	100%	96%	0%	100%	95,096	258,850
5	15%				0%	2020	2028	99%	94%	0%	100%	90,293	244,959
6	20%				0%	2020	2028	99%	91%	0%	100%	85,618	231,003
7	0%	500	500		0%	2020	2027	100%	98%	0%	100%	99,903	277,396
8	250	250	500		0%	2020	2027	100%	97%	0%	100%	98,164	268,473
9	0	600	400		0%	2020	2027	100%	98%	0%	100%	100,035	278,004
10	5%	1300	700		0%	2020	2027	99%	96%	0%	100%	92,504	259,802
11	10%	1300	700		0%	2020	2027	99%	95%	0%	100%	89,951	249,996
12	5%	1000	500		0%	2020	2027	100%	97%	0%	100%	94,952	264,218
13	0	1650	660		0%	2020	2027	99%	97%	0%	100%	93,897	267,976
14	125	375	550		0%	2020	2027	100%	98%	0%	100%	98,729	272,323
15	0	0	0		0%	2019	2022	100%	100%	0%	100%	221,391	560,259

* The numbering of Scenarios is different from those given by the IATTC-WCPFC NC Joint WG meeting and same as Table 3.

* Recruitment is switched from low recruitment during 1980-1989 to average recruitment over the whole assessment period in the following year of achieving the initial rebuilding target.

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

scenario #	Upper Limit increase				Median SSB at 2024	Median SSB at 2034	Expected annual yield in 2019, by area and size category (t)				Expected annual yield in 2024, by area and size category (t)				Expected annual yield in 2034, by area and size category (t)			
	WPO		EPO				WPO		EPO		WPO		EPO		WPO		EPO	
	Small	Large	Small	Large			Small	Large	Commercial	Sport	Small	Large	Commercial	Sport	Small	Large	Commercial	Sport
1	0%				107,098	286,958	4,396	5,444	3,310	508	4,583	6,739	3,315	800	4,499	6,871	3,321	1,167
2	0%				104,973	287,020	4,396	6,924	3,541	504	4,580	6,771	3,724	799	4,495	6,851	3,746	1,168
3	5%				99,968	272,814	4,614	7,260	3,468	501	4,809	7,101	3,468	767	4,720	7,187	3,465	1,130
4	10%				95,096	258,850	4,833	7,590	3,633	499	5,038	7,433	3,634	737	4,945	7,523	3,630	1,091
5	15%				90,293	244,959	5,052	7,914	3,797	496	5,267	7,764	3,798	708	5,171	7,859	3,794	1,053
6	20%				85,618	231,003	5,269	8,223	3,964	494	5,493	8,093	3,963	680	5,394	8,195	3,960	1,014
7	0%	500	500		99,903	277,396	4,396	7,411	3,802	500	4,583	7,269	3,803	781	4,497	7,349	3,800	1,150
8	250	250	500		98,164	268,473	4,640	7,172	3,802	499	4,824	7,017	3,802	756	4,734	7,105	3,800	1,118
9	0	600	400		100,035	278,004	4,396	7,506	3,701	501	4,583	7,370	3,703	783	4,496	7,449	3,699	1,152
10	5%	1300	700		92,504	259,802	4,627	8,153	4,003	497	4,814	8,073	4,005	745	4,723	8,156	4,000	1,107
11	10%	1300	700		89,951	249,996	4,858	8,157	4,003	495	5,042	8,074	4,004	721	4,947	8,163	4,000	1,076
12	5%	1000	500		94,952	264,218	4,627	7,881	3,803	498	4,813	7,773	3,805	753	4,722	7,857	3,800	1,115
13	0	1650	660		93,897	267,976	4,396	8,444	3,963	498	4,587	8,426	3,967	769	4,498	8,501	3,960	1,138
14	125	375	550		98,729	272,323	4,517	7,291	3,852	499	4,703	7,142	3,853	767	4,614	7,226	3,850	1,132
15	0%	0%	0		221,391	560,259	0	0	0	0	0	0	0	0	0	0	0	0

* Catch limits for EPO commercial fisheries are applied for the catch of both small and large fish made by the fleets.

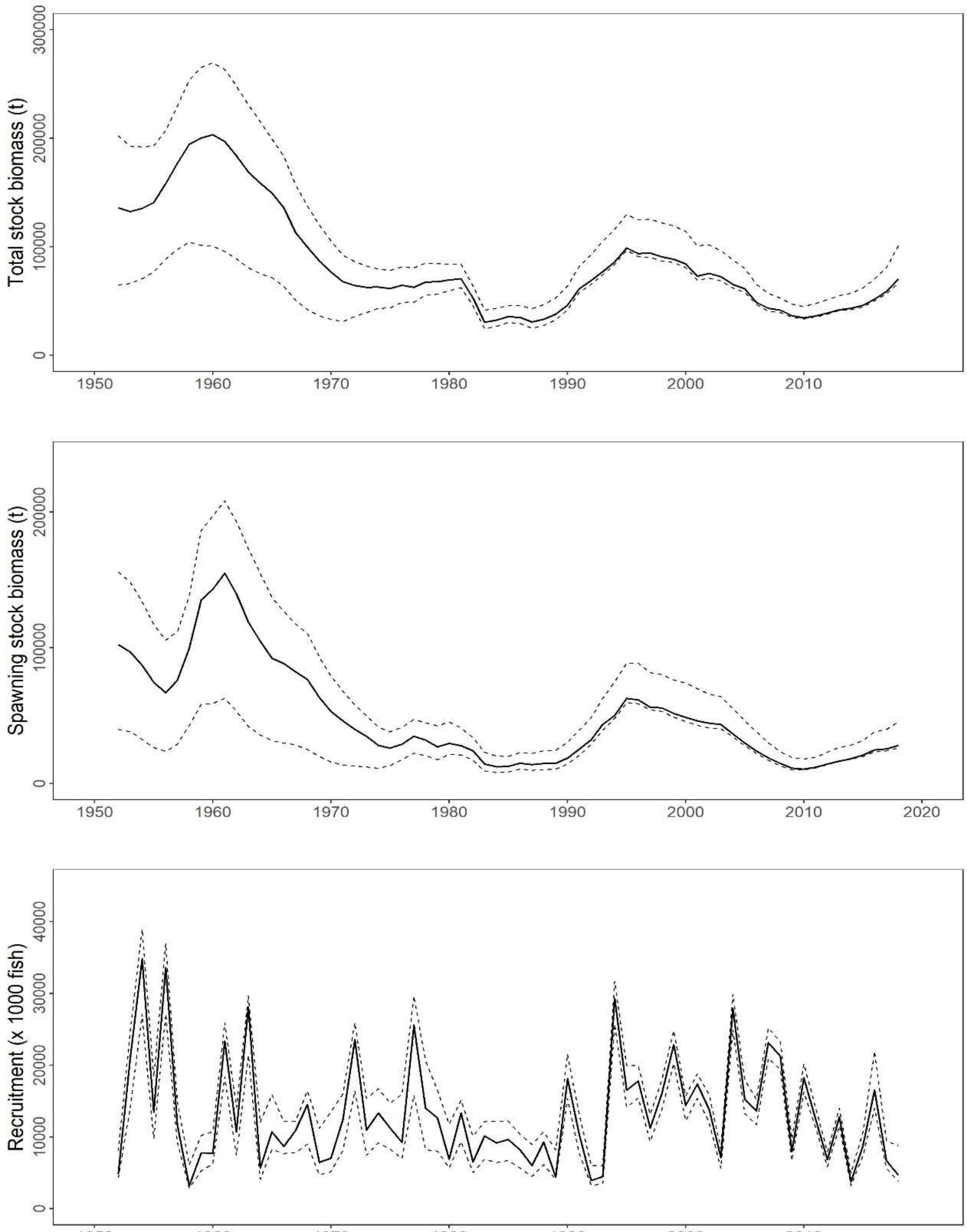


Figure 6. Total stock biomass (top), spawning stock biomass (middle), and recruitment (bottom) of Pacific bluefin tuna (*Thunnus orientalis*) (1952-2018) estimated from the base-case model. The solid line is the point estimate and dashed lines delineate the 90% confidence interval.

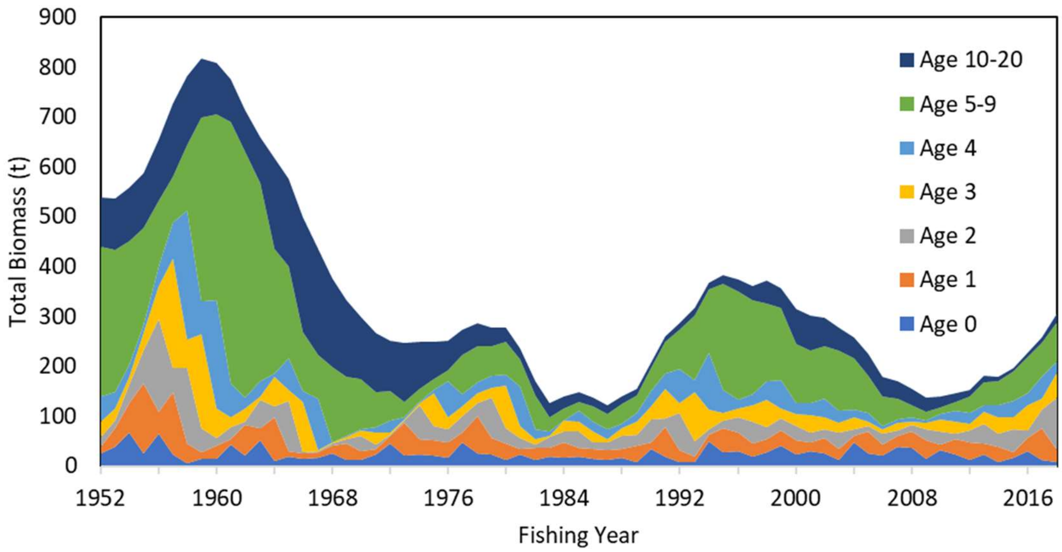


Figure 7. Total biomass (t) by age of Pacific bluefin tuna (*Thunnus orientalis*) estimated from the base-case model (1952-2018).

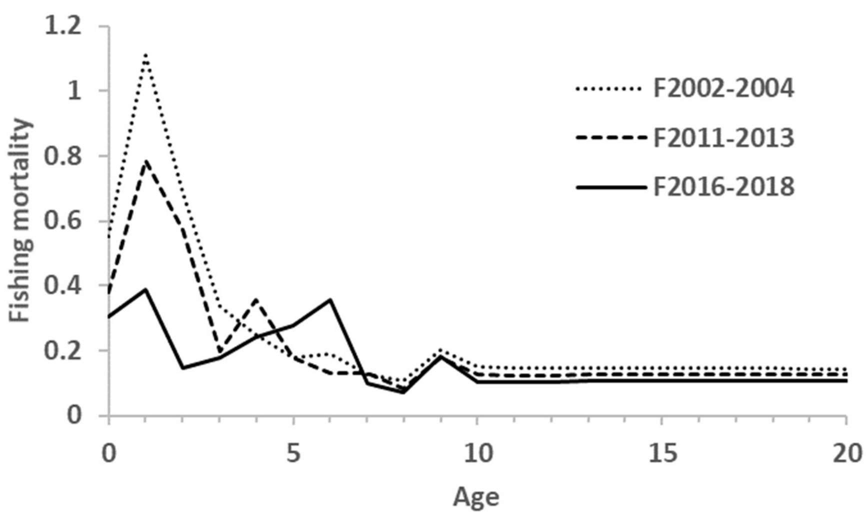


Figure 8. Geometric means of annual age-specific fishing mortalities (F) of Pacific bluefin tuna (*Thunnus orientalis*) for 2002-2004 (dotted line), 2011-2013 (broken line) and 2016-2018 (solid line).

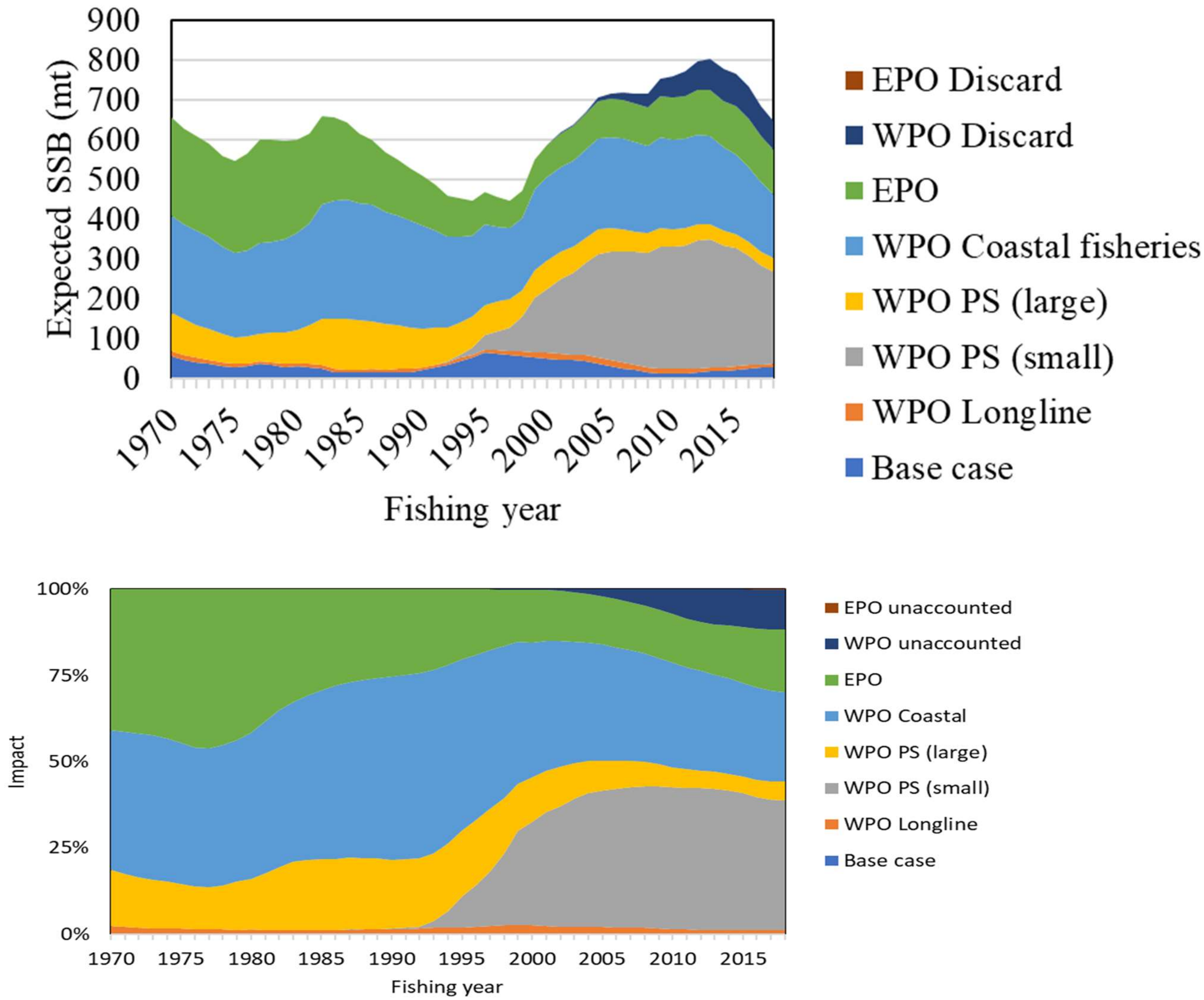


Figure 9. The trajectory of the spawning stock biomass of a simulated population of Pacific bluefin tuna (*Thunnus orientalis*) when zero fishing mortality is assumed, estimated by the base-case model. (top: absolute SSB, bottom: relative SSB). Fisheries group definition; WPO longline fisheries: F1, F12, F17, 23. WPO purse seine fisheries for small fish: F2, F3, F18, F20. WPO purse seine fisheries for large fish: F4, F5. WPO coastal fisheries: F6-11, F16, F19. EPO fisheries: F13, F14, F15, F24. WPO unaccounted fisheries: F21, 22. EPO unaccounted fisheries: F25. For exact fleet definitions, please see the 2020 PBF stock assessment report on the ISC website.

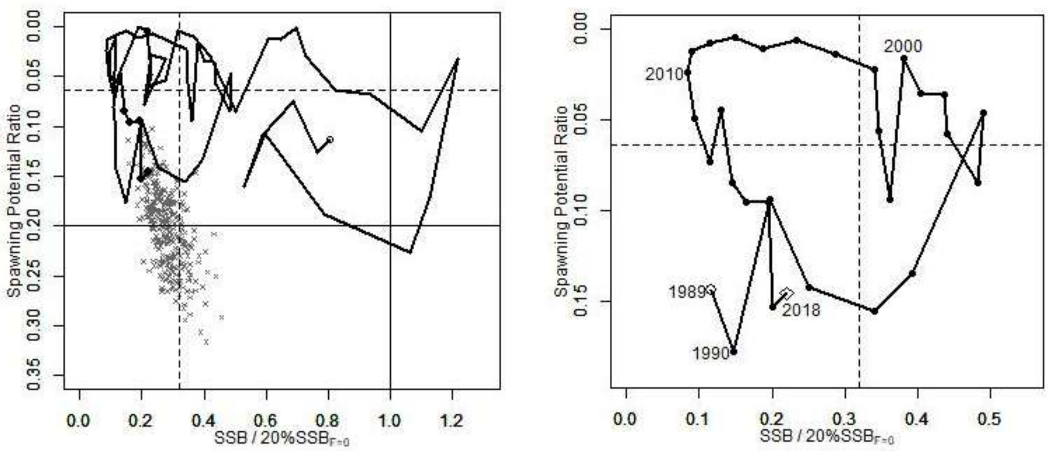


Figure 10. Kobe plots for Pacific bluefin tuna (*Thunnus orientalis*) estimated from the base-case model. The X-axis shows the annual SSB relative to 20%$SSB_{F=0}$ and the Y-axis shows the spawning potential ratio (SPR) as a measure of fishing mortality. Vertical and horizontal solid lines in the left figure show 20%$SSB_{F=0}$ (which corresponds to the second biomass rebuilding target) and the corresponding fishing mortality that produces SPR, respectively. Vertical and horizontal broken lines in both figures show the initial biomass rebuilding target (SSB_{MED} = 6.4%$SSB_{F=0}$) and the corresponding fishing mortality that produces SPR, 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), solid circles indicate the last five years of the assessment (2014-2018), and grey crosses indicate the uncertainty of the terminal year estimated by bootstrapping. The right figure shows the trajectory of the last 30 years. In accordance with Plenary agreement during ISC18, these plots are shown without colour in the quadrats becaause no reference points have been adopted by Regional Fisheries Management Organizations for this stock.

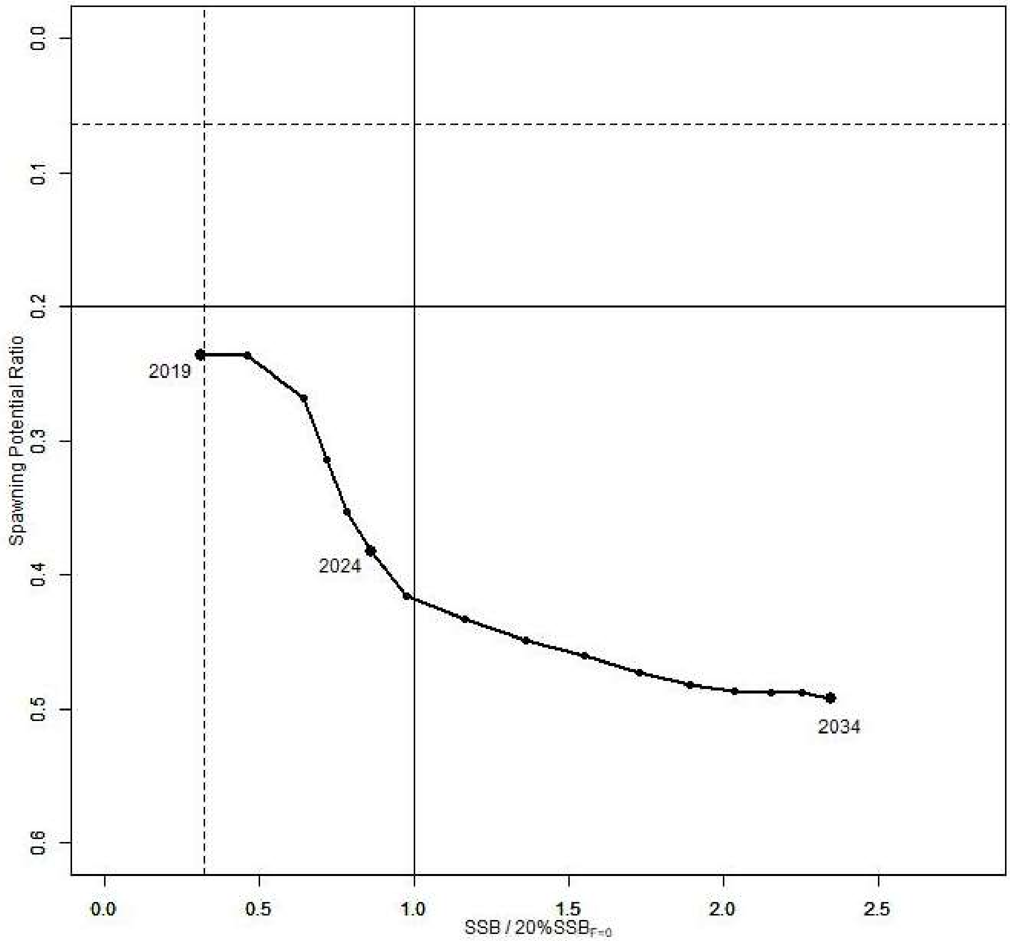


Figure 11. "Future Kobe Plot" of projection results for Pacific bluefin tuna (*Thunnus orientalis*) from Scenario 1 from Table PBF3.

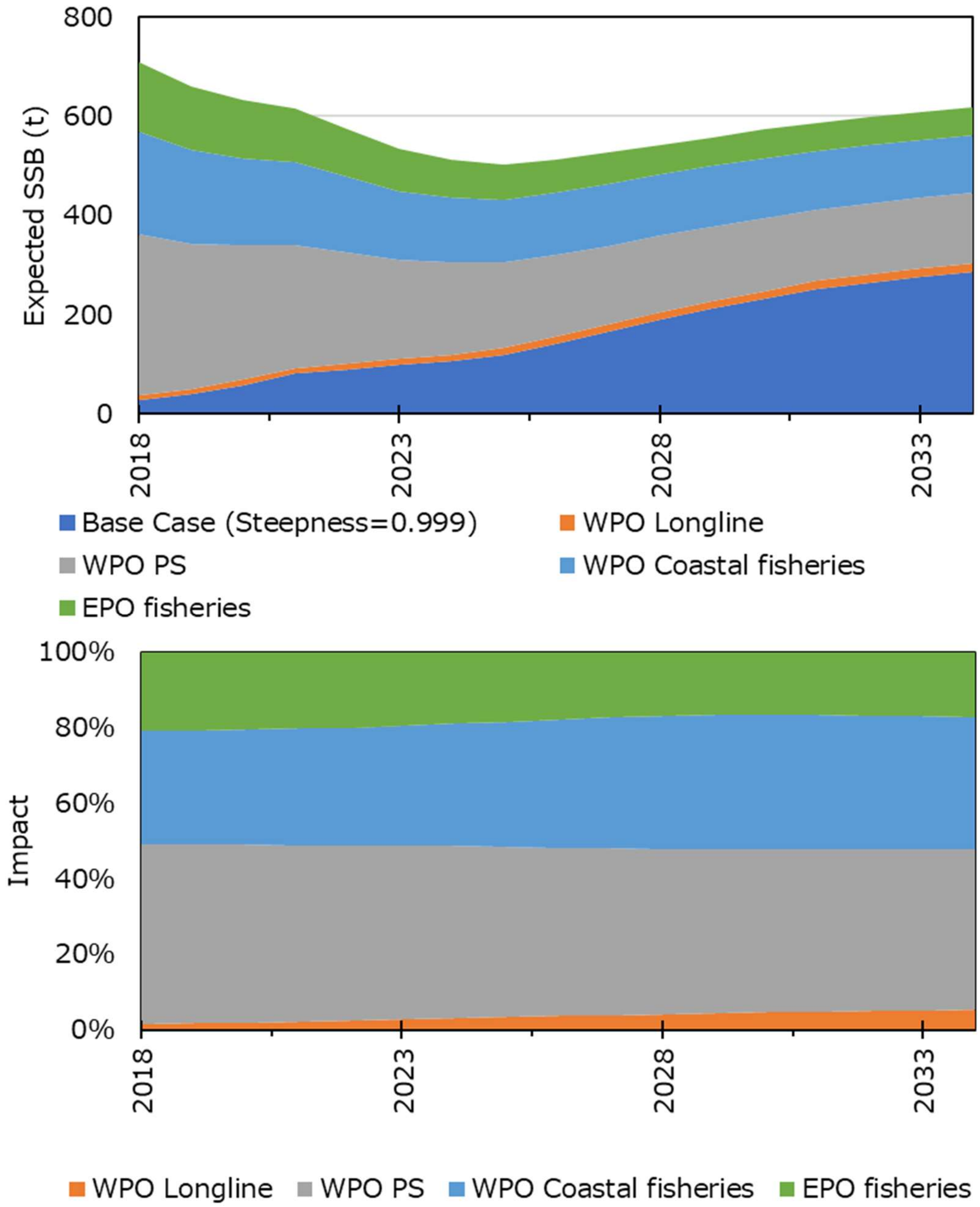


Figure 12. "Future impact plot" from projection results for Pacific bluefin tuna (*Thunnus orientalis*) from Scenario 1 of Table S-3. The impact is calculated based on the expected increase of SSB in the absence of the respective group of fisheries.

3.3 Billfish

3.3.1 Billfish WG Report and Review of Assignments

H. Ijima, Chair of the BILLWG, reported that the BILLWG held a workshop on biological research but did not conduct a stock assessment in 2019-2020 (**ISC/20/ANNEX/07**). The workshop reviewed existing biology and ecology research of billfish species and developed consensus on thirteen collaborative projects on growth, aging, maturity, and stock structure of the three billfish species. The BILLWG also prepared responses to two requests made at NC15:

1. NC15 requested that the ISC provide advice on which future recruitment scenario [for striped marlin] is the most likely one over the near term; and
2. NC15 also requested that the ISC explain why the striped marlin stock decreased and the fishing mortality increased after a drastic decrease in fishing effort by high seas driftnet fisheries in the early 1990s.

The request to identify the most plausible recruitment scenario arose because the ISC's conservation information based on the 2019 Striped Marlin (MLS) stock assessment identified different stock responses depending on the recruitment scenario used. The BILLWG reviewed the two recruitment scenarios and noted that there is a linearly decreasing trend in estimated recruitment with time (Figure 13). The BILLWG also noted that if the long-term recruitment scenario is used for future stock projections, then the observed long-term recruitment time series requires the assumption that there is no time trend (Figure 13). Based on this assessment, the BILLWG recommended that the short-term recruitment scenario was the most appropriate model to use for conducting stochastic stock projections for Western and Central North Pacific MLS (WCNPO MLS).

Responding to the second request by NC15, the BILLWG noted that it is difficult to determine an explanation for the increase in fishing mortality on MLS when high seas driftnet effort decreased. A variety of factors could have affected the fishing mortality of MLS directly, but they are difficult to identify due to various uncertainties of the stock assessment model, at this time. The WG will attempt to address this issue in the next stock assessment.

The BILLWG is planning a data preparation meeting for the Pacific blue marlin (BUM) stock assessment and a second biology workshop in the fall of 2020. A benchmark stock assessment of BUM will be carried out between February and April 2021.

<u>**Discussion**</u>

The ISC Plenary endorsed the BILLWG responses to the NC15 requests and notes that the conservation information provided in 2019 needs to be altered to reflect the recommendation that the short-term recruitment model is more plausible and should be used when considering management responses.

3.3.2 WCNPO Pacific Striped Marlin Stock Status and Conservation Information

H. Ijima, Chair of the BILLWG, noted that WCNPO MLS was last assessed in 2019.

Stock Status and Conservation Information

The Plenary reviewed and agreed to forward the same stock status information that was adopted by ISC19 (see Section 7.4, pp. 24-35 in the ISC19 Plenary Report). Furthermore, the Plenary agreed to revise the conservation information that was adopted by ISC19 in light of its conclusions regarding recruitment scenarios. The ISC Plenary also reiterates the concerns expressed by the BILLWG in their special comments about the stock assessment (**ISC/19/ANNEX/11**) that are reproduced below.

Stock Status

Biomass (age 1 and older) for the WCNPO MLS stock decreased from 17,000 t in 1975 to 6,000 t in 2017 (Table 7; Figure 14). Estimated fishing mortality averaged F=0.97 yr^{-1} during the 1975-1994 period with a range of 0.60 to 1.59 yr^{-1}, peaked at F=1.71 yr^{-1} in 2001, and declined sharply to F=0.64 yr^{-1} in the most recent years (2015-2017). Fishing mortality has fluctuated around F_{MSY} since 2013 (Table 7; Figure 14). Compared to MSY-based reference points, the current spawning biomass (average for 2015-2017) was 76% below SSB_{MSY} and the current fishing mortality (average for ages 3 – 12 in 2015-2017) was 7% above F_{MSY} (Table 8)

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

1. **There are no established reference points for WCNPO MLS;**
2. **Results from the base case assessment model show that under current conditions the WCNPO MLS stock is overfished and is subject to overfishing relative to MSY-based reference points (**Table 7,Table 8**, and** Figure 14**).**

Conservation Information

The status of the WCNPO MLS stock shows evidence of substantial depletion of spawning potential (SSB_{2017} is 62% below SSB_{MSY}), however fishing mortality has fluctuated around F_{MSY} in the last four years (Table 7; Table 8). The WCNPO MLS stock has produced average annual yields of around 2,100 t per year since 2012, or about 40% of the MSY catch amount. However, the majority of the catch are likely immature fish. All the projections show an increasing trend in spawning stock biomass during the 2018-2020 period, with the exception of the high F scenario under the short-term recruitment scenario. This increasing trend in SSB is due to the 2017 year class, which is estimated from the stock-recruitment curve and is more than twice as large as recent average recruitment.

Based on these findings and the ISC conclusion on recruitment scenarios, the following conservation information is provided:

1. **In response to a request from NC15, the ISC evaluated both long-term and short-term recruitment scenarios and concluded that the short-term recruitment model was the most appropriate model to use for conducting stochastic stock projections for WCNPO MLS because the time trend in the recruitment is not captured by the long term recruitment scenario;**
2. **If the stock continues to experience recruitment consistent with the short term recruitment scenario (2012-2016), then catches must be reduced to 60% of the WCPFC catch quota from CMM 2010-01 (3,397 t) to 1,359 t in order to achieve a 60% probability of rebuilding to 20%SSB_0=3,610 t by 2022. This change in catch corresponds to a reduction of roughly 37% from the recent average yield of 2,151 t.**

It was also noted that retrospective analyses (**ISC/19/ANNEX/11**) show that the assessment model appears to overestimate spawning potential in recent years, which may mean the projection results are ecologically optimistic.

Special Comments

The WG achieved a base-case model using the best available data and biological information. However, the WG recognized uncertainty in some assessment inputs including drift gillnet catches and initial catch amounts, life history parameters such as maturation and growth, and stock structure.

Overall, the base case model diagnostics and sensitivity runs show that there are some conflicts in the data (**ISC/19/ANNEX/11**). When developing a conservation and management measure to rebuild the resource, it is recommended that these issues be recognized and carefully considered, because they affect the perceived stock status and the probabilities and time frame for rebuilding of the WCNPO MLS stock.

Research Needs

To improve the stock assessment, the WG recommends continuing model development work, to reduce data conflicts and modeling uncertainties, and reevaluating and improving input assessment data.

Table 7. Reported catch (t) used in the stock assessment along with annual estimates of population biomass (age-1 and older, t), female spawning biomass (t), relative female spawning biomass (*SSB/SSB$_{MSY}$*), recruitment (thousands of age-0 fish), fishing mortality (average F, ages-3 – 12), relative fishing mortality (*F/F$_{MSY}$*), and spawning potential ratio of WCNPO MLS. (Table S1.)

Year	2011	2012	2013	2014	2015	2016	2017[2]	Mean[1]	Min[1]	Max[1]
Reported Catch	2,690	2,757	2,534	1,879	2,072	1,892	2,487	5,643	1,879	10,862
Population Biomass	5,874	6,057	4,937	6,241	5,745	5,832	6,196	12,153	4,509	22,303
Spawning Biomass	618	809	743	864	1,073	1,185	981	1,765	618	3,999
Relative Spawning Biomass	0.24	0.31	0.29	0.33	0.41	0.46	0.38	0.68	0.24	1.54
Recruitment (age 0)	196,590	87,956	330,550	77,274	185,438	195,069	354,391	396,218	77,274	1,049,460
Fishing Mortality	1.11	1.06	0.86	0.63	0.62	0.51	0.80	1.06	0.51	1.71
Relative Fishing Mortality	1.85	1.76	1.42	1.05	1.03	0.85	1.33	1.76	0.85	2.85
Spawning Potential Ratio	9%	11%	11%	16%	17%	20%	14%	12%	20%	6%

[1] During 1975-2017

[2] Estimated from the stock recruitment curve.

Table 8. Estimates of biological reference points along with estimates of fishing mortality (F), spawning stock biomass (SSB), recent average yield (C), and spawning potential ratio (SPR) of WCNPO MLS, derived from the base case model assessment model, where "MSY" indicates reference points based on maximum sustainable yield.

Reference Point	Estimate
F_{MSY} (age 3-12)	0.60
F_{2017} (age 3-12)	0.80
$F_{20\%SSB(F=0)}$	0.47
SSB_{MSY}	2,604 t
SSB_{2017}	981 t
20%SSB0	3,610 t
MSY	4,946 t
$C_{2015-2017}$	2,151 t
SPR_{MSY}	18%
SPR_{2017}	14%
$SPR_{20\%SSB(F=0)}$	23%

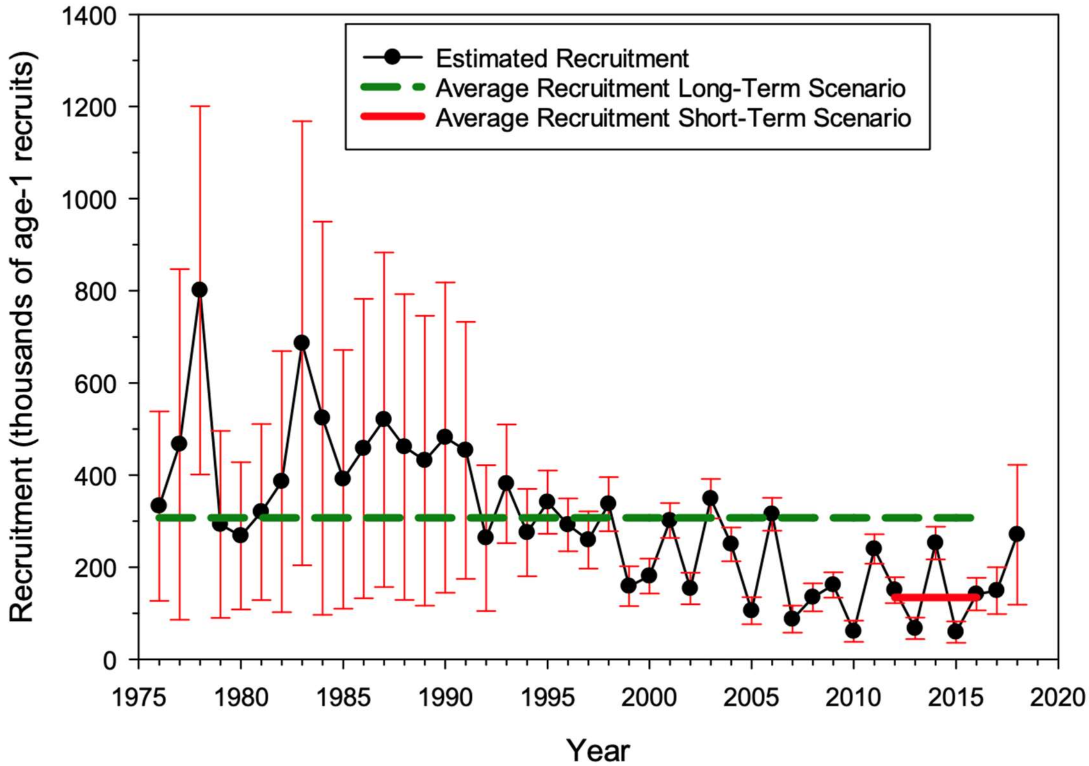


Figure 13. Estimated WCNPO MLS recruitment (black), average recruitment long-term scenario (green) and average short-term scenario (red) evaluated by the BILLWG in response to an NC15 request for advice on which scenario is more plausible.

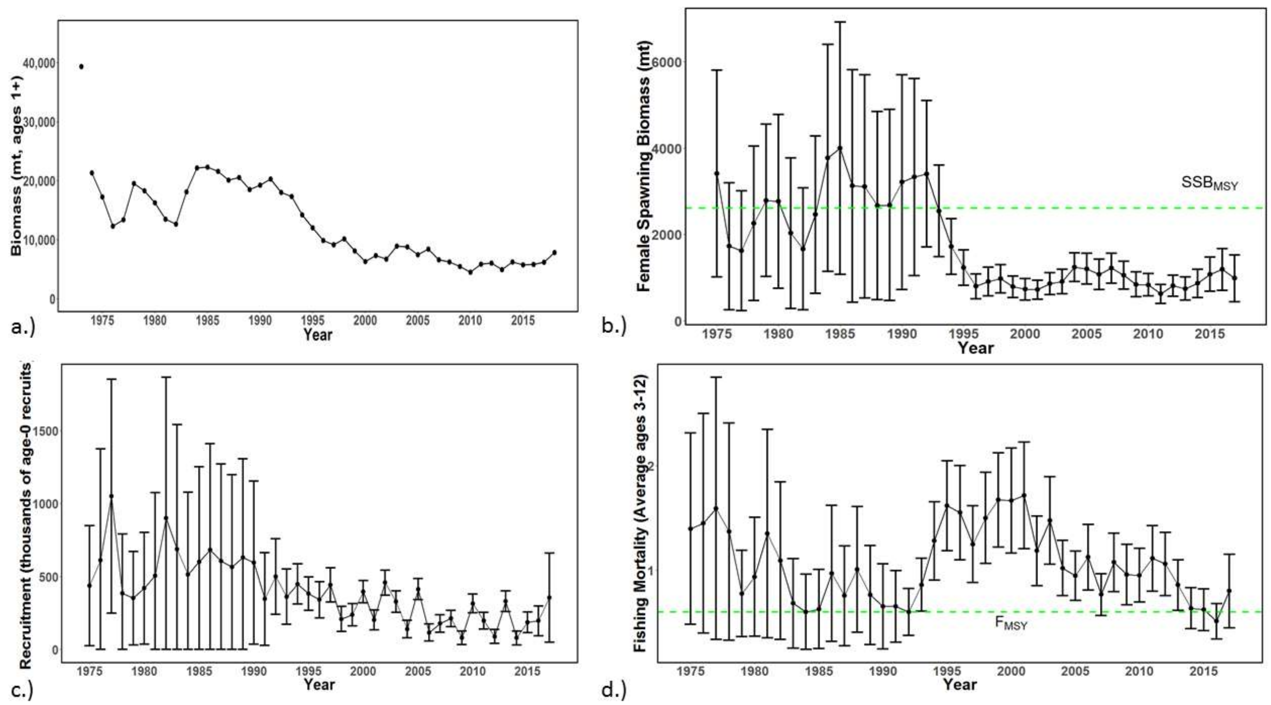


Figure 14. Time series of estimates of (a) population biomass (age 1+), (b) spawning biomass, (c) recruitment (age-0 fish), and (d) instantaneous fishing mortality (average for age 3-12, year^{-1}) for WCNPO MLS (derived from the 2019 stock assessment. The circles represent the maximum likelihood estimates by year for each quantity and the error bars represent the uncertainty of the estimates (95% confidence intervals), green dashed lines indicate SSB_{MSY} and F_{MSY}. (Figure S2.)

3.3.3 Western and Central North Pacific Swordfish Stock Status and Conservation Information

H. Ijima, Chair of the BILLWG, noted that WCNPO SWO was last assessed in 2018.

Discussion

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC19 (see Section 6.4, pp. 33-41 in the ISC19 Plenary Report) unchanged, except for the omission of accompanying figures and tables and slight clarifying modifications.

Stock Status and Conservation Information

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. Female spawning stock biomass was estimated to be 29,403 t in 2016, or about 90% above SSB_{MSY}. 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. The Kobe plot depicts the stock status relative to MSY-based reference points for the base case model 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.

Biomass status is based on female spawning stock biomass in the 2018 benchmark assessment, whereas in 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 SWO 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 SWO 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 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.**

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) $F_{50\%}$. 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 SWO in the WCNPO. 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, with greater increases expected under lower fishing mortality rates; and**

2. **Similarly, projected catch is expected to increase under each of the five harvest scenarios, with greater increases expected under higher fishing mortality rates.**

3.3.4 Eastern Pacific Swordfish Stock Status and Conservation Information

H. Ijima, Chair of the BILLWG, noted that EPO SWO was last assessed in 2014.

Discussion

It was reported that IATTC plans to conduct a stock assessment for south EPO SWO in the near future. The long time frame since EPO stock was assessed brings some uncertainty to the status of the stock. The ISC does not currently have plans to assess this stock as it is within the IATTC's purview, but the BILLWG Chair has raised the idea of collaboration during discussions with the IATTC scientific staff on the assessment. As part of this assessment, the IATTC will reexamine the boundary between the EPO and WCNPO stocks[4].

The Plenary agreed to modify the stock status statement to better characterize uncertainty about the likelihood that overfishing had occurred.

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC19 (see Section 7.6, pp. 37-38 in the ISC19 Plenary Report) unchanged, except for the omission of accompanying figures and tables and clarifying modifications.

Stock Status and Conservation Information

Stock Status

Exploitable biomass (age 2+) of the EPO SWO stock decreased during the 1969-1995 period and increased from 31,000 t in 1995 to over 60,000 t by 2010, generally remaining above B_{MSY}. Harvest rates were initially low, have had a long-term increasing trend, and likely exceeded H_{MSY} in 1998, 2002, 2003, as well as in 2012, the terminal year of the last stock assessment.

[4] For details see: (1) Griffiths, S,, C. Sepulveda, and S. Aalbers. 2020. Movements of swordfish (Xiphias gladius) in the northeastern Pacific Ocean as determined by electronic tags (2002-2019). ISC BILLWorking Group Intersessional Workshop, 30 January-3 February, 2020, National Taiwan University, Taiwan, ISC/20/BILLWG-01/10/G Working Paper, 8 p. (2) Inter-American Tropical Tuna Commission. 2019. Scientific Advisory Committee, Report of the Tenth Meeting, San Diego, California (USA), 13-17 May 2019, SAC-10, 34 p.

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 SWO stock under the auspices of the IATTC. Stock status is assessed relative to MSY-based reference points;**

2. **The Kobe plot shows that overfishing likely occurred (>50%) relative to potential MSY-based reference points in the late 1990s and early 2000s and from 2010 to 2012;**

3. **There was a 55% probability that overfishing occurred in 2012, but there was a less than a 1% probability that the stock was overfished relative to MSY-based reference points.**

Conservation Information

Stochastic projections for the EPO SWO 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 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, then 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.**

3.3.5 Pacific Blue Marlin Stock Status and Conservation Information

H. Ijima, Chair of the BILLWG, noted that BUM was last assessed in 2016.

Discussion

The Plenary reviewed and agreed to forward the stock status and conservation information statements adopted at ISC19 for BUM (see Section 7.7, pp. 38-39 in the ISC19 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 yr^{-1} 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 $SPR_{2012-2014}$ = 21%. Annual recruitment averaged about 897,000 recruits during the 2008-2014 period, 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 BUM stock is not currently overfished and is not experiencing overfishing relative to MSY-based reference points;**

3. **Because Pacific BUM 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 (average 2012-2014).

The Plenary notes that the average annual catch of BUM by SC countries during the 2012-2014 period was 7,978 t and the average annual catch during the 2013-2019 period was 7,544 t. The ISC Plenary notes that the distribution of BUM is pan-Pacific and that these figures do not include catches by non-ISC member.

3.4 Shark

3.4.1 SHARKWG Report and Review of Assignments

M. Kai, SHARKWG Chair, provided a summary of SHARKWG activities over the past year (**ISC/20/ANNEX/06**). The focus of the SHARKWG was mainly on North Pacific Blue Shark (BSH) with the goal of completing an updated stock assessment by ISC20. A full meeting of the SHARKWG was held in Shimizu, Japan, December 2019 to conduct the BSH stock assessment update in addition to the discussion about the administrative business and future ISC collaborative work plans. The SHARKWG also held two webinars before and after the full meeting to discuss the changes in the assessment cycle and plan for the updated BSH assessment, and to review the final outputs of the assessment. Chinese Taipei, IATTC, Japan, Korea, Mexico, and USA actively participated in at least one SHARKWG meeting.

Highlights of the meetings and webinars were briefly presented (**ISC/20/ANNEX/06, 10**). The SHARKWG Chair expressed appreciation to Japan for hosting the SHARKWG meeting for the updated stock assessment for NPO BSH. Through the hard work of Working Group Members at the meetings and during the intercessional webinars, the SHARKWG completed the stock assessment update that is based on updating catch in order to run future projections using SS (**ISC/20/ANNEX 10**). The SHARKWG also agreed to a proposed change in the stock assessment cycle for BSH and Shortfin Mako shark (SMA) from 3 to 5 years. Furthermore, the SHARKWG worked to improve pelagic shark datasets (i.e., BSH and SMA) and held fruitful discussions on future work plans. Finally, the SHARKWG Chair mentioned that the WG recommends identifying their BSH analysis (see next Section) as a "sensitivity analysis" rather than a stock assessment update and that the results not be used to change stock status and conservation information.

The SHARKWG proposed the following a workshop in the first two weeks of November 2020, hosted by the United States in Honolulu, Hawai'i. The objectives of the meeting are to review the update of biological parameters and fishery data for pelagic sharks especially for SMA, and modeling techniques. However, the SHARKWG Chair may change the dates to spring 2021 due to COVID-19 concerns and is now consulting with the US delegation on the logistics of doing so as the meeting is to be held in Hawaii.

3.4.2 Blue Shark Sensitivity Analysis

M. Kai presented the first updated stock assessment of blue shark (*Prionace glauca*) (BSH) in the North Pacific Ocean (**ISC/20/ANNEX/10**). The most recent benchmark stock assessment of BSH was completed in 2017. The ISC plenary meeting in 2019 accepted the proposal of the ISC SHARKWG, which enabled us to change the benchmark assessment period from every 3 years to every 5 years; however, as a condition, an stock assessment update was required to be conducted every 5 years (between benchmark assessments) using the future projection with an updated annual catch data. In response to a request from the ISC Plenary, annual catch data. were updated through 2018 and the stock status and future trajectories were assessed using the future projection of SS with the same parameterization of the SS reference case in 2017, without estimating the parameters, except for unfished recruitment (R_0) and recruitment deviations.

The BSH is widely distributed throughout the temperate and tropical waters of the Pacific Ocean. The ISC SHARKWG recognizes two stocks in the North and South Pacific, respectively, based on biological and fishery evidence. Relatively few BSH are encountered in the tropical equatorial waters separating the two stocks. Tagging data demonstrated long-distance movements with a high degree of mixing of BSH across the NPO, although there is evidence of spatial and temporal structure by size and sex.

Catch records for BSH are limited, and where lacking, have been estimated using statistical models and information from a combination of historical landing data, fishery logbooks, observer records, and research surveys. In these analyses, the estimated BSH catch data refer to total dead removals, which include retained catch and dead discards. Estimated catch data in the NPO date back to 1971, although longline and driftnet fisheries targeting tunas and billfish earlier in the 20th century likely caught BSH. The nations catching the most BSH in the NPO include Japan, Chinese Taipei, Mexico, and the USA, which account for more than 90% of the estimated catch. Estimated catches of BSH were highest from 1976 to 1989, with a peak estimated catch of approximately 88,000 mt in 1981. Over the past decade, BSH estimated catches in the NPO have shown a gradual decline from ~52,000 mt in 2005 to an average of ~32,000 mt annually in 2016–2018 (Figure 15). Although a variety of fishing gear can catch BSH, most are caught in longline fisheries.

The input data in SS were used in the previous assessment in 2017, except for the updated annual catch data for 2016–2018. Annual catch estimates were derived for a variety of fisheries by nation. Catch and size composition data were grouped into 18 fisheries for the period from 1971 to 2018 and from 1971 to 2015, respectively. Standardized catch-per-unit-effort (CPUE) data from the Japanese shallow longline fleet that operated out of Hokkaido and Tohoku ports for the periods 1976-1993 and 1994-2015 were used as measures of relative population abundance in the reference case assessment.

Projections of stock biomass and catch of NPO BSH from 2019 to 2028 were conducted assuming alternative constant-F harvest scenarios (F_{MSY}, $F_{2012\text{-}2014}$, $F_{2015\text{-}2017}$, $F_{20\%\mathrm{plus}}$, $F_{20\%\mathrm{minus}}$). Status-quo F was based on the average over the past 3 years (2015–2017). All the parameters of the SS were fixed except for R_0 and the recruitment deviations.

Female *SB* in 2018 (SB_{2018}) was 65% higher than that for the MSY and estimated as 285,385 mt (Figure 16). Annual fishing mortality (*F*) in 2018 (F_{2018}) was estimated to be well below the F_{MSY} at approximately 29% of the F_{MSY}.

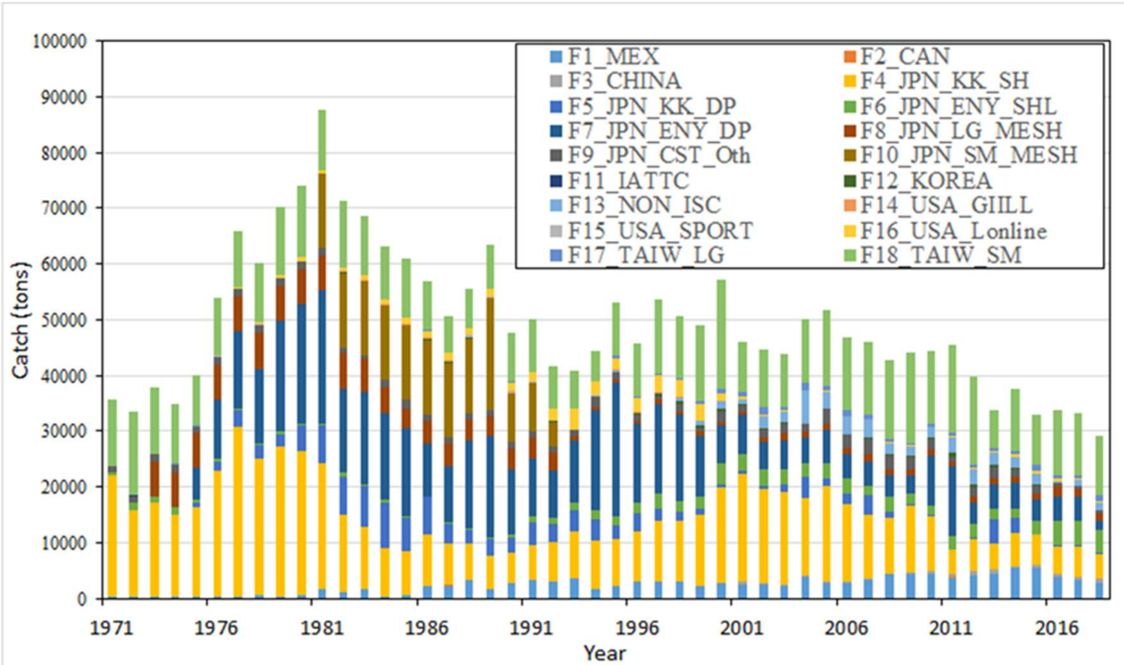


Figure 15. Annual catch of the blue shark in the North Pacific Ocean by fleets used in the updated stock assessment from 1971 to 2018.

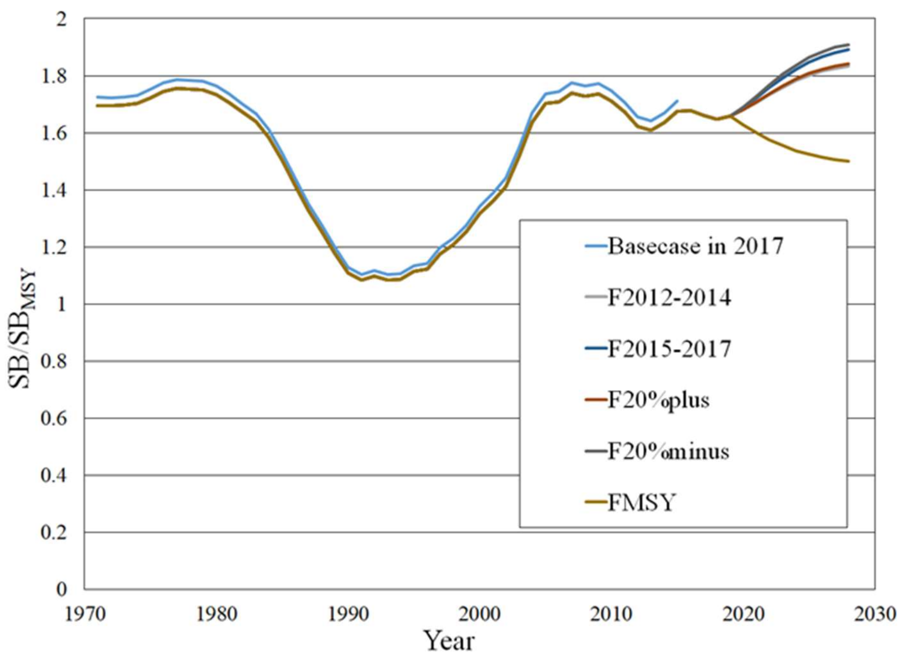


Figure 16. Estimates of annual female spawning biomass (SB; in metric tons) and the projected trajectory for alternative harvest strategies. The value of one denotes the estimate of SB at MSY (SB_{MSY}).

Future projections under different *F* harvest policies (F_{MSY}, $F_{2012\text{-}2014}$, $F_{2015\text{-}2017}$, $F_{20\%plus}$, $F_{20\%minus}$) show that the median BSH biomass will likely remain above SB_{MSY} in the foreseeable future, except for the harvest policy of F_{MSY} (Figure 16).

Discussion

The Plenary requested that the SHARKWG conduct a stock assessment update for BSH at ISC19 owing to the long gap between benchmark assessments that will occur as a result of the revised stock assessment scheduling (5 years) that was approved at ISC19 (Table 9). The Plenary considers an update assessment to consist of updated catch, CPUE, and size composition data inputs into the existing assessment model structure, assumptions and parameterization to run the model and projections and generate new advice. However, as the SHARKWG updated catch data only and then conducted new projections, the ISC Plenary considers these results to be a sensitivity analysis and not suitable for changing stock status and conservation information from a benchmark assessment.

The ISC Chair noted that there were two ways to proceed: (1) conduct a stock assessment update in which all data are updated and the model and projections are rerun with existing structure, assumptions, and parameterizations, or (2) conduct an analysis of indicators of the status of the stock for changes that would trigger the scheduling of a new assessment between benchmark assessments. After considerable discussion with the SHARKWG concerning their schedule (see Table 9) and workload, the Plenary requested that the SHARKWG conduct an indicator analysis for SMA and report the results at the ISC21 Plenary. In addition, the Plenary requested that the SHARKWG provide recommendations on whether a new assessment should occur prior to the scheduled benchmark assessment. The Plenary approved the work schedule of the SHARKWG (Table 9) by substituting update assessment (in previous versions) with indicator analysis.

Given the Plenary conclusion that the analysis produced by the SHARKWG was not suitable for adjusting stock status and conservation information, the ISC Plenary agreed to forward the stock status and conservation information statements adopted at ISC19 for BSH (see Section 7.3, pp. 20-21 in the ISC19 Plenary Report) unchanged except for the omission of accompanying figures and tables, and clarifications if needed.

Stock Status and Conservation Information

Target and limit reference points have not yet been established for pelagic sharks in the Pacific Ocean by either the WCPFC or the IATTC. Stock status is reported in relation to MSY-based reference points. The following information on the status of NP BSH is provided.

Stock Status

1. **Female spawning biomass in 2015 (SSB_{2015}) was 69% higher than at MSY and estimated to be 295,774 t;**
2. **The recent annual fishing mortality ($F_{2012\text{-}2014}$) was estimated to be well below F_{MSY} at approximately 38% of F_{MSY};**

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).**

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 NPO will likely remain above SSB_{MSY} in the foreseeable future. Other potential reference points were not considered in these evaluations.

The Plenary noted that the average annual catch of BSH by ISC members in 2012-2014 was 29,992 t and that the average annual catch in the 2015-2019 period was 25,742 t. As ISC member countries account for at least 90% of the overall catch, these figures are believed to provide a reliable estimator of catch in North Pacific BSH.

Table 9. Stock assessment schedule for 10 years for the SHARKWG approved by the ISC Plenary.

Year	Season/ Month	Contents	Species	Meeting	Assessment Cycle
2019	Dec	Stock assesment update	BSH	SHARKWG	1st Year
2020	July	Report the new stock status	BSH	ISC Plenary	2nd Year
2020	Fall	Indicator Analysis	SMA	SHARKWG	
2021	July	Report Indicator Analysis	SMA	ISC Plenary	3rd Year
2021	Fall	Data Preparation Workhsop	BSH	SHARKWG	
2022	Spring	Benchmark Assessment Workshop	BSH	SHARWG	
2022	July	Report Assessment Results	BSH	ISC Plenary	4th Year
2022	Fall	No Meetings			
2023	July	No assessment report		ISC Plenary	5th Year
2023	Fall	Data Preparation Workshop	SMA	SHARKWG	
2024	Spring	Benchmark Assessment Workshop	SMA	SHARKWG	
2024	July	Report Assessment Results	SMA	ISC Plenary	1st Year
2024	Fall	Indicator Analysis	BSH	SHARKWG	
2025	July	Report Indicator Analysis	BSH	ISC Plenary	2nd Year
2025	Fall	Indicator Analysis	SMA	SHARKWG	
2026	July	Report Inidcator Analysis	SMA	ISC Plenary	3rd Year
2026	Fall	Data Preparation Workshop	BSH	SHARKWG	

2027	Spring	Benchmark Assessment Workshop	BSH	SHARKWG	
2027	July	Report Assessment Results	BSH	ISC Plenary	4th Year
2027	Fall	No Meeting			
2028	July	No Assessment Reports		ISC Plenary	5th Year

3.4.3 Shortfin Mako Shark Stock Status and Conservation Information

M. Kai, Chair of the SHARKWG, noted that the most recent stock assessment for SMA was completed in 2018.

Discussion

The Plenary reviewed and agreed to forward the same stock status and conservation information that was adopted by ISC19 (see Section 7.2, pp. 19-20 in the ISC19 Plenary Report) unchanged except for the omission of accompanying figures and tables and clarifying modifications. No new research needs were identified by ISC19.

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.

Stock Status

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-based reference points.**
2. **The results from the base case model and six sensitivity analyses that represent the most important sources of uncertainty in the assessment show that the NPO 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.**

Conservation Information

Stock projections of biomass and catch of NPO 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%.

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 spawner abundance (SA – the number of mature female sharks) is expected to increase gradually;**
2. **If fishing mortality is increased 20% relative to $F_{2013-2015}$, then 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.**

The ISC Plenary notes that the average annual catch of SMA by ISC members was 1,392 t in the 2013-2015 period and decreased to 1,180 t from 2016-2019.

4 REVIEW OF STATISTICS AND DATABASE ISSUES

4.1 STATWG Report

J. Brodziak, the Interim Chair of the STATWG, summarized the STATWG activities since ISC19 as reported in **ISC/20/ANNEX/13**. The STATWG meeting was held virtually on July 7, 2020 with the Interim Chair running the meeting and 17 participants from Canada, Chinese Taipei, Japan, Korea, USA, and the WCPFC. Regarding the status of the STATWG, seven of the eleven items in the 2019-2020 work plan were completed. The other four items either will be completed in August 2020 or were not completed due to absence of an elected STATWG Chair. The new server housing the ISC database and website has been activated and the old server is scheduled to be closed down in February 2021. The ISC database was transferred to the new server in March 2020. The ISC website on the new server includes regular updates of scheduled Working Group meetings, working papers, stock assessments, fishery statistics, and the ISC organization chart. It was also noted that the Data Administrator (DA) has added information on the MSE process to the ALBWG and PBFWG webpages.

The Interim Chair described the status of ISC Member data submissions in 2019-2020. It was noted that all ISC Members except China have submitted their Category I and II data and metadata. Discrepancies noted from cross-comparisons between the data submitted by Members and the data in their national reports will be distributed to Members for confirmation and correction. Japan has submitted revisions to the historical catch time series for NPO BSH and NPO SMA (1994-2019) and for NPO SWO and NP MLS (1951-2018) in **ISC20/STATWG/WP/01**. These improved statistics provided a more accurate categorization of catches by gear for the gear type "longline-others" for stock assessment purposes. It was noted that species WGs are requested to submit stock assessment data files by November 1 each year for archiving purposes and that this was completed for assessments conducted through 2019. It was noted that the goal of the stock assessment archive was to increase transparency and to publish the assessment files on ISC researcher's website, which has access restricted to species WG members. Extending accessibility from current WG chairs, members, and the DA to external data requesters was discussed. It was noted that the ISC19 Plenary concluded that a non-disclosure agreement and a standard protocol must be established for this purpose. The Interim Chair reported that a draft non-disclosure agreement had been developed as reported in **ISC20/STATWG/WP/02**. The STATWG reviewed the draft non-disclosure agreement and agreed to ask the ISC20 Plenary to review the draft agreement and provide guidance on the development of a data sharing protocol.

It was noted that there was a need for WGs to have a confidential file-sharing space for meeting participants on the new ISC server. The STATWG agreed that a specific working and file-sharing space should be created for each species WG, on the condition that 1) files uploaded to the working space must be relevant to WG as determined by the WG Chair; 2) the WG Chair needs to confirm annually that uploaded files are still necessary, and remove them when they are no longer required; and 3) the space will be accessible only to members of the WG. It was noted that the DA was working to implement this shared work space on the new server.

The STATWG discussed the function of the working group. The STATWG members agreed that the STATWG was needed on an ongoing basis in order to (1) maintain the ISC database and the quality of data submitted by members, (2) maintain the proper function of ISC website, and (3) coordinate internal data sharing and develop protocols for answering external data requests, the STATWG is responsible for overseeing these functions in cooperation with WG chairs and members, providing a link to the ISC Plenary, and recommending appropriate actions when needed. Based on discussion at the July 7th meeting, the STATWG developed a work plan for 2020-2021 with 10 items as reported in section 6.1 of **ISC/20/ANNEX/13**. The STATWG also made the following recommendations to the ISC20 Plenary:

1. The STATWG recommends that the DA turn the old server off after ISC20.
2. The STATWG recommends approval of the data revisions to blue shark, shortfin mako shark, swordfish and striped marlin catches presented by Japan in 2020.
3. The STATWG recommends that Species WG chairs review the Species pages and update information, if necessary, to improve the utility and information content. It is also recommended that links to Albacore and Pacific Bluefin Management Strategy Evaluation (MSE) meeting documents be updated on their respective species webpages as needed.
4. The STATWG recommends that the ISC20 discuss the development of a standard protocol for sharing confidential stock assessment files with external parties and provide guidance to the STATWG on this matter. It is expected that this protocol would include a non-disclosure agreement and rules governing the process and use of shared files.
5. It is recommended that the STATWG hold a face-to-face meeting to complete its work for 2020-2021 and that this meeting be scheduled for 1.5 days in advance of the ISC21 Plenary.
6. It is recommended there is an ongoing need for the STATWG with functions of
7. Maintaining the ISC database and the quality of data submitted by members
8. Maintaining the proper function of ISC website
9. Supporting internal data sharing and developing protocols for external requests for sharing confidential ISC data.

The Interim Chair also noted that the STATWG had elected Sung Il Lee to be Vice Chair of the STATWG and that there was no election of a new STATWG Chair in 2019-2020. Last, the STATWG organization chart was reviewed and updated for 2020-2021.The updates were:

- Sung Il Lee replaces Eric Chang as Vice Chair

- Yuhong Gu replaces John Childers for USA
- Jung-Hyun Lim replaces Mi Kyung Lee for Korea

Discussion

The Plenary thanked J. Brodziak for his leadership of the STATWG. The status of the STATWG Chair was discussed. J. Brodziak is serving in an interim capacity. The USA committed to offering a candidate for the office, whether Dr. Brodziak or somebody else. The Plenary requested that the Vice Chair organize a special purpose online meeting to conduct the election once a candidate has been identified.

The Plenary agreed that the BSH sensitivity analysis files should be archived similar to the current practice for stock assessments, but that a method to clearly identify this type of analysis and distinguish it from regular stock assessments must be part of the archival process.

With respect to standardizing data input file formats used by WCPFC, IATTC, and ISC, the Plenary asked the STATWG to move forward with implementing already developed procedures and looks forward to a progress report at ISC21. The Plenary also requested that the STATWG develop a proposal metrics to track the use of ISC data in the archives and a preliminary analysis of how these data have been used over the last five years and report back at ISC21.

The Plenary reviewed the recommendations presented in the STATWG report and made the following decisions.

1. The old server previously housing the ISC database and website may be turned off.
2. The data revisions submitted by Japan (**ISC20/STATWG/WP/01**) will be incorporated into the ISC database.
3. Species working groups will review the working group pages on the ISC website and submit any necessary changes by the November following the completion of a benchmark stock assessment. It directed the ALBWG to submit the requested information on the MSE (the PBFWG has already submitted such information).
4. The Plenary had a lengthy discussion about the development of a standard protocol for sharing confidential stock assessment files with external parties and the terms contained in associated non-disclosure agreements. Through this discussion it became clear that there are a range of issues that need to be clarified related to who may be considered an external party, how to define confidential data, and responsibilities for administering any process for data sharing. It also became evident that members will likely need to conduct their own internal legal reviews of the terms described in any non-disclosure template before agreeing to its adoption (noting that the template is a framework intended to be tailored for the specifics of a given data sharing arrangement). With the guidance emerging from this discussion, the Plenary directed the STATWG to further develop a data sharing protocol including the terms for non-disclosure agreements, the definition of "external party" and "confidential data," and report back at ISC21. ISC member countries were requested to conduct their internal reviews of the non-disclosure agreement template to identify any issues specific to their country and be prepared to discuss the results at ISC21.
5. The Plenary agreed to the STATWG's proposal for a face-to-face meeting.

6. The Plenary endorsed the continuation of the STATWG and the functions described in its report.

4.2 Total Catch Tables

K. Nishikawa, the Database Administrator (DA), presented the annual catch tables for ISC Member countries for 2018-2019. The catch tables were prepared for the following ISC species of interest: ALB, PBF, SWO (both WCNPO and EPO stocks combined), MLS, 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 are included at the end of this Plenary Report (Table 10 through Table 16) and serve as the official ISC catch tables.

Discussion

In response to a question, the DA clarified that reported SWO catch is for the entire North Pacific Ocean, combining the WCNPO and EPO stock data; these data are disaggregated as needed for stock assessments.

5 REVIEW OF MEETING SCHEDULE

5.1 Time and Place of ISC20

The USA confirmed that it will host ISC21 in Kona, Hawaii, July 14-19, 2021.

5.2 Time and Place of Working Group Intercessional Meetings

A draft schedule of proposed intersessional meetings was reviewed and amended. Proposed ISC WG and RFMO meetings are shown below. Although some WG meetings are proposed to be in-person, the feasbility of in-person meetings for the foreseeable future is unclear due to COVID-19 restrictions on travel and group gatherings. These meetings will be switched to an online format should travel and gathering restrictions implemented by Public Health authorities in Member countries persist. WG Chairs were asked to confirm with the ISC Chair the dates for their proposed meetings as soon as possible in order to post that information on the ISC website.

	Month	ALBWG	BILLWG	PBFWG	SHARKWG	STATWG	PLENARY	WCPFC	IATTC
2020	**July**							Joint WG on Pacific Bluefin Tuna Mgmt TBD	
	Aug	MSE Progress Webinar						SC16, Aug 11-20, Online	95th Meeting, Aug 3-14, La Jolla, CA
	Sept				SMA Indicator Analysis Webinar			NC16, Sep 9-11, Tokyo	
	Oct		BUM Data Prep Workshop + Biological Studies Workshop						
	Nov				SMA Indicator Analysis Workshop (if in person)				
	Dec	Review MSE Progress & complete report Webinar						WCPFC17, Dec 8-15, TBD	
2021	**Jan**					Steering Committee Virtual Meeting			
	Feb	5th MSE Workshop for stakeholders	BUM Stock Assessment Workshop		SMA Indicator Analyis (if Virtual alternative)				
	Mar			Workshop – CPUE Index development; MSE considerations					
	Apr								
	May								SAC, Dates TBD
	June								
	July	July 11 0.5 d	July 12 0.5 d		July 12 0.5 d	July 10-11 1.5 d	July 14-19 (Plenary) July 13 (HOD + Chairs)		

6 ADMINISTRATIVE MATTERS

6.1 External Reviews of ISC Stock Assessments

At ISC19, the Plenary agreed to investigate: a) ways to integrate reviews into the stock assessment process, and b) conduct a peer review of the NP ALB benchmark stock assessment. A pre-plenary peer review of the NP ALB assessment was not possible this year because of the established assessment schedule. A November 2020 in-person retrospective peer review of the assessment was proposed with the goal of improving the assessment model in advance of the next benchmark assessment. However, it is unlikely that an in-person review of NP albacore assessment can occur in November 2020 because of COVID-19 restrictions. The Plenary discussed the type of process it would like to see and draft terms of reference (TOR) for future assessment reviews proposed by the USA.

Three types of review process were identified:

1. Pre-plenary reviews, which would occur after an assessment but before the Plenary meeting. This approach would require either losing one year of data and conducting the assessments earlier in the year to allow time for a review in advance of plenary or keeping the schedule, adding the review meeting at an appropriate time after the assessment once the assessment report is complete, but delaying the discussion by the Plenary to the following year and the provision of advice to the RFMOs;
2. Post-plenary reviews – This process consists of a retrospective review of the assessment structured to make model improvements for the next benchmark assessment, but it would occur after the Plenary has forwarded its advice to the RFMOs; and
3. Participatory reviews – A participatory review process consists of embedding reviewers in the data and assessment meetings, but may this kind of review may not be seen as independent since the reviewers will have a role in shaping the assessment and subsequent recommendations on stock status and conservation.

The Plenary agreed that the pre-plenary review option was not desirable, because the timely consideration of stock status and conservation of stocks may be delayed and because there are questions about the independence of the reviewers and review process from the stock assessment process. The TOR for a participatory review would be critical to the smooth function of this process and the Plenary discussion made it clear that the WG chair should exercise overall control over completion of a stock assessment so that divergent views between WG members and the reviewers do not derail the process. Questions also arose concerning what type of assessment should be reviewed and the frequency with which assessments are reviewed and the costs to support these reviews. The Plenary reiterated its view that independent peer-reviews are valuable for ensuring best scientific information available.

The Plenary agreed that the ISC Chair will work with Members to further elucidate the issues associated with each option, consider funding mechanisms, determine the frequency of peer reviews, determine what types of assessments should be reviewed, consider terms of reference for these reviews as proposed by the USA, and identify other procedural issues. Based on this work, the Chair, cooperating with Members, will further develop a paper and bring it back to ISC21 for further consideration and potential adoption.

6.2 Work Group Election Results

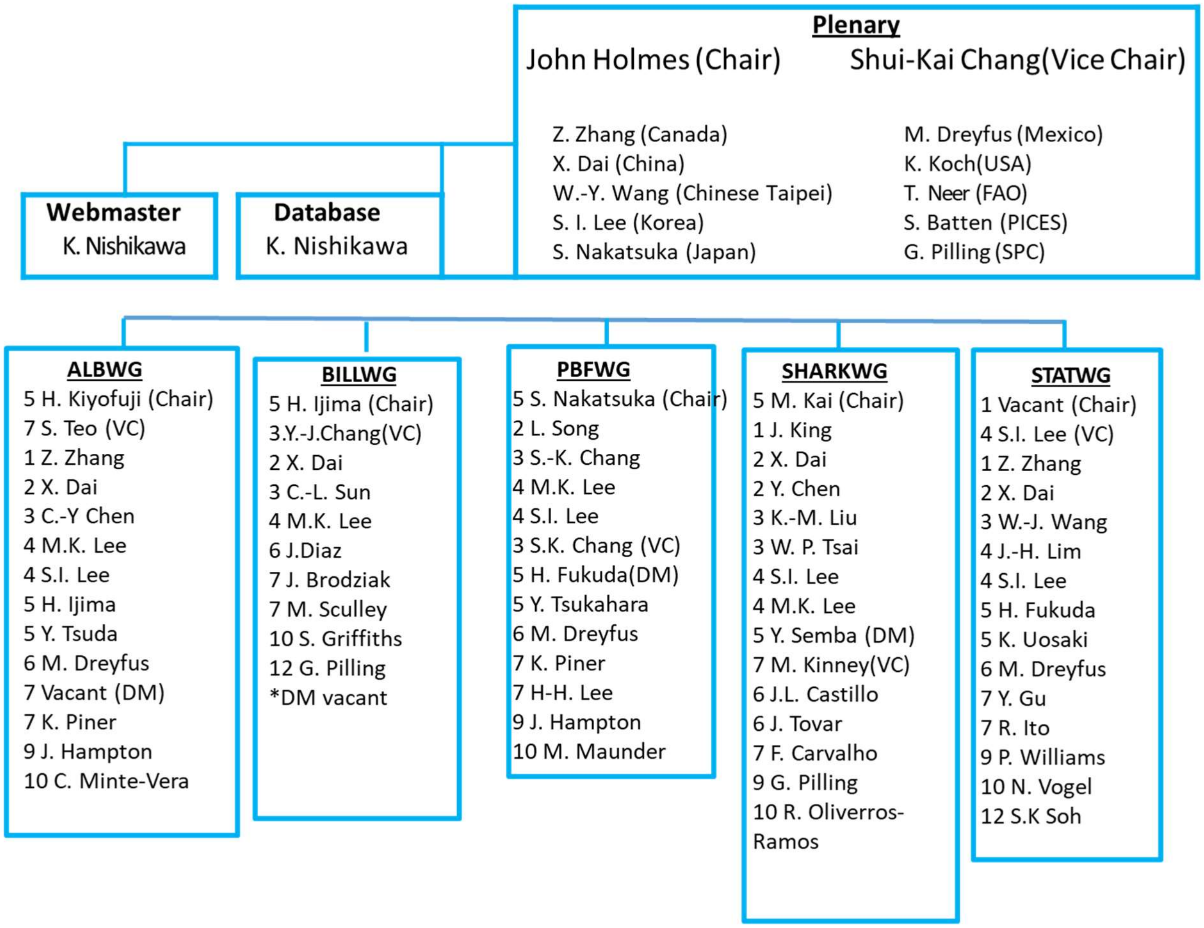
The Plenary reviewed the current WG chair and Vice Chair terms as shown below. It was noted that the Chair and Vice-Chair of the ALBWG were re-elected for a second term and that S.K. Chang (TWN) and S.I. Lee (KOR) were elected Vice-Chairs of the PBFWG and STATWG, respectively. The SHARKWG is expected to hold elections for the Chair and Vice-Chair prior to ISC21. An election for the Chair of the STATWG will also be held in the coming intersessional period.

Title	Name	First Election Date	First Term	Second Election Date	Second Term
ISC Chair	John Holmes	Jul-17	2017-2020	Jul-20	2020-2023
ISC Vice Chair	Shui-Kai (Eric) Chang	Jul-17	2017-2020	Jul-20	2020-2023
ALBWG Chair	Hidetada Kiyofuji	Jul-17	2017-2020	Apr-20	2020-2023
ALBWG Vice-Chair	Steve Teo	Jul-17	2017-2020	Apr-20	2020-2023
BILLWG Chair	Hirotaka Ijima	Jul-19	2019-2022		
BILLWG Vice-Chair	Yi-Jay Chang	Jul-19	2019-2022		
PBFWG Chair	Shuya Nakatsuka	Mar-19	2019-2022		
PBFWG Vice-Chair	SK Chang	Nov-19	2020-2023		
SHARKWG Chair	Mikihiko Kai	Apr-18	2018-2021		
SHARKWG Vice-Chair	Michael Kinney	Apr-18	2018-2021		
STATWG Chair	Jon Brodziak	Jun-20			
STATWG Vice-Chair	Sung Il Lee	Jul-20	2020-2023		

6.3 ISC Organizational Chart

The Plenary reviewed the organizational chart shown below and updated personnel as needed.

ISC Organizational Chart (July 2020)



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.

6.4 ISC Chair/Vice Chair elections

John Holmes, the current ISC Chair, and S.K. (Eric) Chang, the current ISC Vice-Chair, were each re-elected for a second three-year term (2020-2023).

6.5 Public Comment

The Plenary accepted comments from observers. Three observers provided comments.

7 ADOPTION OF REPORT

The Report of the Meeting was adopted.

8 CLOSE OF MEETING

The meeting was closed at 21:00, 20 July 2020 Pacific Daylight Time.

9 CATCH TABLES

Table 10. North Pacific albacore catches (in metric tons) by fisheries, 1952-2018. "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		CAN		JPN								KOR		MEX			TWN						USA									
	Year	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	Set-net	Gill-net (not specified)	Longline	Others	Purse seine	TWN Total	Drift gill-net	Handline	Longline	Pole and line	Troll	Others	Purse seine	Sport	USA Total	Total
	1936																										442				442	442
	1937																										1,681				1,681	1,681
	1938																										8,594				8,594	8,594
	1939	129	129																								8,586				8,586	8,715
	1940	2	2																								6,603				6,603	6,605
	1941	35	35																								5,412				5,412	5,447
	1942																										10,678				10,678	10,678
	1943	13	13																								17,071				17,071	17,084
	1944	210	210																								23,957				23,957	24,167
	1945	648	648																								17,886				17,886	18,534
	1946	196	196																								10,955				10,955	11,151
	1947	36	36																								12,235				12,235	12,271
	1948	984	984																						45		22,457				22,502	23,486
	1949	1,012	1,012																						33		24,901				24,934	25,946
	1950	961	961																						27		32,746				32,773	33,734
	1951	86	86																						24		15,629				15,653	15,739
	1952	71	71	55	-	26,687	41,787	-	237	154	68,920			-	-	-									46		23,843			1,373	25,262	94,253
	1953	5	5	88	-	27,777	32,921	-	132	38	60,956			-	-	-									23		15,740			171	15,934	76,895
	1954			6	-	20,958	28,069	-	38	23	49,094			-	-	-									13		12,246			147	12,406	61,500
	1955			28	-	16,277	24,236	-	136	8	40,685			-	-	-									9		13,264			577	13,850	54,535
	1956	170	170	23	-	14,341	42,810	-	57	0	57,231			-	-	-									6		18,751			482	19,239	76,640
	1957	80	80	13	-	21,053	49,500	-	151	83	70,800			-	-	-									4		21,165			304	21,473	92,353
	1958	17	17	38	-	18,432	22,175	-	124	8	40,777			-	-	-									7		14,855			48	14,910	55,704
	1959	8	8	48	-	15,802	14,252	-	67	0	30,169			-	-	-									5		20,990			+	20,995	51,172
	1960	74	74	23	-	17,369	25,156	-	76	0	42,624			-	-	-									4		20,100			557	20,661	63,359
	1961	212	212	111	-	17,437	18,639	-	268	7	36,462			39	2	41									5	2,837	12,055	1		1,355	16,253	52,968
	1962	141	141	20	-	15,784	8,729	-	191	53	24,757			0	0	0									7	1,085	19,752	1		1,681	22,526	47,424
	1963	4	4	4	-	13,464	26,420	-	218	59	40,165			0	31	31									7	2,432	25,140			1,161	28,740	68,940
	1964	1	1	50	-	15,458	23,858	-	319	128	39,813			-	0	-									4	3,411	18,388			824	22,627	62,441
	1965	5	5	70	-	13,701	41,491	-	121	11	55,394			-	0	-									3	417	16,542	1		731	17,694	73,093
	1966	3	3	64	-	25,050	22,830	-	585	111	48,640			-	0	-									8	1,600	15,333			588	17,529	66,172
	1967	15	15	43	-	28,869	30,481	-	520	89	60,002			-	-	-	-	-	330	189		519			12	4,113	17,814			707	22,646	83,182
	1968	44	44	58	-	23,961	16,597	-	1,109	287	41,992			-	-	-	-	-	216	283		499			11	4,906	20,434			951	26,302	68,837
	1969	161	161	34	-	18,006	31,912	-	925	521	51,398			-	0	-	-	-	65	423		488			14	2,996	18,827			358	22,195	74,242
	1970	1,028	1,028	19	-	16,222	24,283	-	498	317	41,319			-	0	-	-	-	34	59		93			9	4,416	21,032			822	26,279	68,719
	1971	1,365	1,365	5	-	11,473	52,957	-	354	902	65,691	0	0	-	0	-	-	-	20	52		72			11	2,071	20,526			1,175	23,783	90,911
	1972	390	390	6	1	13,022	60,569	-	638	277	74,513	0	0	0	100	100	-	-	187	-		187			8	3,750	23,600			637	27,995	103,085
	1973	1,746	1,746	44	39	16,760	68,767	-	486	1,353	87,449	4	4	-	0		-	-	-			0			14	2,236	15,653			84	17,987	107,186
	1974	3,921	3,921	13	224	13,384	73,564	-	891	161	88,237	91	91	0	1	1	-	-	486	-		486			9	4,777	20,178			94	25,058	117,794
	1975	1,400	1,400	13	166	10,303	52,152	-	230	159	63,023	7,050	7,050	0	1	1	-	-	1,240	-		1,240			33	3,243	18,932	10		640	22,858	95,572
	1976	1,331	1,331	15	1,070	15,812	85,336	-	270	1,109	103,612	2,212	2,212	5	36	41	-	-	686	-		686			23	2,700	15,905	4		713	19,345	127,227
	1977	111	111	5	688	15,681	31,934	-	365	669	49,342	500	500	0	3	3	-	-	572	-		572			37	1,497	9,969			537	12,040	62,568
	1978	278	278	21	4,029	13,007	59,877	-	2,073	1,115	80,122	669	669	0	1	1	-	-	6	-		6			54	950	16,613	15		810	18,442	99,518
	1979	53	53	16	2,856	14,186	44,662	-	1,139	125	62,984	0	0	0	1	1	-	-	81	-		81				303	6,781			74	7,158	70,277
	1980	23	23	10	2,986	14,681	46,742	-	1,177	329	65,925	592	592	0	31	31	-	1	249	20		270				382	7,556			168	8,106	74,947
	1981	521	521	8	10,348	17,878	27,426	-	699	252	56,611	0	0	0	8	8	1	-	143	12		156			25	748	12,637			195	13,605	70,901
	1982	212	212	11	12,511	16,714	29,614	-	482	561	59,893	4,874	4,874	0	0	0	-	-	38	9		47			105	425	6,609	21		257	7,417	72,443
	1983	200	200	22	6,852	15,094	21,098	-	99	350	43,515	366	366	0	0	0	-	-	8	1		9			6	607	9,359			87	10,059	54,149
	1984	104	104	24	8,988	15,053	26,013	-	494	3,380	53,952	1,925	1,925	6	107	113	-	1	-	-		1			2	1,030	9,304		3,728	1,427	15,491	71,588
	1985	225	225	68	11,204	14,249	20,714	-	339	1,533	48,107	2,789	2,789	35	14	49	1	-	-	2		3	2				6,422	118	26	1,176	7,744	58,917
	1986	50	50	15	7,813	12,899	16,096	-	640	1,542	39,005	3,833	3,833	0	3	3	-	-	-	-		0	3				4,713	66	47	196	5,025	47,916
	1987	56	56	16	6,698	14,668	19,082	-	173	1,205	41,842	1,624	1,624	0	7	7	2	2,514	-	-		2,516	5		150		2,772	139	1	74	3,141	49,186
	1988	30	30	7	9,074	14,688	6,216	-	170	1,208	31,383	799	799	0	15	15	6	7,389	-	-		7,395	15		307		4,221	76	17	64	4,700	44,302
	1989	104	104	33	7,437	13,031	8,629	-	433	2,521	32,084	561	561	0	2	2	-	8,350	40	-		8,390	4		248		1,898	10	1	160	2,319	43,460
	1990	155	155	5	6,064	15,785	8,532	-	248	1,995	32,629	29	29	0	2	2	-	16,701	-	39		16,744	29		177		2,733	20	71	24	3,054	52,613
	1991	140	140	4	3,401	6,684	7,103	-	395	2,652	20,219	4	4	0	2	2	-	3,398	12	-		3,410	17		312		1,917	20		6	2,272	26,047
	1992	302	302	12	2,721	19,042	13,888	-	1,522	4,104	41,289	1	1	0	10	10	-	7,866	-	-		7,866			334		4,626	40		2	5,002	54,470
	1993	139	139	3	287	29,933	12,797	-	897	2,889	46,806	2	2	0	11	11	-	-	5	-		5			438		6,325	194		25	6,982	53,945
	1994	1,998	1,998	11	283	29,565	26,389	-	823	2,026	59,077	2	2	0	6	6	-	-	83	-		83	38		544		11,068	66		106	11,822	72,988
	1995	1,761	1,761	28	282	29,050	20,981	856	78	1,177	52,452	13	13	0	5	5	-	-	4,280	-		4,280	52		882		8,302	4		102	9,342	67,853
	1996	3,321	3,321	43	116	32,440	20,272	815	127	581	54,394	157	157	0	21	21	-	-	7,598	-	-	7,598	83		1,185		17,150	10	11	88	18,527	84,016
	1997	2,166	2,166	40	359	38,899	32,238	1,585	135	1,068	74,324	404	404	0	53	53	-	-	9,456	-	-	9,456	60		1,653		14,458	12	2	1,018	17,203	103,606
	1998	4,177	4,177	41	206	35,755	22,926	1,190	104	1,554	61,776	225	225	0	8	8	-	-	8,810	-	-	8,810	80		1,120		14,577	15	33	1,208	17,033	92,029
	1999	2,734	2,734	90	289	33,339	50,389	891	62	6,872	91,912	98	98	57	0	57	-	-	8,393	-	-	8,393	149		1,542		10,451	61	48	3,621	15,872	119,066
	2000	4,531	4,531	136	67	29,995	21,550	645	86	2,408	54,887	15	15	33	70	103	-	-	8,842	-	-	8,842	55		940		9,834	24	4	1,798	12,656	81,033
	2001	5,248	5,248	78	117	28,801	29,430	416	35	974	59,851	63	63	18	0	18	-	1	8,684	+	-	8,685	94		1,295		11,543	39	51	1,635	14,657	88,522
	2002	5,379	5,379	109	332	23,585	48,454	787	85	3,303	76,655	111	111	0	28	28	-	-	7,965	-	-	7,965	30		525		11,003	13	4	2,357	13,932	104,070
	2003	6,847	6,847	69	126	20,907	36,114	922	85	627	58,850	146	146	0	29	29	-	-	7,166	-	-	7,166	16		524		14,246	8	44	2,214	17,052	90,090
	2004	7,857	7,857	30	61	17,341	32,255	772	54	7,200	57,713	77	77	0	104	104	-	-	4,988	-	-	4,988	12		381		13,630	3	1	1,506	15,513	88,252
	2005	4,829	4,829	97	154	20,465	16,133	685	234	850	38,598	419	419	0	0	0	-	-	4,472	-	-	4,472	20		296		8,654	1		1,719	10,690	59,008
	2006	5,833	5,833	55	221	21,168	15,400	460	42	384	37,710	134	134	0	109	109	-	-	4,317	-	-	4,317	3		270		12,642	+		385	13,300	61,403
	2007	6,040	6,040	30	226	22,381	37,768	519	44	5,682	66,650	136	136	0	40	40	-	+	2,916	-	-	2,916	4	94	250		11,911	+	77	461	12,797	88,579
	2008	5,464	5,464	101	1,531	19,092	19,080	549	34	825	41,192	400	400	-	10	10	-	-	3,069	-	-	3,069	1	28	354		11,762	+		418	12,563	62,698
	2009	5,693	5,693	33	149	21,995	31,172	410	43	2,076	55,878	95	95	-	17	17	-	-	2,378	-	-	2,378	4	97	203		12,343	+	31	944	13,622	77,683
	2010	6,527	6,527	42	24	21,167	19,561	588	37	330	41,749	107	107	-	25	25	+	-	2,818	-	-	2,818	5	53	421		11,691	0		862	13,032	64,258
	2011	5,385	5,385	50	12	20,956	25,704	443	78	480	47,723	78	78	-	0	-	+	1	3,434	2	-	3,437	5	84	708		10,147	0		421	11,365	67,988
	2012	2,484	2,484	48	26	22,828	33,742	610	129	4,193	61,576	156	156	0	0	0	2	2	2,643	-	-	2,647	8	253	660		14,152	2		1,212	16,287	83,150
	2013	5,088	5,088	36	14	19,839	33,568	302	211	1,988	55,958	173	173		0	0	1	+	4,427	-	-	4,428	5	46	317		12,312	0		839	13,519	79,166
	2014	4,780	4,780	24	11	19,973	29,433	197	197	2,009	51,844	116	116		0	0	1	1	2,617	+	-	2,619	0	49	209		13,401			1,042	14,701	74,060
	2015	4,391	4,391	17	138	21,013	21,294	239	167	1,072	43,940	38	38		0	0	1	2	3,020	4	-	3,027	1	62	227		11,597	2		932	12,820	64,216
	2016	2,842	2,842	28	19	16,549	14,435	148	128	3,679	34,986	56	56		0	0	+	+	3,406	-	-	3,406	1	24	248		10,759	0		675	11,708	52,998
	2017	1,831	1,831	48	40	17,308	20,891	107	119	1,250	39,763	202	202		0	0	-	5	4,333	-	-	4,338		35	95		7,431	14		372	7,947	54,081
	2018	2,717	2,717	13	35	13,191	17,875	78	70	3,039	34,301	101	101				-	-	4,514	+	-	4,514		20	87		7,729			381	8,217	49,850
	2019	2,402	2,402	13	35	13,365	17,889	78	70	3,039	34,489	65	65				-	-	5,454	+	1	5,455		8	104		7,798	4		1,364	9,277	51,688
Retain catch total		131,532	131,532	2,481	110,310	1,321,602	2,014,797	14,272	23,263	90,934	3,577,659	31,447	31,447	193	913	1,106	15	46,232	134,503	1,095	1	181,846	801	853	17,638	52,932	1,095,943	1,014	4,197	49,141	1,222,518	5,146,109
Release	2013	1	1																													1
	2014	7	7																													7
	2015	14	14																													14
	2016	2	2																													2
	2017	2	2																													2
	2018	18	18									+	+																			-
	2019	13	13																													13
Release total		57	57									+	+																			39
Total		131,589	131,589	2,481	110,310	1,321,602	2,014,797	14,272	23,263	90,934	3,577,659	31,447	31,447	193	913	1,106	15	46,232	134,503	1,095	1	181,846	801	853	17,638	52,932	1,095,943	1,014	4,197	49,141	1,222,518	5,146,166

Table 11. Pacific bluefin tuna catches (in metric tons) by fisheries, 1952-2018. “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			TWN							USA									Total
		Set-net	Longline	Pole and line	Troll[1]	Others	Purse seine	JPN Total	Set-net	Longline	Purse seine	Trawl	Troll	KOR Total [2]	Others	Purse seine	MEX Total	Set-net	Gill-net (not specified)	Drift gill-net	Longline	Others	Purse seine	TWN Total	Drift gill-net	Longline	Pole and line	Troll	Hook and Line	Others	Purse seine	Sport	USA Total[4]	
Retain	1952	2,145	2,694	2,198	667	1,700	7,680	17,084							-	-	0														2,076	2	2,078	19,162
	1953	2,335	3,040	3,052	1,472	160	5,570	15,629							-	-	0														4,433	48	4,481	20,110
	1954	5,579	3,088	3,044	1,666	266	5,366	18,999							-	-	0														9,537	11	9,548	28,547
	1955	3,256	2,951	2,841	1,507	1,151	14,016	25,722							-	-	0														6,173	93	6,266	31,988
	1956	4,170	2,672	4,060	1,763	385	20,979	34,029							-	-	0														5,727	388	6,115	40,144
	1957	2,822	1,685	1,795	2,392	414	18,147	27,255							-	-	0														9,215	73	9,288	36,543
	1958	1,187	818	2,337	1,497	215	8,586	14,640							-	-	0														13,934	10	13,944	28,584
	1959	1,575	3,136	586	736	167	9,996	16,196							32	171	203										56				3,506	13	3,575	19,974
	1960	2,032	5,910	600	1,885	369	10,541	21,337							-	-	0										+				4,547	1	4,548	25,885
	1961	2,710	6,364	662	3,193	599	9,124	22,652							-	130	130										16				7,989	23	8,028	30,810
	1962	2,545	5,769	747	1,683	293	10,657	21,694							-	294	294										+				10,769	25	10,794	32,782
	1963	2,797	6,077	1,256	2,542	294	9,786	22,752							-	412	412										28				11,832	7	11,867	35,031
	1964	1,475	3,140	1,037	2,784	1,884	8,973	19,293							-	131	131										39				9,047	7	9,093	28,517
	1965	2,121	2,569	831	1,963	1,106	11,496	20,086							-	289	289				54			54			11	+		66	6,523	1	6,601	27,030
	1966	1,261	1,370	613	1,614	129	10,082	15,069							-	435	435				-			0			12				15,450	20	15,482	30,986
	1967	2,603	878	1,210	3,273	302	6,462	14,728							-	371	371				53			53			+				5,517	32	5,549	20,701
	1968	3,058	500	983	1,568	217	9,268	15,594							-	195	195				33			33			8				5,773	12	5,793	21,615
	1969	2,187	878	721	2,219	195	3,236	9,436							-	260	260				23			23			9				6,657	15	6,681	16,400
	1970	1,779	607	723	1,198	224	2,907	7,438							-	92	92				-			0			+				3,873	19	3,892	11,422
	1971	1,555	697	938	1,492	317	3,721	8,720		0				0	-	555	555				1			1			+				7,804	8	7,812	17,088
	1972	1,107	512	944	842	197	4,212	7,814		0				0	-	1,646	1,646				14			14			3			42	11,656	15	11,716	21,190
	1973	2,351	838	526	2,108	636	2,266	8,725		0				0	-	1,084	1,084				33			33			5	+		20	9,639	54	9,718	19,560
	1974	6,019	1,177	1,192	1,666	754	4,106	14,904		0				0	-	344	344				47	15		62			+	+		30	5,243	58	5,331	20,641
	1975	2,433	1,061	1,401	1,031	808	4,491	11,225		3				3	-	2,145	2,145				61	5		66			83			1	7,353	34	7,471	20,910
	1976	2,996	320	1,082	830	1,237	2,148	8,613		5				5	-	1,968	1,968				17	2		19			22	+		3	8,652	21	8,698	19,303
	1977	2,257	338	2,256	2,166	1,052	5,110	13,179		0				0	-	2,188	2,188				131	2		133			10			3	3,259	19	3,291	18,789
	1978	2,546	648	1,154	4,517	2,276	10,427	21,568		3				3	-	545	545				66	2		68			4			2	4,663	5	4,674	26,858
	1979	4,558	729	1,250	2,665	2,429	13,881	25,502		0				0	-	213	213				58	-		58			5			1	5,889	11	5,906	31,679
	1980	2,521	811	1,392	1,531	1,953	11,327	19,535		0				0	-	582	582				114	5		119			+			24	2,327	7	2,358	22,594
	1981	2,129	590	754	1,777	2,653	25,422	33,325		0				0	-	218	218				179	-		179	4		+	10		+	867	9	890	34,612
	1982	1,667	718	1,777	864	1,709	19,234	25,969		0	31			31	-	506	506			2	207	-		209	9		1			+	2,639	11	2,660	29,375
	1983	972	217	356	2,028	1,117	14,774	19,464		0	13			13	-	214	214			2	175	-	9	186	31		59			2	629	33	754	20,631
	1984	2,234	142	587	1,874	868	4,433	10,138		1	4			5	-	166	166			-	477	8	5	490	6	1	5			18	673	49	752	11,551
	1985	2,562	105	1,817	1,850	1,175	4,154	11,663		0	1			1	-	676	676			11	210	-	80	301	8					20	3,320	89	3,437	16,078
	1986	2,914	102	1,086	1,467	719	7,412	13,700		0	344			344	-	189	189			13	70	-	16	99	16					41	4,851	12	4,920	19,252
	1987	2,198	211	1,565	880	445	8,653	13,952		13	89			102	-	119	119			14	365	-	21	400	2					18	861	34	915	15,488
	1988	843	157	907	1,124	498	3,605	7,134		0	32			32	1	447	448			37	108	25	197	367	4					46	923	6	979	8,960
	1989	748	209	754	903	283	6,190	9,087		0	71			71	-	57	57			51	205	3	259	518	3					18	1,046	112	1,179	10,912
	1990	716	267	536	1,250	455	2,989	6,213		0	132			132	-	50	50			299	189	16	149	653	11					81	1,380	66	1,537	8,585
	1991	1,485	218	286	2,069	650	9,808	14,516		0	265			265	-	9	9			107	342	12	-	461	4	2				+	410	92	508	15,759
	1992	1,208	513	166	915	1,081	7,162	11,045		0	288			288	-	0	0			3	464	5	73	545	9	38				14	1,928	110	2,099	13,977
	1993	848	812	129	546	365	6,600	9,300		0	40			40	-	0	0				471	3	1	475	32	42				29	580	283	966	10,781
	1994	1,158	1,206	162	4,111	398	8,131	15,166		0	50			50	2	63	65				559	-		559	28	30				1	906	86	1,051	16,891
	1995	1,859	678	270	4,778	586	18,909	27,080		0	821			821	-	11	11				335	2		337	20	29				+	657	245	951	29,200
	1996	1,149	901	94	3,640	570	7,644	13,998		0	102			102	-	3,700	3,700	-	-		956	-	-	956	43	25		2		+	4,639	40	4,749	23,505
	1997	803	1,300	34	2,740	811	13,152	18,840		0	1,054			1,054	-	367	367	-	-		1,814	-	-	1,814	58	26		1		48	2,240	131	2,504	24,579
	1998	874	1,255	85	2,876	700	5,391	11,181		0	188			188	-	1	1	-	-		1,910	-	-	1,910	40	54		128		59	1,771	422	2,474	15,754
	1999	1,097	1,157	35	3,440	709	16,173	22,611		0	256			256	35	2,369	2,404	-	-		3,089	-	-	3,089	22	54		20		88	184	408	776	29,136
	2000	1,125	953	102	5,217	689	16,486	24,572		0	2,401	0		2,401	99	3,019	3,118	-	1		2,780	1	-	2,782	30	19		1		11	693	319	1,073	33,946
	2001	1,366	791	180	3,466	782	7,620	14,205		0	1,176	10		1,186	-	863	863	-	2		1,839	2	-	1,843	35	6		6		1	292	344	684	18,781
	2002	1,100	841	99	2,607	631	8,903	14,181		0	932	1		933	2	1,708	1,710	-	3		1,523	1	-	1,527	7	2		1		2	50	613	675	19,026
	2003	839	1,237	44	2,060	446	5,768	10,394		0	2,601	0		2,601	43	3,211	3,254	-	10		1,863	11	-	1,884	14	1				3	22	355	395	18,528
	2004	896	1,847	132	2,445	514	8,257	14,091		0	773	0		773	14	8,880	8,894	-	1		1,714	2	-	1,717	10	1				+		50	61	25,536
	2005	2,182	1,925	549	3,633	548	12,817	21,654		0	1,318	9		1,327	-	4,542	4,542	1	-		1,368	1	-	1,370	5	1				1	201	73	281	29,174
	2006	1,421	1,121	108	1,860	777	8,880	14,167		0	1,012	3		1,015	-	9,806	9,806	1	-		1,149	-	-	1,150	1	1				+		94	96	26,234
	2007	1,503	1,762	236	2,823	657	6,840	13,821		0	1,281	4		1,285	-	4,147	4,147	2	8		1,401	-	-	1,411	2	+				+	42	12	56	20,720
	2008	2,358	1,390	64	2,377	770	10,221	17,180		0	1,866	10		1,876	15	4,407	4,422	1	1		979	-	-	981	1	+				+		63	64	24,523
	2009	2,236	1,080	50	2,003	575	8,077	14,021		0	936	4		940	-	3,019	3,019	1	10		877	-	-	888	3	1		0		2	410	156	572	19,440
	2010	1,603	890	83	1,583	495	3,742	8,396		0	1,196	16		1,212	-	7,746	7,746	29	7		373	-	-	409	1	0				0		88	89	17,852
	2011	1,651	837	63	1,820	283	8,340	12,993		0	670	14	+	684	1	2,731	2,732	16	7		292	1	-	316	18	0		0		100		225	343	17,068
	2012	1,932	673	113	570	343	2,462	6,093		0	1,421	2		1,423	1	6,668	6,669	2	-		210	2	-	214	4	0		0		38		400	442	14,841
	2013	1,415	784	8	904	529	2,771	6,411	1	-	604	0	+	605		3,154	3,154	2	1		331	-	-	334	7	1		0		3		809	820	11,324
	2014	1,907	683	5	1,023	499	5,456	9,573	6		1,305	-	0	1,311		4,862	4,862	38	4		483	-	-	525	5	0		+	2	0	401	420	828	17,099
	2015	1,242	649	8	413	431	3,645	6,386	1		676		0	677		3,082	3,082	25	1		552	-	-	578	4	0			7	0	86	400	499	11,222
	2016	1,228	691	54	778	508	5,095	8,355	3		1,024	2	0	1,030		2,709	2,709	-	+		454	-	-	454	9	1			31	0	316	372	728	13,276
	2017	2,221	913	49	605	665	4,540	8,994	3		734	6		743		3,643	3,643	-	-		415	+	-	415	1	1			18		466	451	938	14,733
	2018	645	700	9	371	431	4,049	6,205	7		523	5		535		2,482	2,482	+	3		381	+	-	384	18	1		0	31	4	12	505	570	10,177
	2019	941	1,002 *	+	718	372	4,464	7,498	36		542	3		545		2,249	2,249	+	3		486	+	-	489	10	2		1	36	1	226	429	704	10,940
Retain catch total		133,254	92,804	54,787	130,848	48,467	572,829	1,032,989	57	25	26,772	89		26,908	245	106,138	106,383	118	62	539	32,300	126	810	33,955	535	339	376	170	125	842	242,784	9,446	254,617	1,454,852
Total		133,254	92,804	54,787	130,848	48,467	572,829	1,032,989	57	25	26,772	89		26,908	245	106,138	106,383	118	62	539	32,300	126	810	33,955	535	339	376	170	125	842	242,784	9,446	254,617	1,454,852

Table 12. Annual catch of swordfish (*Xiphias gladius*) in metric tons for fisheries monitored by ISC for assessments of North Pacific Ocean stocks, 1951-2018. "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			TWN							USA										Total
		Set-net	Drift gill net	Longline	Others	Not specified	JPN Total	Longline	KOR Total	Others	Sport	MEX Total	Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Drift gill net	Harpoon	Handline	Longline	Pole and line	Troll	Hook-and-line	Other	Purse-seine	USA Total	
Retain	1951	78	10	7,361	4,131	98	11,678																							11,678
	1952	68	-	9,042	2,569	12	11,691																							11,691
	1953	21	-	10,873	1,407	107	12,408									-			0											12,408
	1954	18	-	12,659	813	121	13,611									-			0											13,611
	1955	37	-	13,093	821	160	14,111									-			0											14,111
	1956	31	-	14,606	775	73	15,485									-			0											15,485
	1957	18	-	14,305	858	70	15,251									-			0											15,251
	1958	31	-	18,567	1,069	67	19,734									-			0											19,734
	1959	31	-	17,302	891	44	18,268									427			427											18,695
	1960	67	1	20,109	1,191	30	21,398									520			520											21,918
	1961	15	2	19,766	1,335	30	21,148									318			318											21,466
	1962	15	-	10,685	1,371	44	12,115									494			494											12,609
	1963	17	-	10,420	747	59	11,243									343			343											11,586
	1964	16	4	7,760	1,006	66	8,852									358			358											9,210
	1965	14	-	8,861	1,908	208	10,991									331			331											11,322
	1966	11	-	9,979	1,728	45	11,763									489			489											12,252
	1967	12	-	11,067	891	38	12,008						-	-	5	646	30		681											12,689
	1968	14	-	10,046	1,539	50	11,649						-	8	3	763	1		775											12,424
	1969	11	-	9,712	1,557	56	11,336						-	1	6	843	-		850											12,186
	1970	9	-	7,751	1,748	39	9,547						-	1	5	904	-		910		612		5						617	11,074
	1971	37	1	7,387	473	48	7,946	0	0				-	-	3	992	-		995		99		1						100	9,041
	1972	1	55	7,327	282	22	7,687	0	0				-	-	12	862	-		874		171								171	8,732
	1973	23	720	7,574	121	29	8,467	0	0				-	-	113	860	6		979		399								399	9,845
	1974	16	1,304	6,669	190	29	8,208	0	0				-	-	98	881	38		1,017		406								406	9,631
	1975	18	2,672	7,677	205	60	10,632	0	0				-	-	152	928	1		1,081		557								557	12,270
	1976	14	3,488	8,845	313	182	12,842	0	0				-	-	159	636	35		830		42								42	13,714
	1977	7	2,344	9,301	201	73	11,926	0	0				-	2	139	578	-		719		318		17						335	12,980
	1978	22	2,475	9,069	130	111	11,807	0	0				-	3	10	546	-		559		1,699		9						1,708	14,074
	1979	15	983	9,692	161	49	10,900	0	0				-	5	24	668	4		701		329		7						336	11,937
	1980	15	1,746	6,898	398	30	9,087	135	135				-	4	72	613	1		690	160	566		5						731	10,643
	1981	9	1,848	7,841	129	61	9,888	0	0				-	3	18	658	4		683	473	271		3	2					749	11,320
	1982	7	1,257	6,998	195	59	8,516	166	166				-	3	46	856	-		905	946	156		5	3	6		1		1,116	10,703
	1983	9	1,033	8,752	166	32	9,982	47	47				-	3	164	783	-		950	1,693	58		5	2	3		1	1	1,763	12,752
	1984	13	1,053	8,411	117	98	9,692	27	27				43	5	259	733	-		1,040	2,647	104		15	49				26	2,841	13,600
	1985	10	1,133	10,387	191	69	11,790	12	12				3	29	166	566	61		825	2,990	305	4	2				104		3,405	16,032
	1986	9	1,264	9,815	123	47	11,258	18	18				3	1	201	456	6		667	2,089	291	4	2				109		2,475	14,418
	1987	11	1,051	10,411	87	45	11,605	50	50				-	-	187	1,331	3		1,521	1,529	235	4	24				31		1,823	14,999
	1988	8	1,234	9,317	173	19	10,751	27	27				-	1	80	777	183		1,041	1,376	198	6	24				64		1,668	13,487
	1989	10	1,596	7,482	362	21	9,481	7	7				3	2	61	1,541	35		1,642	1,243	62	7	218				56		1,586	12,716
	1990	4	1,074	6,598	128	13	7,817	46	46		-	-	4	2	118	1,452	88		1,664	1,131	64	5	2,437				43		3,680	13,207
	1991	5	498	5,690	153	20	6,366	37	37		-	-	4	2	205	1,430	56		1,697	944	20	6	4,536				44		5,549	13,649
	1992	6	887	8,505	381	16	9,795	32	32		-	-	12	1	287	1,494	33		1,827	1,356	75	1	5,762				47		7,241	18,895
	1993	4	292	9,777	309	44	10,426	27	27		-	-	13	3	194	1,228	100		1,538	1,412	168	4	5,936				161		7,681	19,672
	1994	4	421	8,723	308	37	9,483	4	4		-	-	12	3	211	1,155	9		1,390	792	157	4	3,807				24		4,784	15,671
	1995	7	561	7,809	423	34	8,834	9	9		-	-	6	2	14	1,185	203		1,410	771	97	6	2,981				29		3,884	14,137
	1996	4	428	7,983	597	45	9,057	15	15		-	-	10	2	19	710	1	-	742	761	81	5	2,848				15		3,710	13,524
	1997	5	365	8,216	346	62	8,994	99	99		-	-	8	1	27	1,397	1	-	1,434	708	84	7	3,398				11		4,203	14,730
	1998	2	471	7,423	476	68	8,440	153	153		-	-	15	9	17	1,198	-	-	1,239	931	48	7	3,681				19		4,686	14,518
	1999	5	724	6,606	416	47	7,798	131	131		-	-	5	5	51	1,455	+	-	1,516	606	81	9	4,329				27		5,052	14,497
	2000	5	808	7,301	497	49	8,660	202	202	602	-	602	5	6	74	3,716	-	-	3,801	649	90		4,834				33		5,606	18,871
	2001	15	732	7,840	230	30	8,847	438	438	516	-	516	8	18	64	4,853	-	-	4,943	375	52		1,969				19		2,415	17,159
	2002	11	1,164	7,195	201	29	8,600	438	438	215	-	215	16	8	1	5,400	1	-	5,426	302	90		1,524				3		1,919	16,598
	2003	4	1,198	6,439	149	28	7,818	380	380	237	-	237	8	3	-	4,771	-	-	4,782	216	107	10	1,958				11		2,302	15,519
	2004	4	1,062	6,904	229	30	8,229	410	410	268	-	268	7	6	1	4,248	2	-	4,264	182	69	7	1,185				44		1,487	14,658
	2005	3	956	6,653	187	337	8,136	403	403	234	-	234	5	3	16	3,964	2	-	3,990	220	77	5	1,622				5		1,929	14,692
	2006	5	796	7,690	244	343	9,078	465	465	328	-	328	7	2	49	4,382	3	-	4,443	443	71	4	1,211				5		1,734	16,048
	2007	2	829	8,125	122	368	9,446	453	453	172	-	172	2	2	20	4,099	2	-	4,125	490	59	5	1,736		1				2,290	16,486
	2008	3	648	6,189	173	349	7,362	794	794	242	-	242	3	6	39	3,745	+	-	3,793	405	48	6	2,014				19		2,492	14,683
	2009	3	682	6,007	239	249	7,180	998	998	394	-	394	83	7	31	3,550	-	-	3,671	253	50	5	1,817		0		0		2,125	14,363
	2010	8	494	5,400	110	230	6,242	662	662	222	-	222	6	4	42	2,844	-	-	2,896	62	37	3	1,676				18		1,796	11,818
	2011	2	193	4,022	10	233	4,460	962	962	-	-	-	8	17	52	3,577	1	+	3,655	119	24	5	1,623				90		1,861	7,283
	2012	8	371	4,034	59	288	4,760	856	856	-	-	-	3	15	30	3,746	+	-	3,794	118	5	6	1,395		1		1		1,526	7,142
	2013	13	290	4,248	163	291	5,005	1,071	1,071	-	-	-	2	8	-	2,846	1	-	2,857	95	6	6	1,270		1		7		1,385	7,461
	2014	7	269	4,381	0	291	4,948	829	829	-	-	-	4	4	-	2,817	+	+	2,825	127	6	7	1,665		1	0	4		1,811	7,588
	2015	3	277	5,012	204	281	5,777	776	776		-	-	4	4	-	3,199	-	-	3,207	101	5	5	1,515		1	0	12		1,639	8,192
	2016	2	303	5,497	169	256	6,227	582	582		-	-	2	3	+	2,054	+	-	2,069	183	26	4	1,092			1	42		1,348	8,157
	2017	3	291	4,657	274	289	5,514	583	583				+	3	-	2,194	+	+	2,197	180	28	6	1,618			1	44		1,876	10,170
	2018	5	230	4,803	480	287	5,785	708	708				1	+	-	2,124	+	-	2,125	148	10	3	1,053		1	1	67		1,281	9,899
	2019	5	230	4,179	480	287	5,161	373	373				1	+	-	2,113	+	-	2,114	52	12	3	733			2	185		986	8,635
Retain catch total		945	44,818	597,732	40,129	7,392	########	13,420	13,420	3,430	0	3,430	316	220	3,545	104,647	911	0	109,639	29,255	8,625	169	73,560	56	15	5	1,395	27	########	930,611
Release	2010																											0	0	0
	2011																											0	0	0
	2018							+	+																					+
	2019							+	+																					+
Release total								+	+																			0	0	0
Total		945	44,818	597,732	40,129	7,392	########	13,047	13,047	3,430	0	3,430	316	220	3,545	104,647	911	0	109,639	29,255	8,625	169	73,560	56	15	5	1,395	27	########	930,940

Table 13. Annual catch of striped marlin (*Kajikia audax*) in metric tons for fisheries monitored by ISC for assessments of North Pacific Ocean stocks, 1951-2018 "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		TWN							USA							Total
		Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	Purse seine	KOR Total	Sport	MEX Total	Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine	TWN Total	Handline	Longline	Troll	Others	Purse seine	Sport	USA Total	
Retain	1951	92	-	3,167	1,149	39	4,447																				4,447
	1952	203	-	3,623	1,321	40	5,187																		23	23	5,210
	1953	126	-	2,185	793	36	3,140										0		0						5	5	3,145
	1954	82	-	3,120	938	67	4,207										0		0						16	16	4,223
	1955	106	-	3,110	850	82	4,148										0		0						5	5	4,153
	1956	133	-	3,788	1,822	41	5,784										0		0						34	34	5,818
	1957	71	-	3,308	2,312	76	5,767										0		0						42	42	5,809
	1958	82	3	4,383	2,704	127	7,299									543	387		930						59	59	8,288
	1959	87	2	4,308	2,905	200	7,502									391	354		745						65	65	8,312
	1960	161	4	3,963	1,689	87	5,904									398	350		748						30	30	6,682
	1961	161	2	4,589	1,538	98	6,388									306	342		648						24	24	7,060
	1962	197	8	5,849	1,607	108	7,769									332	211		543						5	5	8,317
	1963	92	17	6,197	1,527	292	8,125									560	199		759						68	68	8,952
	1964	81	2	14,346	2,223	41	16,693									392	175		567						58	58	17,318
	1965	81	1	11,621	2,640	73	14,416									355	157		512						23	23	14,951
	1966	226	2	8,531	1,313	31	10,103									370	180		550						36	36	10,689
	1967	82	3	11,825	1,394	75	13,379						-	0	141	387	63		591						49	49	14,019
	1968	71	0	16,143	914	58	17,186						-	40	134	333	34		541						51	51	17,778
	1969	71	3	9,147	2,516	81	11,818						-	5	159	573	28		765						30	30	12,613
	1970	55	3	13,867	824	153	14,902						-	8	175	495	6		684						18	18	15,604
	1971	61	10	11,891	1,674	307	13,943	0		0			-	16	101	449	18		584						17	17	14,544
	1972	72	243	7,988	827	94	9,224	0		0			-	1	124	389	1		515						21	21	9,760
	1973	80	3,265	7,107	476	146	11,074	0		0			-	4	115	569	20		708						9	9	11,791
	1974	90	3,112	7,076	581	104	10,963	0		0			-	7	53	674	58		792						55	55	11,810
	1975	105	6,534	5,605	492	89	12,825	0		0			-	7	86	796	3		892						27	27	13,744
	1976	37	3,561	5,414	441	107	9,560	0		0			-	9	61	379	70		519						31	31	10,110
	1977	103	4,424	3,290	337	107	8,261	0		0			-	9	207	541	3		760						41	41	9,062
	1978	93	5,593	4,227	210	243	10,366	0		0			-	7	70	618	1		696						37	37	11,099
	1979	66	2,532	5,948	327	133	9,006	0		0			2	18	104	458	0		582						36	36	9,624
	1980	80	3,467	6,990	397	59	10,993	73		73			-	39	92	284	1		416						33	33	11,515
	1981	88	3,866	4,377	385	69	8,785	0		0			-	25	70	508	0		603						60	60	9,448
	1982	52	2,351	5,666	476	128	8,673	102		102			-	26	112	404	0		542						41	41	9,358
	1983	124	1,867	4,052	547	156	6,746	49		49			-	31	144	555	39		769						39	39	7,603
	1984	144	2,333	3,901	398	177	6,953	39		39			-	16	314	965	0		1,295						36	36	8,323
	1985	81	2,363	4,632	499	153	7,728	13		13			1	6	152	513	23		695			18			42	60	8,496
	1986	131	3,584	7,336	343	103	11,497	14		14			-	13	119	179	16		327			19			19	38	11,876
	1987	102	1,888	8,731	244	167	11,132	15		15			1	2	132	414	16		565	1	272	29			28	330	12,042
	1988	63	2,211	7,030	400	205	9,909	16		16			7	12	70	464	80		633		504	54			30	588	11,146
	1989	47	1,664	5,834	345	145	8,035	24		24			-	23	124	192	10		349	+	612	24			52	688	9,096
	1990	65	1,945	3,496	287	193	5,986	1		1	-	-	12	16	207	139	21		395	+	538	27			23	588	6,970
	1991	56	1,329	4,045	320	131	5,881	7		7	-	-	-	81	173	290	32		576	+	663	41			12	716	7,180
	1992	71	1,204	4,212	137	95	5,719	53		53	-	-	-	11	163	220	24		418	1	459	37			25	522	6,712
	1993	27	828	5,200	308	373	6,736	568		568	-	-	3	7	132	226	0		368	1	471	67			11	550	8,222
	1994	73	1,443	4,196	218	92	6,022	556		556	-	-	4	5	176	138	11		334	+	326	35			17	378	7,290
	1995	58	970	5,337	139	86	6,590	307		307	-	-	4	5	67	110	6		192	+	543	52			14	609	7,698
	1996	39	703	3,791	25	88	4,646	429		429	-	-	3	8	30	188	6	-	235	1	418	53			20	492	5,802
	1997	34	813	3,523	61	68	4,499	1,017		1,017	-	-	3	9	33	351	0	-	396	1	352	37			21	411	6,323
	1998	34	1,092	3,761	123	147	5,157	635		635	-	-	6	16	19	304	0	-	345	+	378	26			23	427	6,564
	1999	28	1,126	3,163	66	90	4,473	433		433	-	-	5	8	26	197	0	-	236	1	364	27			12	404	5,546
	2000	41	1,062	2,269	165	91	3,628	536		536	-	-	6	18	29	315	1	-	369		200	15			10	225	4,758
	2001	51	1,077	2,322	150	36	3,636	253		253	-	-	5	16	30	250	0	-	301		351	44			+	395	4,585
	2002	80	1,264	1,565	182	28	3,119	187		187	-	-	8	15	6	477	0	-	506	+	226	30			+	256	4,068
	2003	41	1,064	1,858	135	27	3,125	205		205	-	-	5	27	11	922	0	-	965	+	538	29			+	567	4,862
	2004	23	1,339	1,701	33	34	3,130	75		75	-	-	5	10	7	522	2	-	546	2	376	31			+	409	4,160
	2005	28	1,214	1,231	35	35	2,543	136		136	-	-	9	9	5	783	9	-	815	+	511	20			+	531	4,025
	2006	30	1,190	1,162	33	32	2,447	55		55	-	-	-	30	117	741	0	-	888	+	611	21			+	632	4,022
	2007	21	970	1,171	20	38	2,220	46		46	-	-	-	29	141	301	0	-	471		276	13			+	289	3,026
	2008	26	1,302	1,009	43	28	2,408	29		29	-	-	-	43	168	270	2	-	483		427	14				441	3,361
	2009	17	821	809	34	39	1,720	22		22	-	-	-	46	92	262	0	-	400		258	10				268	2,410
	2010	20	913	1,061	26	36	2,056	18		18	-	-	-	42	131	253	3	-	429		165	19				184	2,687
	2011	30	347	1,306	32	26	1,741	48		48	-	-	1	27	95	343	4	0	470		362	16				378	2,637
	2012	52	597	1,336	33	34	2,052	33		33	-	-	-	34	114	443	1	+	592		282	11				293	2,970
	2013	39	336	1,496	19	34	1,924	65		65	-	-	+	24	197	372	+	+	593		398	8				406	2,988
	2014	35	173	1,155	0	22	1,385	82		82	-	-	+	5	64	140	+	1	210		426	12			1	439	2,116
	2015	37	287	1,366	37	27	1,754	44		44	-	-	1	4	28	228	+	-	261		493	11	0			504	2,563
	2016	25	308	1,027	41	32	1,433	61		61	-	-	-	3	21	214	+	1	239		390	12				402	2,135
	2017	28	241	930	23	28	1,250	81		81			+	7	41	389	-	-	437		406	6				412	2,180
	2018	28	278	824	52	36	1,218	70		70			+	5	27	330	-	+	362		465	12				477	2,126
	2019	28	278	1,286	52	36	1,680	39		39			+	5	27	373	-	+	405		548	13				561	2,685
Retain catch total		5,044	81,432	321,772	45,207	6,559	460,014	6,436		6,436	-	-	91	889	5,236	24,877	2,967	2	34,062	8	13,609	893	0		1,484	15,993	516,505
Release	2010																							1		1	1
	2011																							0		0	0
	2016								+	+								1	1								1
	2018							0	2	2								+	+								2
	2019																	1	1								1
Release total								0	2	2								2	2					1		1	5
Total		5,044	81,432	321,772	45,207	6,559	460,014	6,436	2	6,437	0	0	91	889	5,236	24,877	2,967	4	34,064	8	13,609	893	0	1	1,484	15,994	516,510

Table 14. 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 Longline	JPN Total	KOR Longline	KOR Purse seine	KOR Total	MEX Sport	MEX Total	TWN Set-net	TWN Gill-net (not specified)	TWN Harpoon	TWN Longline	TWN Others	TWN Purse seine	TWN Total	USA Handline	USA Longline	USA Troll	USA Others	USA Purse seine	USA Total	Total
Retain	1953											-			-							-
	1954											-			-							-
	1955											-			-							-
	1956											-			-							-
	1957											-			-							-
	1958											887			887							887
	1959											781			781							781
	1960											948			948							948
	1961											703			703							703
	1962											628			628							628
	1963											691			691							691
	1964											934			934							934
	1965											1,016			1,016							1,016
	1966											957			957							957
	1967								-	-	317	898	167		1,382							1,382
	1968								-	30	649	1,433	120		2,232							2,232
	1969								-	58	465	1,232	103		1,858							1,858
	1970								1	21	604	1,385	70		2,081							2,081
	1971	5,461	5,461	0		0			-	13	473	1,331	118		1,935							7,396
	1972	6,772	6,772	0		0			-	14	490	1,205	50		1,759							8,531
	1973	6,453	6,453	0		0			-	12	275	1,650	265		2,202							8,655
	1974	6,545	6,545	0		0			1	6	355	2,144	146		2,652							9,197
	1975	4,374	4,374	0		0			-	3	421	2,638	207		3,269							7,643
	1976	5,018	5,018	0		0			-	9	511	1,315	162		1,997							7,015
	1977	4,780	4,780	0		0			-	11	391	1,183	110		1,695							6,475
	1978	5,900	5,900	0		0			1	15	364	1,633	7		2,020							7,920
	1979	5,949	5,949	0		0			3	19	362	1,646	164		2,194							8,143
	1980	5,613	5,613	155		155			-	35	444	1,185	170		1,834							7,602
	1981	5,518	5,518	0		0			-	35	313	1,840	69		2,257							7,775
	1982	6,051	6,051	351		351			-	7	306	2,139	120		2,572							8,974
	1983	4,796	4,796	82		82			-	26	741	2,122	127		3,016							7,894
	1984	6,248	6,248	155		155			-	22	960	1,789	111		2,882							9,285
	1985	5,164	5,164	45		45			9	11	747	1,187	43		1,997			145			145	7,351
	1986	5,922	5,922	86		86			4	90	839	1,723	107		2,763			220			220	8,991
	1987	5,370	5,370	89		89			12	9	973	4,627	1		5,622		51	261			312	11,393
	1988	5,054	5,054	133		133			20	8	658	2,822	589		4,097		102	266			368	9,652
	1989	5,117	5,117	50		50			10	14	640	2,691	9		3,364		356	326			682	9,213
	1990	4,116	4,116	44		44	-	-	3	24	427	1,749	143		2,346		378	295			673	7,179
	1991	4,094	4,094	75		75	-	-	4	50	338	2,288	152		2,832		297	346			643	7,644
	1992	3,721	3,721	60		60	-	-	25	40	432	3,786	110		4,393		347	260			607	8,781
	1993	4,600	4,600	36		36	-	-	44	41	400	4,135	82		4,702		339	311			650	9,988
	1994	5,832	5,832	2		2	-	-	12	30	206	3,007	7		3,262		362	298			660	9,756
	1995	5,907	5,907	0		0	-	-	15	36	895	3,896	5		4,847		570	315			885	11,639
	1996	3,260	3,260	10		10	-	-	13	35	270	3,337	10	-	3,665		467	409			876	7,811
	1997	3,697	3,697	145		145	-	-	5	48	194	3,683	-	-	3,930		487	378			865	8,637
	1998	3,438	3,438	335		335	-	-	8	59	91	3,624	1	-	3,783		395	242			637	8,193
	1999	3,751	3,751	164		164	-	-	21	32	135	3,417	-	-	3,605		357	293			650	8,170
	2000	3,606	3,606	96		96	-	-	24	40	186	4,131	2	-	4,383		314	235			549	8,634
	2001	3,594	3,594	166		166	-	-	18	57	229	4,733	-	-	5,037		399	291			690	9,487
	2002	2,976	2,976	152		152	-	-	13	63	32	4,448	6	-	4,562		264	225	1		490	8,180
	2003	2,836	2,836	158		158	-	-	20	107	52	7,685	4	-	7,868		363	210			573	11,435
	2004	2,977	2,977	226		226	-	-	14	93	36	6,672	9	-	6,824		283	188	5		476	10,503
	2005	2,506	2,506	303		303	-	-	8	65	48	7,630	16	-	7,767		337	187			524	11,100
	2006	2,414	2,414	217		217	-	-	12	15	30	5,729	-	-	5,786		409	160			569	8,986
	2007	2,016	2,016	120		120	-	-	3	17	20	5,117	-	-	5,157	1	262	127			390	7,683
	2008	2,096	2,096	219		219	-	-	10	16	15	5,477	1	-	5,519	1	349	198			548	8,382
	2009	1,840	1,840	224		224	-	-	9	12	9	4,638	1	-	4,669	1	360	15			376	7,109
	2010	2,457	2,457	257		257	-	-	5	27	15	4,959	1	-	5,007	2	306	148			456	8,177
	2011	2,343	2,343	684		684	-	-	3	18	17	4,625	9	2	4,674	2	373	199			574	8,275
	2012	2,019	2,019	587		587	-	-	6	13	16	4,097	+	12	4,144	2	298	141			441	7,191
	2013	2,179	2,179	963		963	-	-	2	6	16	4,607	+	9	4,640	3	406	137			546	8,328
	2014	1,903	1,903	801		801	-	-	4	11	124	4,861	5	7	5,012	4	535	159		1	699	8,415
	2015	1,622	1,622	531		531	-	-	3	14	177	4,306	+	3	4,503	3	631	196			830	7,486
	2016	1,581	1,581	1,116	-	1,116	-	-	3	23	158	3,398	3	4	3,589	2	554	161			717	7,003
	2017	1,405	1,405	1,453		1,453			-	7	138	3,977	+	6	4,128	4	687	155		3	849	7,835
	2018	1,256	1,256	1,336		1,336			-	11	108	3,501	-	10	3,630	3	664	165		2	833	7,055
	2019	1,339	1,339	778		778			-	11	108	3,359	-	4	3,482	5	902	178		3	1,087	6,686
Retain catch total		193,486	193,486	12,404	-	12,404	-	-	368	1,489	17,220	180,235	3,602	57	202,971	33	13,203	7,839	6	9	21,090	429,952
Release	2010																			1	1	1
	2011																			6	6	6
	2012																					
	2013													5	5							5
	2014																					
	2015				-	-								3	3							3
	2016				1	1								4	4							5
	2017													6	6							6
	2018			1	1	2								6	6							8
	2019			-										5	5							5
Release total				1	2	3								29	29					7	7	39
Total		193,486	193,486	12,405	2	12,407	0	0	368	1,489	17,220	180,235	3,602	86	203,000	33	13,203	7,839	6	16	21,097	429,990

Table 15. 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		TWN		USA						Total
		Set-net	Drift gill-net	Longline	Others	Not specified	JPN Total	Longline	KOR Total	Others	MEX Total	Longline	TWN Total	Drift gill-net	Longline	Troll	Others	Sport	USA Total	
Retain	1985													-			1		1	1
	1986													1			1		2	2
	1987													1			1		2	2
	1988													-			3		3	3
	1989																6		6	6
	1990													-			20		20	20
	1991													-			1		1	1
	1992													1			1		2	2
	1993													-			-		0	0
	1994	9	577	33,368	19	4	33,977							-			12		12	33,989
	1995	7	483	37,567	11	4	38,072							-			5		5	38,077
	1996	7	474	29,015	19	4	29,519							-			-		0	29,519
	1997	9	598	32,457	8	6	33,078							-			-		0	33,078
	1998	7	611	30,610	5	4	31,237							-			1		1	31,238
	1999	8	828	27,270	7	2	28,114							-			-		0	28,114
	2000	8	730	29,569	11	1	30,319							-			-		0	30,319
	2001	8	731	30,615	9	2	31,365			-	-						-		0	31,365
	2002	7	768	26,181	13	1	26,970			-	-						-		0	26,970
	2003	7	1,350	26,780	12	2	28,151			-	-			-			-		0	28,151
	2004	8	1,202	25,684	7	3	26,904			-	-						-		0	26,904
	2005	0	1,321	29,482	13	2	30,818			2,721	2,721						-		0	33,539
	2006	5	1,204	25,106	2	2	26,319			2,765	2,765						-		0	29,084
	2007	5	1,323	23,725	19	2	25,074			3,324	3,324			9	8		-		17	28,415
	2008	0	944	20,115	14	1	21,074			4,355	4,355				7				7	25,436
	2009	0	1,208	19,330	4	1	20,543			4,423	4,423	11,541	11,541	1	9		1		11	36,518
	2010	4	963	22,608	9	1	23,585			4,469	4,469	7,670	7,670	-	7		0		7	35,731
	2011	7	765	20,231	1	3	21,007			3,719	3,719	13,117	13,117		13		0		13	37,856
	2012	2	1,076	13,892	3	3	14,975			4,108	4,108	10,606	10,606		16		0		16	29,705
	2013	6	1,103	17,203	4	2	18,319	75	75	4,494	4,494	6,321	6,321		1	0	0		1	29,210
	2014	4	1,060	16,241	0	2	17,306	100	100	5,502	5,502	8,151	8,151		0	-	-	0	0	31,059
	2015	21	1,080	12,470	0	2	13,573	53	53			8,551	8,551				0	0	0	22,177
	2016	26	1,832	14,483	1	2	16,343					8,563	8,563							24,906
	2017	4	1,366	14,787	0	1	16,158	8	8			11,121	11,121				1	0	1	27,287
	2018	40	1,236	10,921	0	1	12,198	4	4			11,761	11,761				1		1	23,964
	2019	40	1,236	10,921	0	1	12,198	4	4			18,165	18,165				11	0	11	30,377
Retain catch total		248	26,066	600,630	192	60	627,196	243	243	39,880	39,880	115,567	115,567	13	61	0	65	1	140	783,026
Release	2015							-	-											-
	2016							8	8											8
	2017							11	11											11
	2018							58	58											58
	2019							12	12											12
Release catch tota								90	90											90
Total		172	24,842	553,991	12,017	60	591,082	333	333	39,880	39,880	115,567	115,567	13	61	0	65	1	140	783,116

Table 16. 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					KOR		MEX		TWN			USA										
		Drift gill-net	Longline	Others	JPN Tota	Longline	KOR Total	Others	MEX Tota	Longline	Purse seine	TWN Tota	Drift gill-net	Harpoon	Handline	Longline	Troll	ook and lir	Others	urse-sein	Sport	USA Tota	Total
Retain	1985							43	43				129	1					19			149	192
	1986							84	84				250	1					59			310	394
	1987							197	197				208	3					188			399	596
	1988							248	248				106	3					214			323	571
	1989							135	135				117	1					137			255	390
	1990							288	288				229	3					141			373	661
	1991							228	228				125	1					91			217	445
	1992							376	376				118	3					19			140	516
	1993							442	442				87	1					32			120	562
	1994	123	748	18	889			336	336				80	1					46			127	1,527
	1995	103	985	13	1,102			333	333				79	1					14			94	1,376
	1996	101	1,152	14	1,267			413	413				85	1					9			95	1,593
	1997	127	877	15	1,020			401	401				118	3					11			132	1,530
	1998	130	667	12	809			386	386				85	1					12			98	1,432
	1999	176	1,051	13	1,241			439	439				52	0					9			61	1,829
	2000	156	1,020	14	1,189			539	539				64	+					12			76	1,632
	2001	156	1,132	14	1,301			491	491				30	1					10			41	1,635
	2002	122	803	5	930			488	488				69	+					12			81	1,669
	2003	229	849	6	1,083			471	471				57	+					9			66	1,575
	2004	134	920	1	1,054			865	865				38	1					13			52	2,036
	2005	155	938	43	1,135			609	609				25	1					8			34	1,756
	2006	178	996	6	1,180			641	641				38	+					7			45	1,716
	2007	244	1,041	15	1,299			689	689				37	+					6			43	1,883
	2008	212	968	14	1,194	-	-	609	609				27	1					5			33	1,886
	2009	294	1,201	1	1,496	-	-	653	653	78		78	21	1			0		7			29	2,065
	2010	272	917	20	1,208	-	-	760	760	54		54	10	0					10			20	2,068
	2011	163	648	11	823	-	-	758	758	208		208	8	0					8			16	1,720
	2012	229	716	2	948	-	-	715	715	74		74	9	0			0		11			20	1,595
	2013	345	700	9	1,054	8	8	711	711	107		107	16	0					12			28	1,820
	2014	263	784	3	1,051	8	8	-	-	119		119	7	0		53	+	3	6		9	78	1,066
	2015	334	553	11	898					322		322	7			58		1	4			71	1,291
	2016	446	413	16	874	+	0			220		220	12	0	1	70		1	4		0	89	1,183
	2017	271	637	10	918	+	+			187		187	13	0		71		1	5			89	1,195
	2018	223	575	28	826	+	+			265		265	11			60		1	5			77	1,169
	2019	223	575	28	826	+	+			273		273	7			47		1	20			75	1,175
Retain catch total		5,410	21,865	341	27,616	16	16	13,348	13,348	1,907		1,907	2,374	30	1	359	0	8	1,175	0	9	3,956	46,843
Release	2011																			0		0	0
	2012										-	-											0
	2016					1	1																1
	2018					1	1																1
	2019					1	1																1
Release catch total						3	3																3
Total		5,410	21,865	341	27,616	19	19	13,348	13,348	1,907	-	1,907	2,374	30	1	359	0	8	1,175	0	9	3,956	45,499

Numbers in paranthesus 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).