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SEVENTEENTH REGULAR SESSION**

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5 – 7 October 2021**

**Report of the 21st Meeting of the International Scientific Committee for
Tuna and Tuna-like Species in the North Pacific Ocean**

WCPFC-NC17-2021/IP-01

ISC¹

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



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

PLENARY SESSION

12-15 and 19 July 2021
Virtual Meeting

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ACRONYMS AND ABBEVIATIONS

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

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

ISC Working Groups

Acronym	Name	Chair
ALBWG	Albacore Working Group	Sarah Hawkshaw (Canada)
BILLWG	Billfish Working Group	Hirota Ijima (Japan)
PBFWG	Pacific Bluefin Working Group	Shuya Nakatsuka (Japan)
SHARKWG	Shark Working Group	Mikihiko Kai (Japan)
STATWG	Statistics Working Group	Felipe Carvalho (U.S.A)

Other Abbreviations and Acronyms that may be Used in the Report

CDS	Catch documentation scheme
CIE	Center for Independent Experts
CKMR	Close-kin mark-recapture
CMM	Conservation and Management Measure
CPFV	Charter passenger fishing vessel
CPUE	Catch-per-unit-of-effort
CSIRO	Commonwealth Scientific and Industrial Research Organization
DWLL	Distant-water longline
DWPS	Distant-water purse seine
EEZ	Exclusive economic zone
EPO	Eastern Pacific Ocean
F	Fishing mortality rate
$F_{x\%}$	Fishing mortality that produces x% of the spawning potential ratio, SPR
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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12/13-15/16 and 19/20 July 2021

Highlights of the ISC21 Plenary Meeting

The 21st ISC Plenary, held as a virtual meeting, July 12-15 and 19, 2021 (Pacific Daylight Time) was attended by Members from Canada, Chinese Taipei, Japan, Republic of Korea, Mexico and the United States as well as the Inter-American Tropical Tuna Commission and Western and Central Pacific Fisheries Commission representatives. Observers from Monterey Bay Aquarium/Duke University, Pew Charitable Trusts, Western Fishboat Owners' Association, and the Western Pacific Fisheries Management Council, World Wildlife Fund-Japan, and Wild Oceans also attended the ISC21 Plenary session. The Plenary reviewed results, conclusions, new data, and updated analyses of the Billfish, Albacore, Shark, and Pacific Bluefin Tuna working groups. The Plenary endorsed the Pacific Blue Marlin (BUM) stock assessment and considers it to be the best available scientific information on this stock. Although reference points have not been established for the BUM stock, the stock is very likely (>90%) not overfished and overfishing is very likely (>90%) not occurring relative MSY-based reference points. An indicator analysis was conducted for North Pacific Shortfin Mako Shark (SMA) based on trends in catches and abundance indices supplemented by size frequency data because of the long period between benchmark stock assessments. The Plenary endorsed the conclusion that there were no obvious signs of shifts in abundance or fishery dynamics and the conclusion that a change in the date for the next benchmark stock assessment of SMA in 2024 was not warranted. The Plenary endorsed the BILLWG recommendation to expedite the next WCNPO MLS assessment for completion in 2022 and the responses prepared by the BILLWG to questions posed by WCPFC17 regarding discrepancies in catches of Western and Central Pacific Ocean Striped Marlin (MLS) stock. The Plenary revised the conservation information for WCNPO MLS with additional information related to updating the rebuilding plan with the most recent scientific information produced by the expedited benchmark assessment in 2022 and some remarks regarding the rebuilding target definition. The Plenary re-iterated stock status and conservation information provided at ISC20 for North Pacific Albacore (NPALB), Pacific Bluefin Tuna (PBF), WCNPO Swordfish (SWO), Eastern Pacific Ocean Swordfish (EPO SWO), Pacific Blue Marlin (BUM), North Pacific Blue Shark (BSH), and North Pacific Shortfin Mako Shark (SMA). The ISC work plan for 2021-22 includes benchmark stock assessments of MLS and BSH, an update assessment for PBF, advancing biological sampling for billfish and shark species, engaging the IATTC and WCPFC-NC on a PBF MSE process, reviewing the ISC Operations Manual to improve accountability and transparency, and continued

implementation of enhancements to database and website management. Sarah Hawkshaw (CAN) was elected Chair of the ALBWG and Felipe Carvalho (USA) was elected Chair of the STATWG. Mikihiro Kai (JPN) and Michael Kinney (USA) were reelected to their second 3-yr term as Chair and Vice-Chair, respectively, of the SHARKWG. The next ISC Plenary will be hosted by the United States of America in Kona, Hawai'i, July 12-18, 2022.

1 INTRODUCTION AND OPENING OF THE MEETING

1.1 Introduction

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

The ISC provides scientific advice on the stocks and fisheries of tuna and tuna-like species in the North Pacific Ocean to the Member governments and regional fisheries management organizations. Fishery data tabulated by ISC Members and peer-reviewed by the species and Statistics Working Group (STATWG) 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 by ISC Member countries in 2020 were 36,226 t of North Pacific albacore tuna (NPALB, *Thunnus alalunga*), 13,779 t of Pacific Bluefin tuna (PBF, *T. orientalis*), 8,508 t of North Pacific swordfish (SWO, *Xiphias gladius*), 2,443 t of North Pacific striped marlin (MLS, *Kajikia audax*), 4,703 t of Pacific blue marlin (BUM, *Makaira nigricans*), 1,259 t of North Pacific shortfin mako shark (SMA, *Isurus oxyrinchus*) and 22,415 t of North Pacific blue shark (BSH, *Prionace glauca*).¹ The total estimated catch of these seven species is 89,333 t, or approximately 80% of the 2020 total estimated catch of 112,186 t. Annual catches of priority stocks throughout their ranges reported by ISC Members are shown in Table 5 through

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

Table 11.

1.2 Opening of the Meeting

The Twenty-first Plenary session of the ISC (ISC21) was convened as a virtual meeting, at 18:00 on 12 July 2021 by the ISC Chair, J. Holmes.² A roll call confirmed the presence of delegates from Canada, Chinese-Taipei, Japan, Mexico, Republic of Korea, and U.S.A.

(ISC/21/ANNEX/01). Non-voting members from the Secretariat of the Pacific Community (SPC), the Western and Central Pacific Fisheries Commission (WCPFC) and the Inter-American Tropical Tuna Commission (IATTC) were also present. Representatives from Monterey Bay Aquarium/Duke University, Pew Charitable Trusts, Western Fishboat Owners' Association, and the Western Pacific Fisheries Management Council, World Wildlife Fund-Japan, and Wild Oceans were present as observers.

ISC Member China, as well as the non-voting Members, the Fisheries and Agriculture Organization of the United Nations (FAO) and North Pacific Marine Science Organization (PICES), while extended an invitation, did not attend the Plenary.

2 ADOPTION OF AGENDA

The proposed agenda for the session (ISC/21/ANNEX/02) was considered and adopted. C. Dahl was assigned lead rapporteur duties. A list of meeting documents is contained in ISC/21/ANNEX/03.

Due to the constraints of the online format, national reports were not presented during Plenary. Written reports are compiled as documents ISC/21/PLENARY/04 through ISC/21/PLENARY/09.

A list of common abbreviations and acronyms used by the ISC is provided in the preface to this report.

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

3.1 North Pacific Albacore

3.1.1 ALBWG Working Group Report and Review of Assignments

S. Teo reported on the activities of the ALBWG over the past year (ISC/21/ANNEX/11/13/XX). There were three ALBWG workshops focusing on the NPALB management strategy evaluation (MSE), as well as three MSE workshops for managers and stakeholders. All workshops were held online due to COVID-19 related travel restrictions. The first ALBWG management strategy

² Time given as Pacific Daylight Time (UTC -7) or for other members 09:00 China Standard Time (UTC +8), 10:00 Japan/Korea Standard Time (UTC +9) (July 13), or 15:00 Hawai'i Standard Time (UTC -10).

evaluation (MSE) workshop was held during 31 August – 3 September, and 8 September 2020 (EPO dates) to: 1) review the progress of the MSE after the initial round of the MSE; 2) assess if any additional modifications to the MSE framework or additional analyses were required; and 3) provide feedback on presentation of results. The second ALBWG MSE workshop was held during 1 – 4, and 8 December 2020 (EPO dates) to: 1) review the progress of the MSE after the first MSE workshop in September; 2) draft the final report of the NPALB MSE; and 3) organize the MSE workshops for managers and stakeholders in 2021. The ALBWG organized three separate MSE workshops for managers and stakeholders to alleviate issues with different languages and time zones (Japan: 17 – 19 March 2021; Canada and U.S.: 22 – 25 March 2021; and Taiwan: 7 – 8 April 2021). The objectives of these workshops were to: 1) help managers and stakeholders understand the MSE results; and 2) provide feedback to the ALBWG on the presentation of results. The third ALBWG MSE workshop was held during 18 – 19, and 24 May 2021 (EPO dates) to: 1) review feedback from the NPALB MSE workshops with managers and stakeholders; 2) propose and review response to the feedback; and 3) election of new ALBWG Chair. The ALBWG supported the main results of the MSE and agreed with the ISC Chair that the MSE results need to be assimilated by managers and stakeholders before further iterations of the MSE.

The ALBWG proposed the following 2021 – 2022 meeting schedule:

Date	Location/Method	Task/Event
11 – 19 Aug 2021	Online	WCPFC SC17. Report of MSE results and recorded video presentation provided for posting on SC17 online discussion forum website. Authors are responsible for any text communications.
5 – 7 Oct 2021	Online	WCPFC NC17. Format of presentation of MSE results to be determined.
Early 2022	Yokohama, Japan	ALBWG: Workshop for Assessment Improvements

Discussion

The Plenary endorsed the ALBWG's proposed work plan.

3.1.2 North Pacific Albacore Stock Status and Conservation Information

The ALBWG recommended carrying forward the stock status and conservation information from ISC20, because there is no new stock assessment or other substantive information that would suggest a need to change these determinations. The Plenary endorsed this recommendation.

The Plenary discussed whether the adoption of additional biological reference points for the stock, based on the results of the management strategy evaluation (see Section 3.1.3), could

potentially affect this stock status and conservation information. The ALBWG Vice Chair suggested that the WG could consider the implications of any newly adopted reference points at its proposed meeting in early 2022 and bring forward recommendations to ISC22.

In response to a question about the relationship between “current” fishing intensity ($F_{2015-2017}$) and the conservation measures adopted by the WCPFC and IATTC that limit fishing effort to the average of the 2002-2004 level (IATTC Resolution C-05-02 only specifies that the ‘current’ level of fishing is not to be exceeded but the ‘current’ in the Resolution is interpreted as the average of 2002-2004), it was noted that current fishing intensity would correspond to fishing effort below the 2002-2004 level.

Stock Status and Conservation Information

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC20 (see Section 3.1.2 pp. 5-15 in the ISC20 Plenary Report) unchanged, except for the omission of accompanying figures and tables.

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. Estimated female SSB exhibits a similar population trend, with an initial decline until 2003 followed by fluctuations without a clear trend through 2018. 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), 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.

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).

The WCPFC -NC, which manages this stock in conjunction 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 NPALB 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-NC have adopted F -based reference points for the NPALB 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 $1-SPR_{20\%}$). 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. 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 the more extreme assumption. 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 t of 25,573 t (95% CI: 19,150 – 31,997 t). 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 NPALB stock.

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.**

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 catch³ (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. 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. 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**

³ 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).

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.**

3.1.3 Final Management Strategy Evaluation Report

The ALBWG conducted an MSE for NPALB to examine the performance of alternative harvest control rules (HCRs) and associated reference points for the stock. Performance was evaluated based on management objectives pre-agreed upon with managers and stakeholders in a series of workshops.

Management objectives and performance metrics were finalized in October 2017, at the 3rd ISC NPALB MSE Workshop in Vancouver, Canada, where candidate reference points and HCRs for testing were also agreed upon. An initial set of MSE results was presented to managers and stakeholders during the 4th ISC NPALB MSE Workshop in February 2019 in Yokohama, Japan. Managers and stakeholders at the 4th MSE Workshop recommended removal from further consideration of two candidate harvest strategies and target reference points (TRPs) and assessment of performance of additional candidate HCRs focused on the best performing TRPs of $F_{40\%}$ and $F_{50\%}$.

The results presented here focus on evaluation of the 16 HCRs and associated reference points proposed at the 4th MSE Workshop. The MSE tested HCR performance under total allowable catch (TAC) control and mixed control management procedures. Under the mixed control procedure, longline fleets catching NPALB incidentally are subject to a TAC, while the surface fleets targeting NPALB are controlled by total allowable effort (TAE). Mixed control maintained higher and less variable stock biomass than TAC control because the catches of surface fleets under effort control responded quickly to changes in biomass and their catch levels were not impacted by assessment errors in biomass estimates.

Because the NPALB stock is in good condition – even when considering the range of uncertainties in stock productivity; recruitment variability; availability to the EPO surface fleet; and observation, assessment, and implementation error – SSB rarely fell below the WCPFC’s adopted LRP of 20% unfished dynamic spawning stock biomass ($20\%SSB_{\text{current}, F=0}$). This was true across the range of the candidate HCRs under both TAC and mixed control management procedures across all the reference stock productivity scenarios that were tested.

Under mixed control, there was a tradeoff between the odds of biomass being above the LRP and catch-related performance metrics. Under TAC control, the tradeoff between fishing intensity and catch variability led to the comparable odds of catch being above the historical average with both the $F_{50\%}$ and $F_{40\%}$ TRP families of HCRs.

Both mixed and TAC control were able to maintain the stock above the LRP with high probability (>0.8) even with increasing catches from an unknown, unmanaged fleet. This result

occurred because the estimation model (the simulated stock assessment) correctly detects the decrease in biomass from the abundance indices and composition data despite observation error. As the TAC and TAE of the managed fleets are dependent on stock biomass, they are reduced over time and catches of the managed fleets diminish. Thus, maintenance of stock biomass comes at the cost of decreased catches for the managed fleets.

Discussion

The Plenary endorsed the MSE results, reiterating that no additional work is anticipated at this time.

The Plenary discussed the future validity of MSE results if a new benchmark stock assessment changes our understanding of stock status. The MSE evaluated management procedures across a wide range of operating models consolidated into four productivity scenarios. This approach should make the results robust in the face of changes in stock status. However, if assessment results suggest conditions outside the evaluated range, the MSE may need to be revisited. Otherwise, in presentations to managers it should be emphasized that no further iterations of the MSE results is planned at present.

It was noted that the recruitment scenarios used for MSE projections were not explicitly based on potential changes in environmental conditions, but the historical time series upon which they were based exhibits some year-to-year autocorrelation, suggesting environmental conditions that propagate across several years.

It was clarified that the ALBWG developed additional catch-related performance metrics by subsetting years within the 1981-2010 times series based on stakeholder recommendations.

It was noted that the robustness of management procedures under the scenario of undetected catch by a “ghost fleet” is a result of the simulated stock assessments interpreting changes in the abundance index and composition data as a reduction in spawning biomass resulting from a drop in recruitment. Corresponding controls are imposed on the managed fleets, which are thus “paying the price” for the catch of unmanaged fleets.

The upcoming presentation of the MSE in regional fishery management forums was discussed at length. Finding the right balance between technical detail, clarity, and conciseness is challenging. A more technical presentation would be appropriate for an audience such as the WCPFC Scientific Committee while focusing on the MSE results with less technical detail would be better for fishery managers participating in the next Northern Committee meeting. Providing materials in advance, including a prerecorded presentation, would likely enhance uptake by managers. The ISC Chair will work with the Northern Committee Chair to ensure necessary time is allocated on its meeting agenda and that other arrangements discussed by the Plenary are accommodated.

3.2 Pacific Bluefin Tuna

3.2.1 PBFWG Report and Review of Assignments

S. Nakatsuka, PBFWG Chair, reported the activities of WG for the past year (ISC/21/ANNEX/12). The WG did not conduct a PBF stock assessment last year and held one intersessional meeting in April 2021. In the intersessional meeting, the WG reviewed the latest catch data and noted catch increases by several members that were within the catch limits of the CMMs currently in force (WCPFC CMM 2020-02; IATTC Resolution C-20-02). The WG also reviewed abundance indices. The longline indices from Japan and Chinese Taipei, from which SSB abundance is inferred, showed a strong increase, supporting the continuing recovery trend of the stock. As to the recruitment index that has been used in the assessment, the WG is concerned with the impact of stricter management controls implemented in 2017 on data availability. Because these controls affect fishery behavior, the WG believes that the current index may be negatively biased after the 2016 fishing year and thus the index from subsequent years should not be included in future stock assessments. This bias is related to management measures in Japan encouraging the voluntary release of young PBF, which are not captured in the sales slip records (landings) that are the data source for this index. The WG will consider options for the inclusion of an appropriate recruitment index for the next stock assessment. The WG further noted that the terminal year (2018 fishing year) recruitment estimate was low in the last assessment, which was primarily informed by the Japanese troll recruitment index that is likely to be negatively biased. However, the effect of this issue on the stock status or conservation information is considered minimal, because the assessment and projections take into account the high uncertainty of recruitment estimates. The WG concluded that there is no new information that necessitates revisions to the 2020 ISC Stock Status and Conservation Information for PBF.

The WG also reviewed the model structure of the current stock assessment and developed a basic framework for the updated stock assessment scheduled for completion in 2022. The WG also discussed how to proceed with a PBF MSE. One of the main benefits of an MSE is to account for data uncertainties. The WG concluded that given the high quality of the PBF assessment and lack of data inconsistencies, that is the catch data explained indices with good contrast, the need for a full MSE analysis is diminished. Therefore, the WG discussed using an ensemble approach rather than MSE to evaluate harvest strategies based on the 2020 stock assessment. However, if uncertainty cannot be captured in the ensemble approach, an MSE with a feedback loop may be needed. The WG agreed to discuss this issue further in fall 2021, based on the preliminary results from the ensemble model. In addition, the WG discussed the current status of close-kin mark recapture (CKMR) research on PBF. Members reported on their domestic research activities related to CKMR, but several members noted difficulties with continuing domestic CKMR research, because of the lack of a clear workplan endorsed by the ISC. WG members agreed to continue their domestic CKMR projects as they see fit.

The WG proposed the following schedule of meetings and deadlines as part of its workplan.

Date	Topic
November 2021	Data preparation workshop, including MSE progress review (Webinar);

December 31, 2021	Data submission for Catch and Size composition data, and preliminary results for the abundance indices
January 31, 2022	Data submission for the abundance indices
Early March 2022	Assessment meeting (format TBD)
April 1st, 2022	Submit the executive summary of the stock assessment report to the ISC chair for his review

Discussion

The Plenary discussed the barriers to progress on the PBF CKMR research agenda. Effective collaboration has been stymied by limitations of domestic capacity in the necessary analytical techniques and the reluctance to share confidential information on genetic markers in the interest of further developing such capacity. As a result, lack of coordination of research methods, such as which genetic markers to use, threatens the international research program. Overall, the lack of a coherent research plan agreed to by the Plenary has been the main contributor to these impediments. The Plenary asked the PBFWG to report back to the Plenary in 2022 on the need for CKMR to improve the accuracy and reliability of future stock assessments. Based on that advice, the Plenary may decide on any further development of an ISC sponsored CKMR research program.

The Plenary discussed progress on the MSE and its importance for strategic decision making. A major impediment to the development of the MSE has been the lack of input from managers on management objectives and alternatives management procedures (BRPs, HCRs, management controls, etc.) despite PBFWG efforts. Concern was expressed regarding the capacity needed to conduct an MSE, given the assessment workload and the fact that the WCPFC and IATTC have not provided clear direction and guidance on the MSE process. It was agreed that the ISC Chair and the PBFWG Chair would draft a document describing these concerns and submit it for discussion at the Sixth Meeting of the IATTC-WCPFC NC Joint Working Group on the Management of Pacific Bluefin Tuna scheduled for July 27-29, 2021.

Issues with the current recruitment indices were discussed. As noted by the PBFWG, the Japanese troll index may be negatively biased since 2017 because of management controls affecting landings, the data source for this index. Japan has also developed an index based on electronic monitoring of troll vessels that is expected to be less affected by these changes in behavior because it is not landings based, but this index has a much shorter time series. The PBFWG Chair noted that the problems with the current Japanese troll index and the implications of switching to an alternative index will be further discussed at the WG's planned November 2021 meeting.

The selection of the Taiwanese longline index from the results of different statistical methods was also discussed. A delta-generalized linear mix model (delta-GLMM) has heretofore been used while a vector-auto-regressive spatiotemporal (VAST) model was tested since 2018. The two methods produce similar results, but the VAST model approach has the disadvantage that it can only be applied to a shorter historical time period with detailed geo-location information in the data.

The Plenary endorsed the PBFWG's proposed workplan.

3.2.2 Pacific Bluefin Tuna Stock Status and Conservation Information

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC20 (see Section 3.2.2, pp. 17-31 in the [ISC20 Plenary Report](#)) unchanged, except for the omission of accompanying figures and tables and clarifying modifications.

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 $F_{14\%SPR}$. Although no reference points have been adopted to evaluate the status of PBF, an evaluation of stock status against some common reference points 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). These changes in biomass coincide with a decline in fishing mortality over the last decade. 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 (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. 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 by this fishing mortality, 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 in the ISC20 Plenary Report. 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. In most of the scenarios, the SSB biomass is projected to recover to the initial rebuilding target (SSB_{MED}) in the 2020 fishing year (April of 2021) with a probability above the 60% level prescribed in the WCPFC CMM 2019-02.

A Kobe chart and impacts by fleets estimated from future projections under the current management scheme are provided for information. Because the projections include catch limits, fishing mortality ($F_{x\%}$) 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.**
- 2. The projection results assume that the CMMs are fully implemented and are based on certain biological and other assumptions. For example, the future projection results do not contain assumptions about discard mortality. Although the impact of discards on SSB is small compared to other fisheries, 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.**

3.3 Billfish

3.3.1 BILLWG Report and Review of Assignments

H. Ijima, Chair of the BILLWG, outlined four WG meetings held in 2020 and 2021.

In the 3-4 and 13 November 2020 biological research workshop, the number of samples for each length bin was determined based on the analysis of length composition data from Japan, Chinese Taipei, and the United States. The BILLWG also established a standard sampling methodology for billfish species. The workshop also addressed the use of the updated growth curve for BUM used in the stock assessment. The BILLWG updated the BUM growth curve based on new research; however, the BILLWG decided to build the SS3 model using both the old growth curve and the new growth curve and to adopt the growth curve exhibiting better model diagnosis results as the base case model.

At its 6-7, 10 and 13 November 2020 data preparation workshop the WG agreed on the input data and the model settings for conducting a benchmark stock assessment for BUM using Stock Synthesis 3.

At its 9-11 and 15 March 2021 intersessional meeting, in addition to reviewing progress on the BUM stock assessment, the WG also prepared a response to three questions posed by WCPFC 17 about the status of the WCNPO MLS stock. To formulate the WCNPO MLS stock rebuilding plan, the WG proposed, first, to conduct the MLS stock assessment in 2022 and update the rebuilding plan accordingly. The next SWO assessment would be delayed to 2023 to accommodate this work. The IATTC has proposed a new stock boundary dividing WCNPO and EPO SWO stocks. In consultation with SPC-OFP scientists, the WG agreed to consider this new stock boundary.

While WCPFC-NC14 requested that the BILLWG prepare a rebuilding plan for WCNPO MLS, the WG needs clarification on the rebuilding target, $20\%SSB_{F=0}$. It is not clear whether the rebuilding target is based on equilibrium SSB_0 or whether dynamic SSB_0 is required. If the rebuilding target is defined with a dynamic SSB_0 , then the WG requests that the WCPFC-NC specify the target year for rebuilding.

WCPFC17 requested that the ISC address the three issues arising from the most recent WCNPO MLS stock assessment. The BILLWG recommended responses are summarized for each of these requests below. More detail is provided in **ISC/21/ANNEX/08**:

1. *Examine differences between ISC stock assessment catch estimates by CCM and WCPFC catch estimates, and work with the Scientific Services Provider to provide an assessment of the shortcomings.*

The BILLWG, which includes members from the Scientific Services Provider, SPC, discussed this question at a workshop in early 2021 in the context of a retrospective review of the quality of Japanese catch statistics (**Working Paper ISC/21/BILLWG-01/05**). The differences in catch estimates between the ISC stock assessment and the WCPFC occurs for longline fisheries that record the catch in numbers. These differences in catch estimates are due to the different methods used to convert numbers to biomass for the WCPFC catch estimates and for the stock assessment, whether it is SS or MFCL model. The WCPFC catch estimates conversion is based on the product of the number of fish caught and average weight of the individuals caught on a trip or within the reporting strata. The stock assessment estimates catch as product of the numbers caught, the fishery selectivity function, and the weight-at-age of individuals. When conducting a stock assessment it is important to account for potential conversion error by using the catch in the original recorded units, which for longline fisheries is numbers. The BILLWG noted that in the early part of the longline catch time series prior to 2000, the WCPFC catch estimates did not include Japanese longline training vessel catches. The inclusion of these catches after 2000 resulted in similar trends and catches although small differences remain. Based on these observations, the BILLWG concluded that WCPFC Japanese longline fishery statistics and the output from SS are similar.

2. *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 BILLWG identified three potential contributing factors: (1) The model assumes that selectivity for Japanese driftnet catches in the 1975-1993 period is the same selectivity as in the Japanese coastal driftnet fishery from 1994 to 2017, although there are no size data available

from 1975-1993. The coastal driftnet fishery targets large adult MLS, which means that the model is assuming the majority of the catch from 1975 to 1993 also is large adult fish. In 1994, the majority of the catch is from CCM longline fleets, which caught predominately juvenile MLS. This assumed shift from catching large adults to small juveniles would result in an increase in fishing mortality even if the overall catch decreased; (2) The CPUE time series has a break in 1993 to 1994, which could be driving a shift in the model results due to a lack of continuity; and (3) the Japanese logbook data also change their reporting requirements in 1993 to 1994, which could contribute to the shift in fishing mortality, however not all CCMs agreed that this would drive the change in fishing mortality.

The WG noted that excluding data prior to 1994 in the MLS assessment was explored in the 2019 assessment meeting. The WG compared two models that started in 1994. A sensitivity run fixing the initial equilibrium catch (run 22, MLS SAR, ISC19, Figure 3 a) showed no difference relative to the base-case model results. In contrast, estimating the initial equilibrium catch (Model 2 in the Carvalho, et al. 2019, Figure 3 b) resulted in the same trend but produced different estimates of initial population size. It was noted that SSB_0 is strongly associated with the initial equilibrium catch. However, the WG did not have strong information to justify setting the initial catch (5,000mt). **Based on this discussion, the WG agreed to estimate the initial equilibrium catch in the stock assessment model, and agreed that differences due to starting year were likely driven by the uncertainty in catches before 1993.**

3. *Develop a roadmap to address the issues identified in the latest stock assessment by ISC.*

The BILLWG recommends revising its work plan to assess WCNPO MLS in 2022 and postpone the WCNPO SWO assessment to 2023 to address the concerns identified by the questions above and by the WG in its WCNPO MLS stock assessment report (ISC/19/ANNEX/11). For example, there were concerns about providing a rebuilding plan in 2021 and then reassessing the stock in 2022. However, the proposed revised workplan would permit updating of the rebuilding plan after the stock assessment in 2022.

The WG presented the following schedule of upcoming meetings as part of its workplan.

Year	Meeting	Remarks
October 2021	WCPFC-NC17	Confirm the definition of rebuilding target and suggest the change of stock assessment schedule.
December 2021	WCPFC18	Confirm the definition of rebuilding target and suggest the change of stock assessment schedule.
Mid December 2021	Data preparatory meeting for MLS	
March 2022	Benchmark stock assessment meeting for MLS	
April 2022	Rebuilding meeting for MLS	

Year	Meeting	Remarks
November 2022	Data preparatory meeting for SWO	

At its April 2021 BUM stock assessment meeting, the ensemble model for Pacific BUM was finalized, diagnostics were discussed, and projections and sensitivity runs were completed. While the ensemble model approach was not initially planned for Pacific BUM, it became apparent that it was most appropriate approach for this assessment.

Discussion

The Plenary endorsed the BILLWG’s responses to the questions posed by WCPFC17, the request for clarification of the MLS rebuilding target and the BILLWG proposed workplan for 2021-22.

3.3.2 Pacific Blue Marlin Stock Assessment

Stock Identification and Distribution: The Pacific blue marlin (*Makaira nigricans*) is considered a pan-Pacific stock caught primarily in tropical and sub-tropical waters. All available fishery data from the IATTC and the WCPFC were used for this benchmark stock assessment. For modeling observations of CPUE and size composition data, it was assumed that there was instantaneous mixing of fish throughout the stock area on a quarterly basis.

Catches: Pacific blue marlin catches increased from the 1970s to the 1990s, and remained high until the 2000s when they started to decline. The relative catch by Japanese fleets has decreased and the relative catch from the Chinese Taipei and other longline fleets has increased since 2000 (Figure 1). Overall, longline gear has accounted for the majority of Pacific BUM catches (67%), Japanese fleets dominating the catch before 2000, and Chinese Taipei and other longline fleets dominating thereafter.

Data and Assessment: Catch and size composition data were collected from three ISC countries (Japan, Chinese Taipei, and the USA), the IATTC, and the WCPFC. Standardized catch-per-unit effort data used to measure trends in relative abundance were provided by Japan, the USA, and Chinese Taipei. The BUM stock was assessed using a two-model ensemble of age- and length-structured Stock Synthesis models fit to time series of standardized CPUE and size composition data. The two models in the ensemble differed only in the assumption of the growth curve used. One model used the growth curve from the 2016 Pacific blue marlin assessment (hereafter referred to as the “old growth” model). The other model used a growth curve presented to the working group that was a collaboration between ISC members (hereafter the “new growth” model see Figure 2). The BILLWG noted some substantial differences between the two growth models, including the parameterization (von Bertalanffy vs. two-stanza growth) and the asymptotic length (L_{inf}) for old fish, which was about 50 cm larger for the old growth model. Previous work has demonstrated that stock assessment models can be highly sensitive to the L_{inf} parameter; therefore, the WG explored both models for their ability to describe the input data. Neither model could be discarded based upon model fit and diagnostics; therefore, biological reference points, spawning stock biomass, and fishing mortality were averaged between the two models using the multivariate lognormal approximation method assuming equal weights. The

value for stock-recruitment steepness used for the base case model was $h = 0.87$. The assessment model was fit to relative abundance indices and size composition data in a likelihood-based statistical framework with smoothing penalties for fishery selectivity. Maximum likelihood estimates of model parameters, derived outputs, and their covariances were used as inputs to the model averaging using the multivariate lognormal approach to characterize stock status and to develop stock projections. Several sensitivity analyses were conducted to evaluate the effects of changes in model parameters, including the natural mortality rate, the stock-recruitment steepness, the growth curve parameters, and the female age at 50% maturity, as well as uncertainty in the input data (i.e., CPUE indices used and the weighting of the size composition data) and model structure (i.e., initial fishing mortality).

Biological Reference Points: Biological reference points were computed for the combined ensemble model using a multivariate lognormal approximation that accounts for the inherent covariance between F/F_{MSY} and SSB/SSB_{MSY} (Table 2). The combined estimate of the spawning biomass to produce MSY (adult female biomass) was $SSB_{MSY} = 20,677$ mt. The point estimate of F_{MSY} , the fishing mortality rate to produce MSY (average fishing mortality on ages 1 – 10) was $F_{MSY} = 0.23$ and the corresponding equilibrium value of spawning potential ratio at MSY was $SPR_{MSY} = 17\%$.

Projections: Stock projections were conducted with Stock Synthesis to evaluate the impact of alternative future levels of harvest intensity on female spawning stock biomass, fishing mortality, and yield for Pacific blue marlin. These projections were considered deterministic, because future recruitment was predicted based on the stock-recruitment curve. These projections used all the multi-fleet, multi-season, size- and age-selectivity, and complexity in the assessment model to produce consistent results. The stock projections started in 2020 and continued through 2029 (10 years) under 4 levels of constant fishing mortality: (1) constant fishing mortality equal to the 2003-2005 average ($F_{2003-2005}$); (2) constant fishing mortality equal to F_{MSY} ; (3) constant fishing mortality equal to the 2016-2018 average defined as current; and (4) constant fishing mortality equal to $F_{30\%}$ (corresponding to the fishing mortality that produces 30% of the spawning potential ratio). Stock projections for each F scenario were run for both growth models in the ensemble and combined using the multivariate lognormal method. Using the deterministic projection result, the multivariate lognormal approximation was applied to generate 10,000 trajectories of SSB and F to calculate the model-averaged results of the new and old growth models. Results showed the projected female spawning stock biomasses, fishing mortality, and the catch biomasses under each of the combined scenarios (Table 3 and Figure 5).

Discussion

The WG Chair was asked about the rationale for using an ensemble model approach. The WG did not make an *a priori* decision to employ an ensemble approach. Rather, model diagnostics indicated both the old growth model used in the previous assessment and the new growth model were equally plausible and both provide useful information about different aspects of growth. The Plenary noted that this is the first use of an ensemble modeling approach in an ISC stock assessment.

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

3.3.3 Pacific Blue Marlin Stock Status and Conservation Information

Based on the stock assessment results, the Plenary adopted the following stock status and conservation advice for Pacific BUM.

Stock Status

Stock status, biomass trends, and recruitment of Pacific blue marlin (*Makaira nigricans*) for both models in the ensemble had similar trends, although the estimates of initial conditions are different. All reported results are the model-averaged estimates from the ensemble model unless otherwise noted. Estimates of population biomass declined until the mid-2000s, increased again until 2021, and has been relatively flat until the present. The minimum spawning stock biomass is estimated to be 17,592 mt in 2006 (5% above SSB_{MSY} , the spawning stock biomass to produce MSY, 95% C.I. 14,512-20,703 mt, SSB/SS_{MSY} 95% C.I. 0.70-1.01, Figure 3). In 2019, $SSB = 24,272$ mt and the relative $SSB/SS_{MSY} = 1.17$ (95% C.I. 0.87-1.51). Combined median fishing mortality on the stock (average F on ages 1-10) is currently below F_{MSY} (Figure 3). It averaged roughly $F = 0.13$ during 2017-2019, or 40% below F_{MSY} , and in 2019, $F=0.11$ with a relative fishing mortality of $F/F_{MSY} = 0.50$ (95% C.I. 0.37-0.69). Median fishing mortality has been below F_{MSY} every year except 2003 to 2006. The predicted value of the spawning potential ratio (SPR, the predicted spawning output at current F as a fraction of unfished spawning output) is currently $SPR_{2017-2019} = 31\%$ for the combined model, which is above the SPR required to produce MSY (17%). Recruitment was relatively consistent throughout the assessment time period, with occasional pulses in recruitment, but no notable periods of below-average recruitment (Figure 3). No target or limit reference points have been established for Pacific BUM under the auspices of the WCPFC. Blue marlin is expected to be highly productive due to its rapid growth and high resilience to reductions in spawning potential. Although fishing mortality has approached MSY and exceeded MSY from 2003 to 2006, the biomass of the stock has remained above MSY (Figure 4). With continued decreases in Pacific BUM catch and fishing effort, the stock is expected to remain within MSY limits. When the status of BUM is evaluated relative to MSY-based reference points, the 2019 spawning stock biomass of 24,272 mt is 17% above SSB_{MSY} (20,677 mt, 95% C.I. -13% to +50%) and the 2017-2019 fishing mortality is 50% below F_{MSY} (95% C.I. 37% to 69%) (Table 2).

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

1. **No target or limit reference points have been established for Pacific blue marlin by the WCPFC;**
2. **Female spawning stock biomass was estimated to be 24,241 mt in 2019, or about 17% above SSB_{MSY} and 17% above $20\%SSB_0$.**
3. **Fishing mortality on the stock (average F , ages 1 to 10) averaged roughly $F = 0.13$ during 2016-2019, or about 40% below F_{MSY} and 28% below $F_{20\%SSB_0}$.**
4. **Blue marlin stock status from the ensemble model indicates that relative to MSY-based reference points, overfishing was very likely not occurring (>90% probability) and Pacific blue marlin is likely not overfished (81% probability, Figure 4).**

Conservation Information

The Pacific blue marlin stock has produced annual yields of around 18,800 mt per year since 2015, or about 90% of the MSY catch. Blue marlin stock status from the ensemble model indicates that the current median spawning biomass is above SSB_{MSY} and that the current median fishing mortality is below F_{MSY} . However, uncertainty in the stock status indicates a 19% chance of Pacific blue marlin being overfished relative to SSB_{MSY} . Both the old and new growth models show evidence of spawning biomass being above SSB_{MSY} and fishing mortality being below F_{MSY} during the last 5 years. Catch biomass has been declining for the last 5 years, and therefore the stock has a low risk of experiencing overfishing or being overfished unless fishing mortality increases to above F_{MSY} based upon stock projections (Table 3, Figure 5). However, it is also important to note that retrospective analyses show that the assessment model tends to overestimate biomass and underestimate fishing mortality in recent years, in part due to rapid changes in longline CPUE.

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

1. **There is no evidence of excess fishing mortality above F_{MSY} ($F_{2016-2019}$ is 40% of F_{MSY}) or substantial depletion of spawning potential (SSB_{2019} is 17% above SSB_{MSY});**
2. **It is important to note that retrospective analyses show that the assessment model appears to overestimate spawning stock biomass in recent years; and**
3. **The results show that projected female spawning biomass is expected to increase under the $F_{status\ quo}$ and $F_{30\%}$ harvest scenarios and decline to SSB_{MSY} under the High F and F_{MSY} harvest scenarios. The probability that the stock is overfished or overfishing occurring by 2029 under each harvest scenario is low.**

Special Comments

1. **Uncertainty regarding the choice of BUM growth curve led to the ensemble model approach for this assessment.** The BILLWG recognized that there is considerable uncertainty in input CPUE data in the recent years and life history parameters, especially growth. The BILLWG considered an extensive suite of model formulations and associated diagnostics for developing the assessment models. Overall, the BILLWG found issues with both the new growth and old growth model diagnostics and sensitivity runs that are consistent with the presence of data conflicts, but none of the model diagnostics show that the results of either model were invalid. It is recommended model development work to reduce data conflicts and modeling uncertainties continue and that input assessment data be reevaluated to improve the time series.
2. **It is recommended that biological sampling to improve life history parameter estimates continue to be collected and ISC countries participate in the BILLWG International Biological Sampling program to improve those estimates.**

Table 1. Reported catch (tonnes, mt) used in the stock assessment along with annual model-averaged estimates of female spawning biomass (tonnes, mt), relative female spawning biomass (SSB/SSB_{MSY}), recruitment (thousands of age-0 fish), fishing mortality (average F, ages 1 – 10), relative fishing mortality (F/F_{MSY}), and spawning potential ratio (SPR) of Pacific blue marlin..

Year	2013	2014	2015	2016	2017	2018	2019	Mean ¹	Min ¹	Max ¹
Reported Catch	22,166	23,741	21,861	22,644	14,443	18,589	16,503	18,873	10,882	26,138
Spawning Biomass	27,707	26,321	25,476	23,693	22,942	23,222	24,279	35,007	17,601	69,331
Relative Spawning Biomass	1.33	1.26	1.22	1.15	1.11	1.12	1.18	1.70	0.84	3.51
Recruitment (thousands of age 0 fish)	960	785	608	862	870	1,399	876	895	502	1,399
Fishing Mortality	0.18	0.19	0.19	0.21	0.13	0.16	0.11	0.16	0.08	0.25
Relative Fishing Mortality	0.81	0.85	0.83	0.95	0.58	0.71	0.50	0.71	0.35	1.11
Spawning Potential Ratio	0.26	0.24	0.25	0.22	0.33	0.27	0.34	0.33	0.17	0.60

¹During 1971-2019

Table 2. 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 Pacific blue marlin, derived from the assessment ensemble model, where “MSY” indicates reference points based on maximum sustainable yield..

Reference Point	Estimate
F_{MSY} (age 1-10)	0.23
F_{2019} (age 1-10)	0.11
$F_{20\%SSB0}$	0.18
SSB_{MSY}	20,677 mt
SSB_{2019}	24,241 mt
$SSB_{20\%SSB0}$	20,729 mt
MSY	24,600 mt
$C_{2017-2019}$	16,512 mt
SPR_{MSY}	17%
SPR_{2019}	34%
$SPR_{20\%SSB0}$	23%

Table 3. Projected median values of Pacific blue marlin spawning stock biomass (SSB, mt) and catch (mt) under four constant fishing mortality rate (F) scenarios during 2020-2029..

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
<u>Scenario 1: F = F₂₀₀₃₋₂₀₀₅</u>										
SSB	25,459	23,462	21,752	20,498	19,262	18,689	18,252	17,835	17,583	17,475
Catch	33,111	30,527	28,638	27,331	26,431	25,806	25,363	25,044	24,811	24,641
<u>Scenario 2: F = F_{MSY}</u>										
SSB	25,318	23,351	21,583	20,255	19,216	18,405	18,186	17,809	17,513	17,466
Catch	32,875	30,436	28,662	27,439	26,606	26,037	25,645	25,370	25,177	25,039
<u>Scenario 3: F = F₂₀₁₆₋₂₀₁₈</u>										
SSB	26,930	28,182	28,764	28,675	28,428	28,731	28,052	28,142	27,861	28,081
Catch	23,321	23,546	23,591	23,561	23,513	23,472	23,443	23,422	23,407	23,397
<u>Scenario 4: F = F_{30%}</u>										
SSB	27,757	30,064	30,624	30,976	31,072	31,624	31,415	31,800	31,753	32,132
Catch	20,828	21,404	21,764	22,001	22,167	22,294	22,393	22,471	22,532	22,580

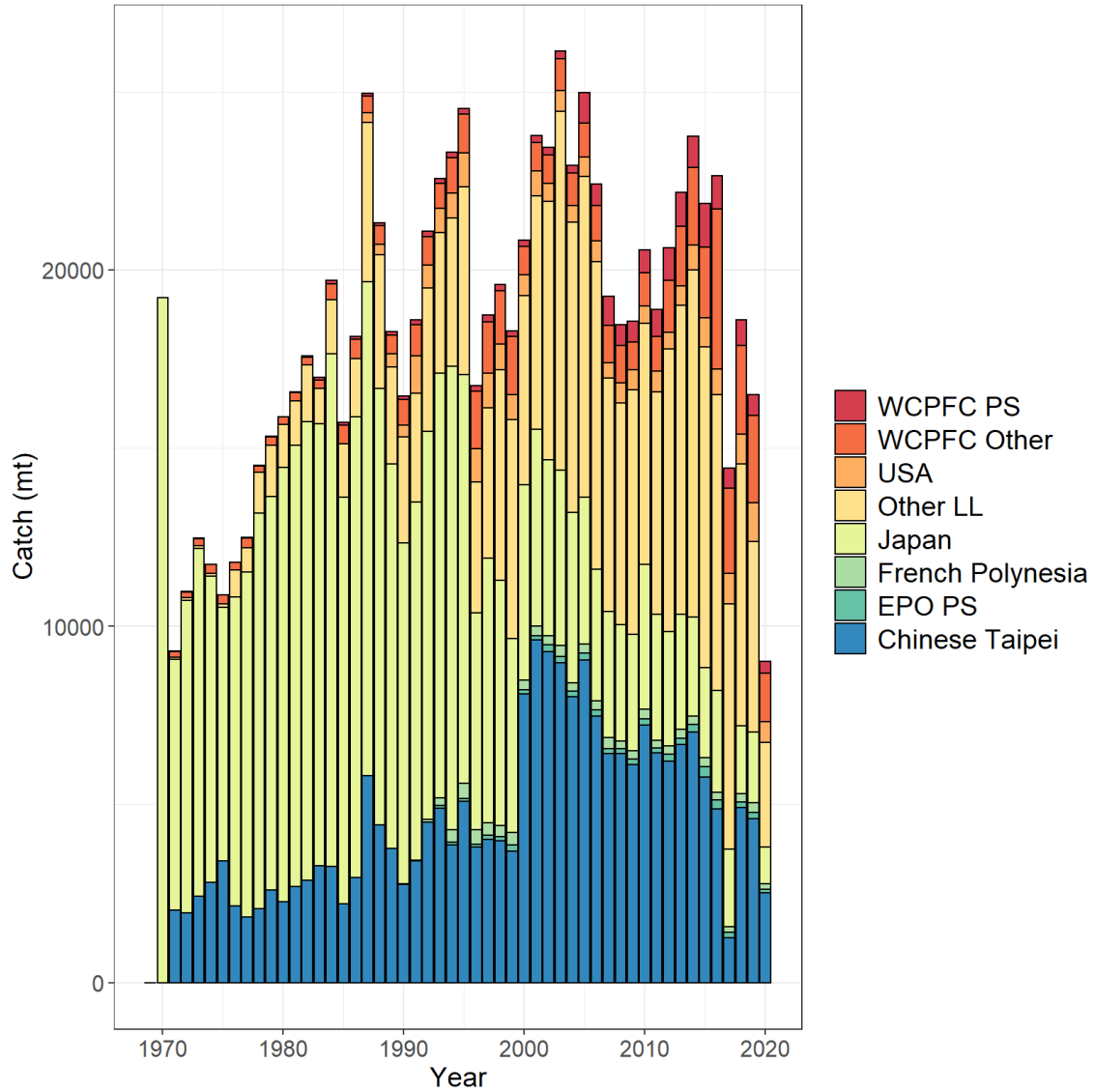


Figure 1. Annual catch biomass (tonnes, mt) of Pacific blue marlin (*Makaira nigricans*) by country for Japan, Chinese Taipei, the U.S.A., and all other countries during 1975-2019.

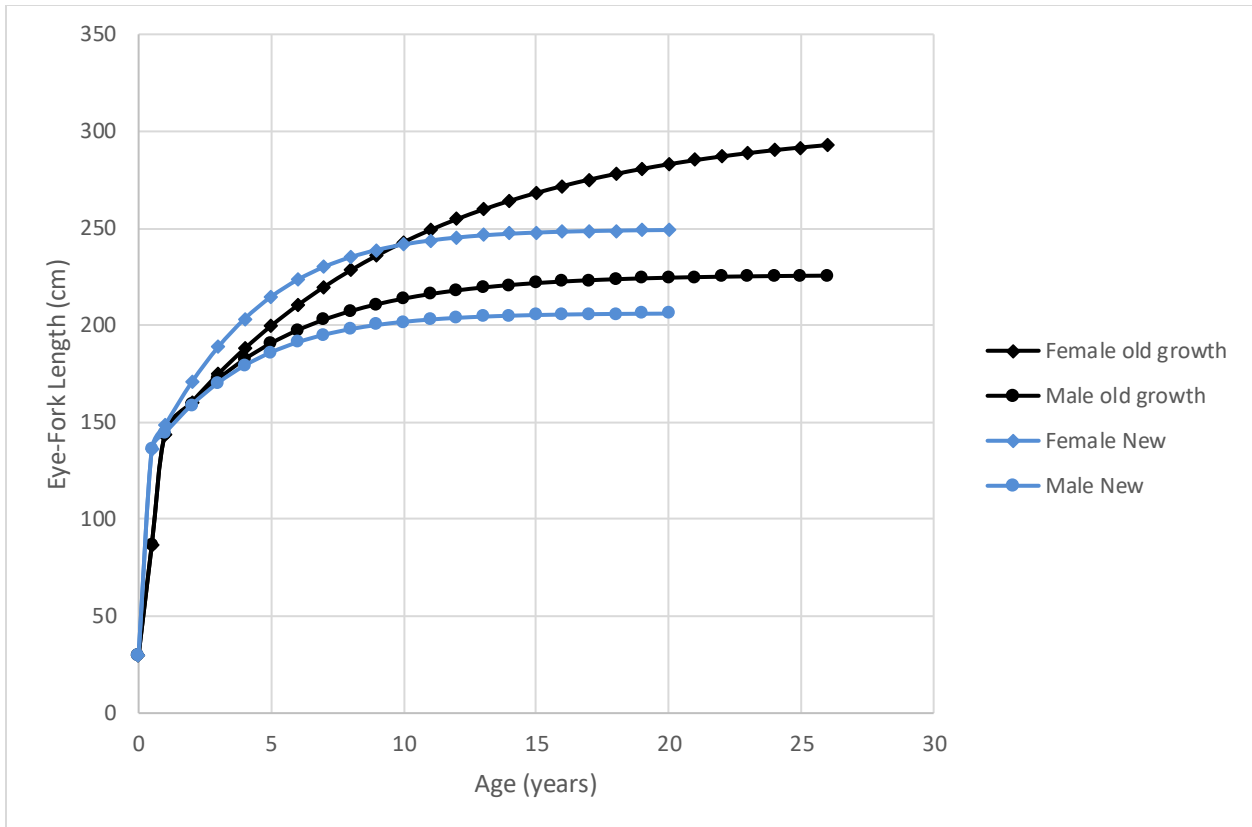


Figure 2. Length-at-age for Pacific blue marlin from the old growth model (von-Bertalanffy curve, black lines) and the new growth model (Richards curve, blue lines) by sex (females diamonds, males circles) used in the 2021 assessment..

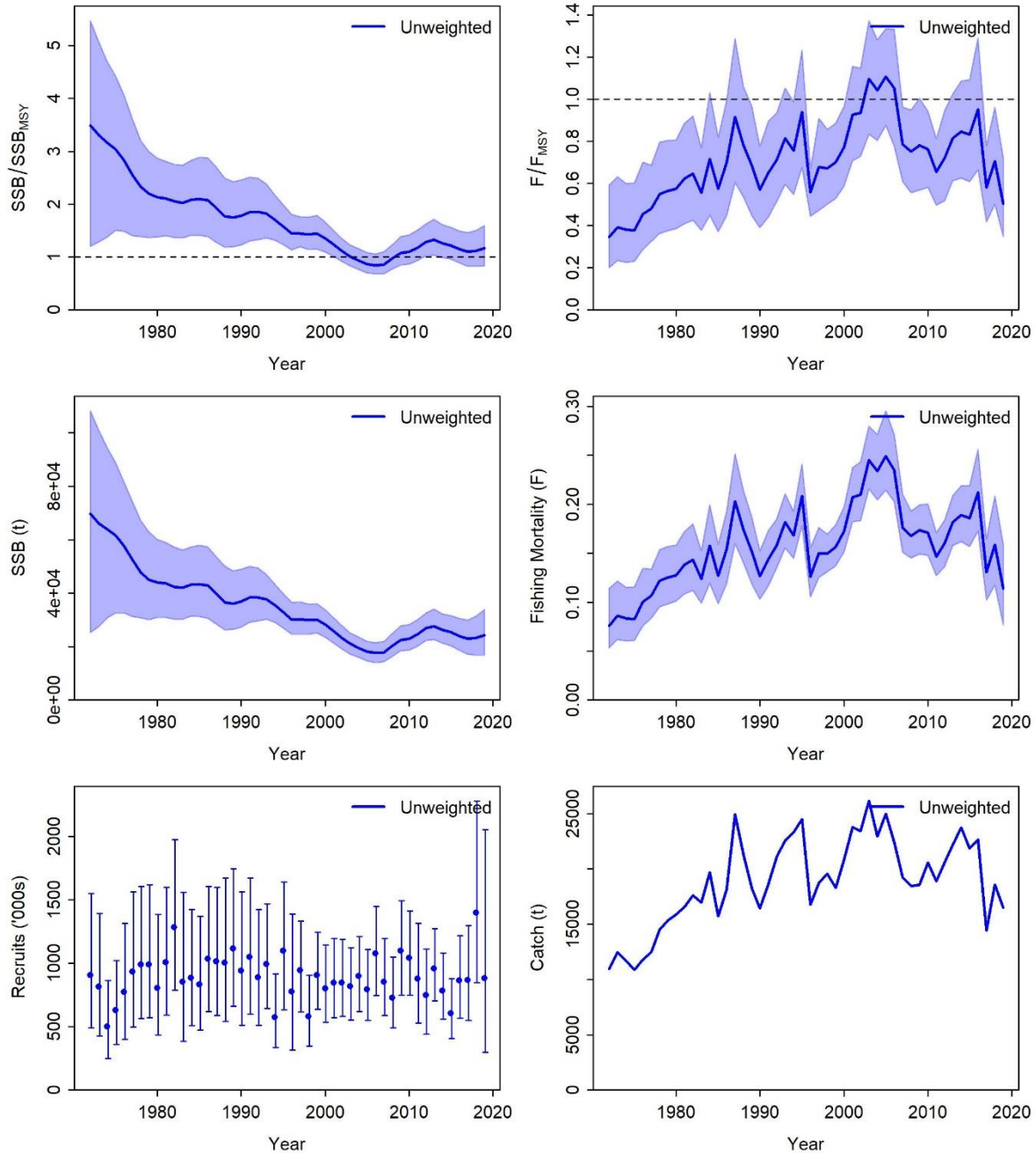


Figure 3. Time series of estimates of female spawning stock biomass over female spawning stock biomass at MSY (top left), fishing mortality over fishing mortality at MSY (top right), spawning stock biomass (center left), instantaneous fishing mortality (ages 1-10 year⁻¹, center right), recruitment (age-0 fish, bottom left), and catch (bottom right) for Pacific blue marlin (*Makaira nigricans*) derived from the 2021 stock assessment model ensemble. Lines (or points for recruitment) indicate the median value estimated from the joint multivariate delta-lognormal estimation, shaded areas (or error bars for recruitment) indicate the 95% confidence intervals. Unweighted indicates that both models have equal weights in the ensemble.

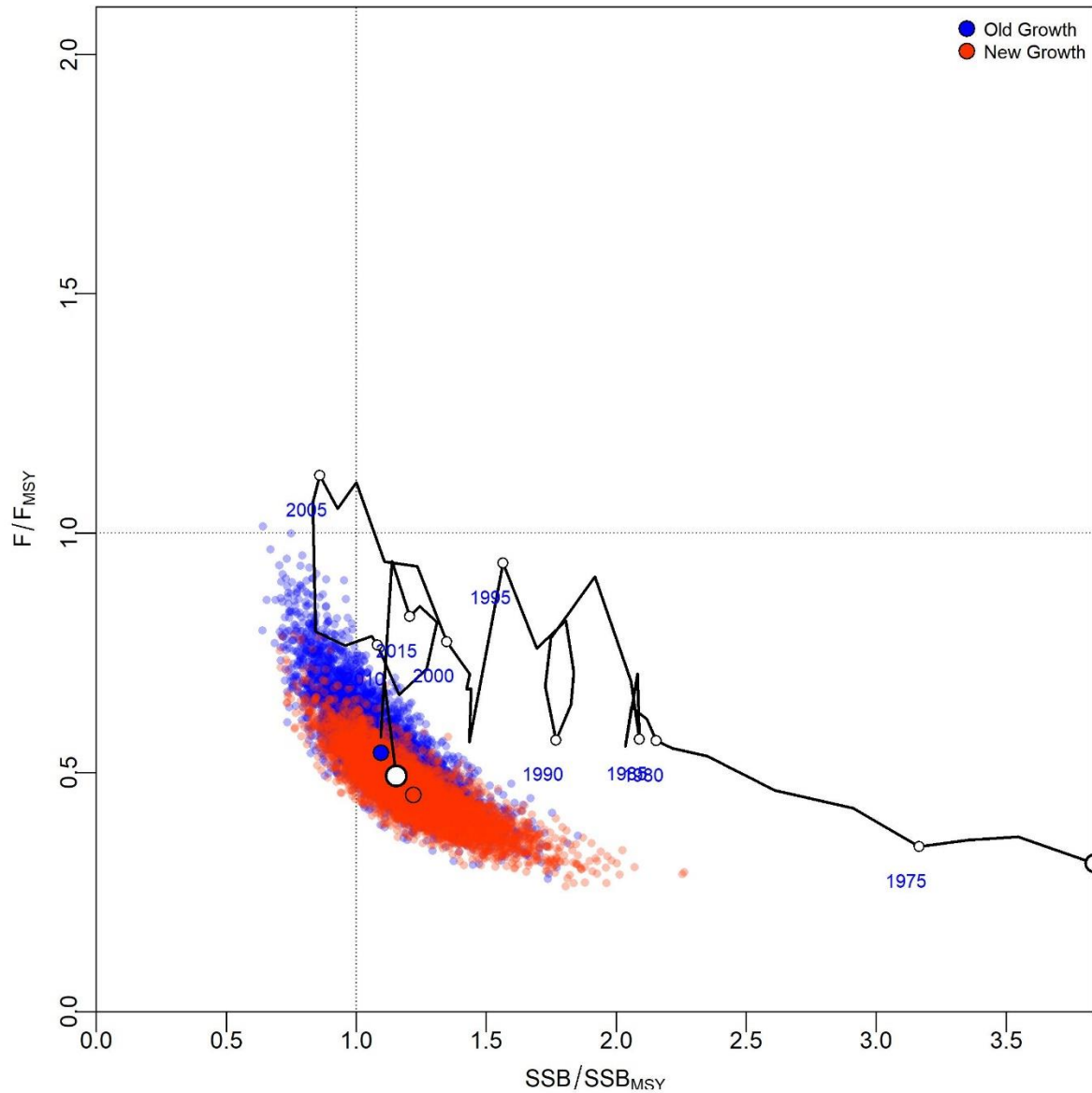


Figure 4. Kobe plot of the time series of estimates of relative fishing mortality (average of age 1-10) and relative spawning stock biomass of Pacific blue marlin (*Makaira nigricans*) during 1971-2019. The white circle denotes the delta-lognormal multivariate estimate of the ensemble model in 2019, blue dots indicate the final year stock status of the old growth model with the 10,000 multivariate draws, and red dots indicate the final year stock status of the new growth model with the 10,000 multivariate draws.

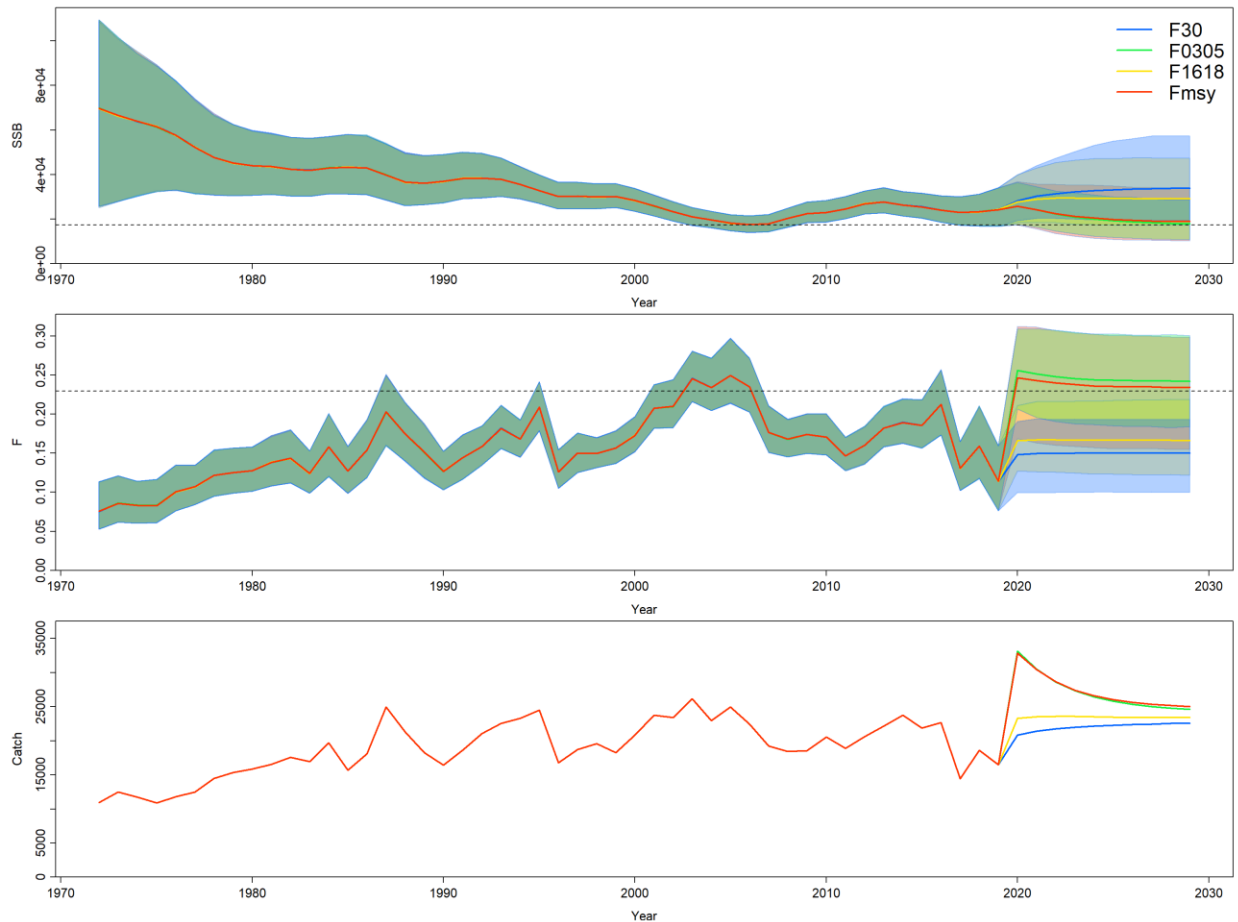


Figure 5. Historical and projected trajectories of spawning biomass and total catch from the Pacific blue marlin ensemble models based upon the four F scenarios: projected spawning biomass, dotted line indicates SSB_{MSY} , shading indicates 95% confidence intervals (top); projected instantaneous fishing mortality (ages 1-10 year⁻¹), dotted line indicates F_{MSY} , shading indicates 95% confidence intervals (center); and projected catch (tonnes, mt; bottom). Green indicates scenario 1, $F_{2003-2005}$; red indicates scenario 2, F_{MSY} ; yellow indicates scenario 3, $F_{2016-2018}$; and blue indicates scenario 4, $F_{30\%}$. The list of projection scenarios can be found in Table 3.

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

H. Ijima, the BILLWG Chair, noted that the WCNPO SWO stock was last assessed in 2018 and that the next assessment is planned for 2023.

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC20 (see Section 3.3.3, pp. 37-39 in the [ISC20 Plenary Report](#)) unchanged, except for the omission of accompanying figures and tables and slight clarifying modifications.

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 SSB 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 $F = 0.08 \text{ yr}^{-1}$ 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 fish during 2012-2016, and no long-term trend in recruitment was apparent. Overall, the time series of spawning stock biomass and recruitment estimates show a stable 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 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 SSB 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 two-thirds 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 biomass 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.**

3.3.5 Eastern Pacific Swordfish Stock Status and Conservation Information

H. Ijima, the BILLWG Chair, noted that the EPO SWO stock was last assessed in 2018 and that the IATTC is planning an assessment based on new boundaries in 2022.

Discussion

The Plenary discussed the proposed change in stock boundaries for swordfish at length. It was noted that IATTC is planning to conduct an assessment for the EPO stock south of 10°N latitude and east of 150°W longitude. The BILLWG has proposed conducting a WCNPO SWO assessment including the EPO area southeast of the current stock boundary to the Americas as a separate area. The BILLWG Chair explained that the proposed change to the stock boundaries is based on new movement information from tagging studies (Sepulveda et al. 2020⁴; BILLWG discussion summarized in **ISC/21/ANNEX/08**). It was also noted that there may be some stock mixing between WCNPO and EPO SWO in the roughly triangular area defined by the current stock boundary, 10°N latitude, and the coast of the Americas.

It was also noted that SPC-OFP is planning an assessment of the SWO stock in the South Pacific west of 150°W longitude for the WCPFC. The BILLWG noted that a more detailed analysis would need to be undertaken to incorporate fully the newest data on swordfish stock boundaries in order to produce a scientifically supported new stock boundary. The Plenary recommended that the BILLWG, IATTC scientific staff, and SPC-OFP staff closely coordinate on defining stock boundaries in preparation for assessments to ensure a consistent approach and scientifically defensible boundaries.

The Plenary noted that the current stock status and conservation advice for EPO SWO, carried forward from ISC20 is based on the pre-existing stock boundary and is inconsistent with stock boundaries proposed for future assessments in the north and south EPO.

Stock Status and Conservation Information

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC20 (see Section 3.3.4, pp. 39-40 in the [ISC20 Plenary Report](#)) unchanged, except for the omission of accompanying figures and tables.

⁴ Sepulveda, C.A., Wang, .M, Aalbers, S.A., and Alvarado-Bremer, J.R., 2020. Insights into the horizontal movements, migration patterns, and stock affiliation of California swordfish. *Fisheries Oceanography* 29:152-168.

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.

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 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.**

3.3.6 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 ISC20 (see Section 3.3.2, pp. 33-37 in the [ISC20 Plenary Report](#)) unchanged, except for the omission of accompanying figures and tables and slight clarifying modifications. Furthermore, the Plenary agreed to an addition to the conservation information adopted by ISC20 in light of questions and clarifications regarding the rebuilding plan (see Section 3.3.1 of this report) initiated by the WCPFC. 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. Estimated fishing mortality averaged $F=0.97 \text{ yr}^{-1}$ during the 1975-1994 period with a range of 0.60 to 1.59 yr^{-1} , peaked at $F=1.71 \text{ yr}^{-1}$ in 2001, and declined sharply to $F=0.64 \text{ yr}^{-1}$ in the most recent years (2015-2017). Fishing mortality has fluctuated around F_{MSY} since 2013. 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} .

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.**

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. 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, both long-term and short-term recruitment scenarios were evaluated. The ISC 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%SSB₀=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.**
3. **The Interim Rebuilding Plan for North Pacific Striped Marlin (Attachment L, WCPFC16 Summary Report) was adopted by WCPFC16 in 2019. The ISC responded to several technical questions during ISC21 and based on these responses (see Section 3.3.1 and ISC/21/ANNEX/08) recommends that the next WCNPO MLS stock assessment be completed in 2022 followed by updating of the rebuilding plan using the latest scientific information. Further, the ISC seeks clarification prior to the assessment on whether or not the rebuilding target, 20%SSB_{F=0}, is based on dynamic biomass. If the rebuilding target is based on dynamic biomass, then a target rebuilding date will be needed for the projections to support the rebuilding plan.**

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.

3.4 Sharks

3.4.1 SHARKWG Report and Review of Assignments

M. Kai, SHARKWG Chair, provided a summary of SHARKWG activities over the past year (**ISC/21/ANNEX/04**). The focus of the SHARKWG was mainly on SMA with the goal of completing an indicator-based analysis by the ISC21 Plenary. This indicator-based analysis was requested in response to the ISC20 Plenary approving a change in the schedule for benchmark stock assessments of BSH and SMA from 3 to 5 years. The SHARKWG met virtually 22-26 February 2021, to conduct the SMA indicator-based analysis in addition to the discussing administrative matters and planning future SHARKWG activities. The SHARKWG also held an online meeting before the full meeting (17 September 2020) to (1) discuss which indicators should be used for SMA and (2) to discuss how an indicator approach should be presented. The WG decided to use annual catch and standardized CPUE up to 2019 as key indicators, supplemented by size-frequency data. The purpose of the analysis was to detect major changes in abundance and fishing pressure as triggers for a new assessment rather than updating stock status and conservation information based on the results.

The WG Chair briefly presented highlights of the WG meetings to the Plenary; **ISC/21/ANNEX/04** contains the report of the 22-26 February 2021 SHARKWG meeting and the 17 September 2020 intersessional meeting. The WG Chair expressed appreciation to all participants in the SHARKWG meeting for their hard work at the meetings and during the intersessional webinar, on the SMA indicator-based analysis (**ISC/21/ANNEX/05**).

In conclusion, there were no obvious signs of major shifts in the tracked indicators that would necessitate a revision to the current stock assessment schedule for SMA. The SHARKWG therefore plans to conduct the next benchmark stock assessment for SMA in 2024, as scheduled.

The WG proposed the following tentative meeting schedule to accomplish its future work.

Potential Timing	Location	Purpose
Oct.-Dec. 2021	Japan or Chinese Taipei (depending on COVID-19 situation)	BSH data preparatory for stock assessment
Dec. 2021-Feb 2022	online	BSH pre-stock assessment meeting
Mar,-May 2022	TBD	BSH stock assessment meeting

Discussion

The SHARKWG described two issues in the previous BSH stock assessment that will be addressed in the upcoming assessment scheduled for 2022. First, species-specific catch data are unavailable for most of the Japanese fleet prior to 1994 and catch data from the Japan high seas driftnet fishery are particularly uncertain. Second, the stock-recruit relationship was poorly specified in the previous assessment. The low fecundity of BSH has made it difficult to specify

the appropriate relationship. The WG will update the growth curve, age-at-maturity, and the age-specific mortality schedule to improve the estimate of the stock-recruit relationship.

The Plenary approved the SHARKWG workplan for 2021-22.

3.4.2 Shortfin Mako Shark Indicator Analysis

M. Kai, SHARKWG Chair, presented the results of the indicator-based analysis of SMA in the NPO conducted in 2021 (**ISC/21/ANNEX/05**). A benchmark stock assessment was completed in 2018 with the next full benchmark scheduled for 2024. In the interim, an indicator-based analysis was conducted to monitor key indicators for signs of potential changes in the stock abundance or fisheries dynamics that could warrant a shift in the schedule for the next benchmark assessment. For the present analysis, annual trends in all available catch data (F1-F19) from 1957 to 2019 and seven abundance indices (S1-S7) from 1992-2019 were visually inspected. Length frequency data were also used alongside the catch and the abundance indices as supplemental information for the indicator-based analysis.

Catch was estimated for multiple fleets and nations based on the best available information. Catch estimates for each fishery were made based on fishing effort, knowledge of the species composition of the catch, estimated CPUE, and scientific knowledge of the operations and catch history. Species-specific SMA catch was available for all major fisheries since 1993; however, catch for the early period, from 1957 up to 1993, is highly uncertain. The highest catches came from Taiwan (F7-9), Japan (F10-14), and Mexico (F15-16) (Figure 6). After 2016, the last year of data in the 2018 benchmark stock assessment, the catch amount in 2019 reached its second highest value during the last decade. Recent increases in annual catches from 2017 to 2019 may be a sign of an increase in population size; however, this increase also could be explained by an increase in fishing pressure. The uncertainty surrounding this uptick in recent catch makes current catch data alone insufficient for describing the stock status of SMA in the NPO.

The four major abundance indices (S1: US Hawaii longline shallow-set; S3: Taiwan longline large-scale; S5: Japan research and training vessels; and S7: Mexico observer for longline) used in the base case benchmark stock assessment in 2018 were also used in this analysis as key indicators to determine whether the next benchmark stock assessment, scheduled for 2024, should be expedited. The scaled CPUEs showed a stable and slightly increasing trend in the four major fleets (Figure 7). A five-year moving average of CPUE, an approach used to reduce the effect of large fluctuations in CPUEs from year to year, was also used to examine trends in the abundance indices. The moving average of CPUE (Figure 8) reflected the trends of annual CPUEs with more smoothing (Figure 7). The moving average of CPUE for three surveys (S1, S3, and S5) showed an increasing trend throughout the period for which data were available. In contrast, the moving average of the S7 CPUE index showed a slight decrease up until 2018, followed by a large increase in 2019.

Percent changes in the moving average of annual CPUE over the long-term (the whole period for which CPUE data was available) and over the short term (the most recent 5 years) were used to evaluate historical and recent changes in the indices of relative abundance for the four major fleets. The percent change in the moving average of CPUE in the long-term series for four major fleets indicated positive values while the percent change in the short-term series indicated

slightly negative values for S3 and S7 (Table 4). These results showed that the indices of relative abundance of SMA in the NPO exhibited no signals of population decline since the 1990s.

In conclusion, based on updated data for the abundance indices and length frequencies used in the base case benchmark assessment of SMA in 2018, no signs of shifts in stock abundance or fishery dynamics were apparent. As such, the SHARKWG concluded that there was no reason to shift the schedule for the next benchmark stock assessment of SMA, currently scheduled for 2024.

As a research need, threshold values of key indicators (i.e., indices of relative abundance) should be explored to help in determining when shifts may be needed in the benchmark stock assessments schedule.

Discussion

The Plenary discussed the conditions under which indicator analyses like the just completed SMA analysis, should be carried out. This discussion included workload considerations relative to the usefulness of the information derived for determining a need to expedite a benchmark assessment for a stock. The history of the use of indicator analyses by the ISC was reviewed. Generally, the rationale for conducting these analyses relates to the shift from a three-year to a five-year assessment cycle for selected stocks. The shift in the assessment cycle for these stocks is premised on information indicating the stocks are healthy and trends in status are stable.

The Plenary agreed that a specified set of rules and procedures should be adopted to decide the timing and frequency of these indicator analyses. One option discussed is to develop a set of criteria to determine whether the results of the most recent benchmark stock assessment indicate the need to conduct an interim indicator analysis. Another option is to simply default to conducting an indicator analysis at the midpoint of a five-year assessment cycle. This latter option would be premised on a methodology that does not demand substantial work that would impinge on other workload priorities.

The Plenary tasked the WG to develop recommendations on a decision framework and process for conducting indicator analyses.

Table 4. Percent change of moving average of CPUE for four major fleets (S1, S3, S5 and S7) used in the benchmark stock assessment in 2018. Moving averages were calculated using the mean value of CPUE for five years. The percentage indicates the positive and negative change in the moving average of CPUE between the start and end years from long term (all years with data) and short term (the most recent 5 years). The last year of S5 was removed from the calculation due to data from 2020 being preliminary. S1_US_SS (US Hawaii longline shallow-set), S3_TW_LALL (Taiwan longline large-scale), S5_JP_RTV (Japan research and training vessels), and S7_MX_OBS (Mexico observer for longline)..

Period	S1	S3	S5	S7
Long term (all years with data)	16%	39%	93%	10%
Short term (the most recent 5 years)	23%	-13%	47%	-5%

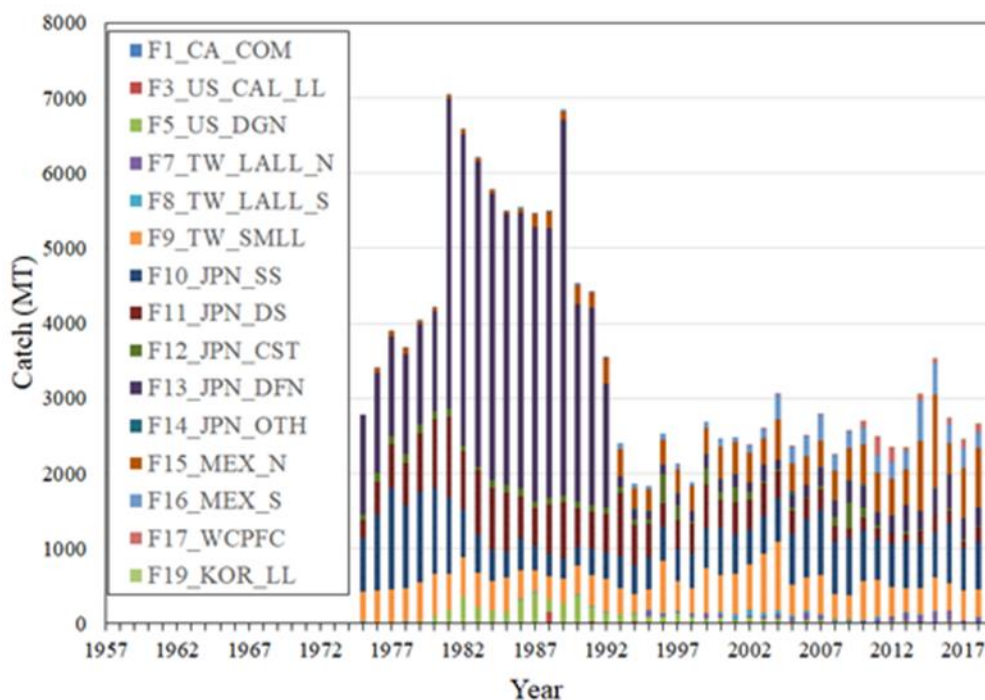


Figure 6. Annual catch (tonnes, MT) of shortfin mako in the North Pacific Ocean by fishery (fleet) from 1954 to 2019. Catch of some fleets are removed from this figure due to different units of catch.

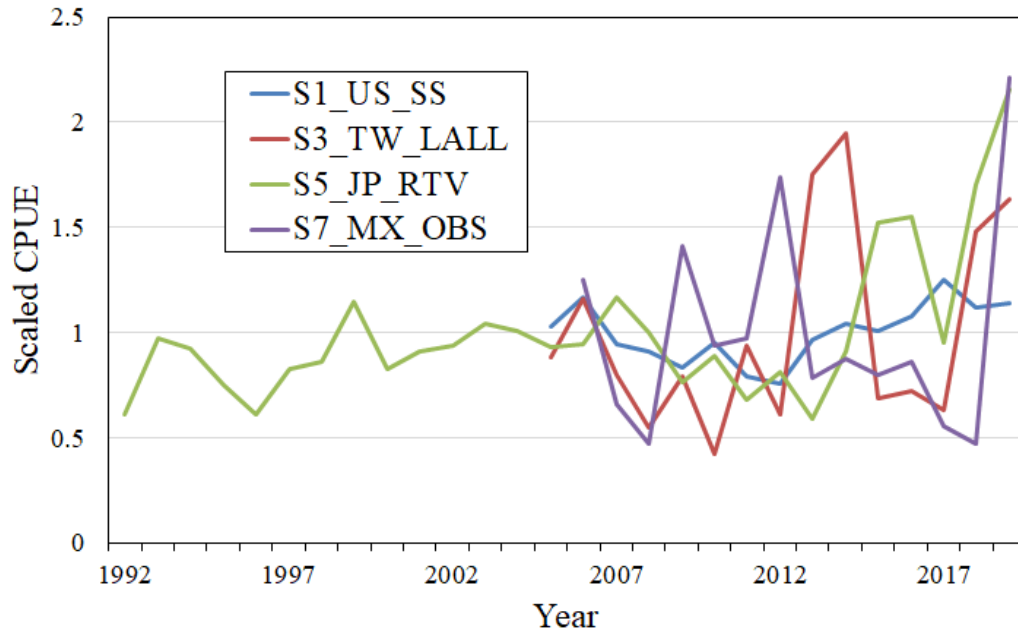


Figure 7. Annual indices of relative abundance of shortfin mako in the North Pacific Ocean from 1992 to 2019 (CPUE of each year relative to average CPUE) for four major fleets (S1, S3, S5 and S7) used in the previous benchmark stock assessment in 2018. S1_US_SS (US Hawaii longline shallow-set), S3_TW_LALL (Taiwan longline large-scale), S5_JP_RTV (Japan research and training vessels), and S7_MX_OBS (Mexico observer for longline).

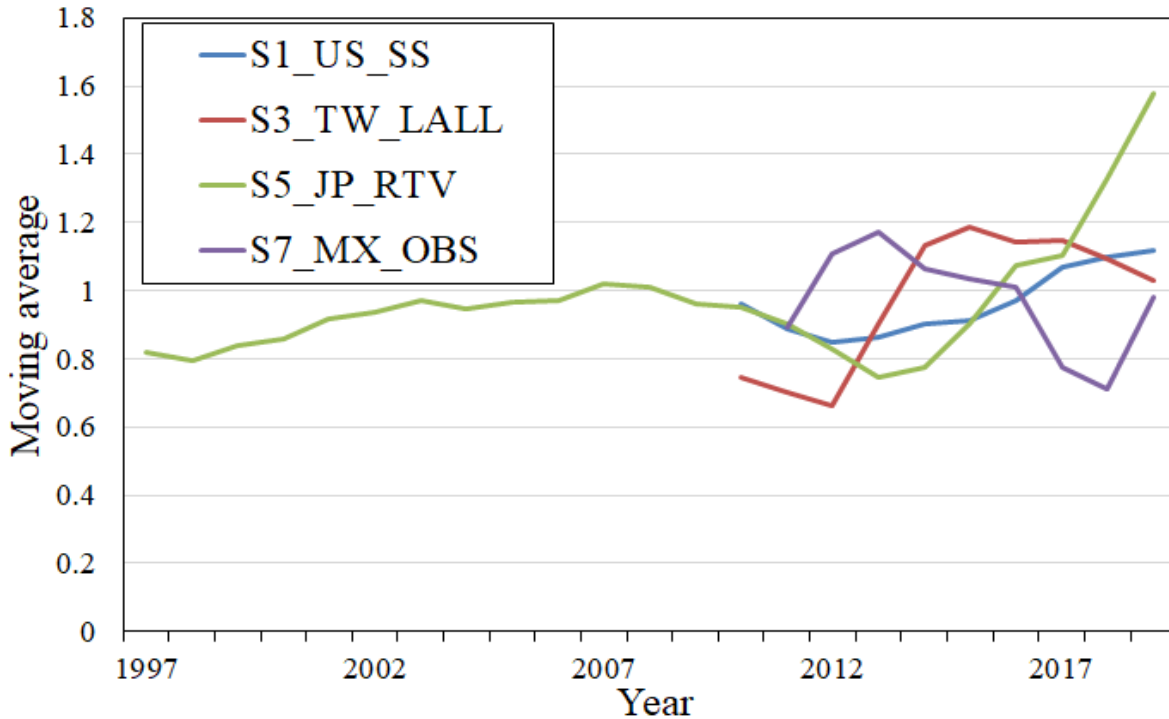


Figure 8. Annual 5-year moving average of CPUE for major fleets (S1, S3, S5 and S7) used in the previous benchmark stock assessment in 2018. S1_US_SS (US Hawaii longline shallow-set), S3_TW_LALL (Taiwan longline large-scale), S5_JP_RTV (Japan research and training vessels), and S7_MX_OBS (Mexico observer for longline).

3.4.3 Blue Shark Stock Status and Conservation Information

M. Kai, SHARKWG Chair, noted that an update stock assessment was completed in 2019 and that the next benchmark stock assessment is scheduled for completion in 2022.

Stock Status and Conservation Information

The Plenary reviewed and agreed to forward the stock status and conservation information adopted at ISC20 (see Section 3.4.2, pp. 42-47 in the [ISC20 Plenary Report](#)) unchanged, except for the omission of accompanying figures and tables.

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 ($F_{2012-2014}$) 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.

3.4.4 Shortfin Mako Shark Stock Status and Conservation Information

M. Kai, SHARKWG Chair, noted that SMA was last assessed in 2018 and an indicator analysis was completed in 2021.

Stock Status and Conservation Information

Based on the conclusions of the SMA indicatory analysis, the Plenary agreed to forward the stock status and conservation information adopted at ISC20 (see Section 3.4.3, pp. 47-48 in the [ISC20 Plenary Report](#)) unchanged, except for the omission of accompanying figures and tables.

Stock Status

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.

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. **In scenarios where fishing mortality remains constant at $F_{2013-15}$ or is decreased by 20%, then spawner abundance (SA – the number of mature female sharks) is expected to increase gradually;**
2. **If fishing mortality is increased by 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.

3.5 Observer Comments

Several observers participated in the ISC21 Plenary Sessions and were provided with an opportunity to address the Plenary during each session. Their comments and observations over four sessions are summarized below in the same order as the agenda. These comments have been edited so that they conform to the style of this report, but their content has not been changed.

Pew welcomed the completion of the MSE of NPALB as robust and offering a wide array of harvest strategies for consideration and adoption. Pew asked whether the video presentations being prepared for the WCPFC-SC and WCPFC-NC would be made publicly available to help stakeholders learn more about the MSE.

Pew urged the ISC to move forward with a MSE of PBF. If the ISC is uncertain how to proceed or lacks information to proceed, then Pew urged the ISC to send a clear request for guidance to the IATTC-NC Joint Working Group on PBF Management this year. Pew pointed out that the WCPFC-NC and IATTC have requested that the ISC complete the MSE by 2024 – a request reiterated in 2020 by the WCPFC-NC Chair. The WCPFC harvest strategy for PBF includes a list of management objectives. In 2019, a list of candidate reference points and harvest control rules for testing in the MSE was agreed by the joint working group, as well as a terms of reference to clarify the roles and responsibilities of the ISC and joint working group. Pew expressed concern that relying on the stock assessment and projections for future management is not sufficient as PBF requires a modernized, long-term approach to management. Pew reiterated that the need for the MSE is clear.

WWF Japan welcomed the ISC's decision to discuss at a Sixth Meeting of the IATTC-WCPFC NC Joint Working Group on the lack of input from managers on management objectives and alternative management procedures for PBF, which has contributed to a lack of progress on the

MSE process for this stock. In addition, WWF Japan stressed the importance of continue to improve the accuracy of data collection through actions such as increased observer coverage and electronic monitoring.

Wild Oceans expressed concern about the proposal to move the boundary of the WCNPO SWO stock, asked whether and how recent genetic research was considered, and suggested the ISC work to align the boundaries with the other scientific bodies before the next round of SWO stock assessments.

Wild Oceans sees the expedited MLS assessment as an opportunity for the BILLWG to consider important questions about the stock and rebuilding goals. More specifically, Wild Oceans asked the ISC to consider adjusting the stock assessment and rebuilding plan to account for uncertainty in MLS catch and discards. Recent catch may be significantly above what is reported and scientists should consider including the highest possible value of mortality that includes unreported catch and discards. Additionally, Wild Oceans highlighted the need for further research analyzing how well measures such as release of live marlin, use of circle hooks and other gear modifications can reduce catch and mortality and help achieve the rebuilding goal.

4 REVIEW OF STATISTICS AND DATABASE ISSUES

4.1 STATWG Report

F. Carvalho, the Chair of the STATWG, summarized the STATWG activities since ISC20 (ISC/21/ANNEX/14). The STATWG meeting was held virtually on July 6 and 7, 2021 with participants from Canada, Chinese Taipei, Japan, Korea, USA, and the WCPFC. Regarding the status of the STATWG, six of the ten items in the 2020-2021 work plan were completed. The “Data share space” designed for the WGs to share files during their work processes has been activated. The ISC website was updated with scheduled Working Group meetings, working papers, stock assessments, fishery statistics, and the ISC organization chart. The uncompleted workplan items include:

1. Development of error-checking protocols to be used to post-data submission by Data Correspondents to confirm the quality of the data in the database;
2. The STATWG will pursue harmonizing the ISC data submission formats with those used by the WCPFC and the IATTC;
3. The STATWG Steering Group will hold an intersessional meeting or conference call/webinar January 2022 to conduct work to complete this workplan; and
4. The STATWG Chair, Vice-Chair and other interested parties will continue to develop a Non-Disclosure Agreement (NDA) for data sharing requests. This NDA will incorporate comments from ISC20 and will be reviewed at the next STATWG meeting. A standard operating protocol will be developed to handle data sharing.

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 revised the catch in weight data “Category 1c” of SMA for 1994-2019 in **ISC21/STATWG/WP/01**. These annual catches estimates are based on annual CPUEs and the

proportion of the catches and in this case the proportion of catches attributed to SMA changed. 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 2021. It also 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.

The STAWG Chair discussed the draft NDA for confidential ISC stock assessment data and modeling files. The Chair noted that the draft NDA was a template for a contract between the two parties that outlines confidential data that the parties wish to share for a specified scientific purpose but that the ISC is restricting access. The Chair emphasized that the template would need to be modified for specific applications.

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 6 and 7th meeting, the STATWG developed a work plan with 9 items as reported in section 6.1 of **ISC/21/ANNEX/14**. The STATWG recommended the following workplan for 2021-22 to the ISC21 Plenary:

1. The DA will continue to distribute the ISC data inventory for Category I, II, and III to ISC Data Correspondents for review by September 30, 2021. The DA will then distribute the ISC data inventory to Chairs of the species WG by October 15, and publish on the ISC website by October 31, 2021.
2. The DA will continue to archive stock assessment files from all 2020-2021 ISC assessments, which are required to be submitted by Chairs of species WG by November 1, 2021.
3. After the Data Correspondents have reviewed and updated their metadata prior to the ISC21 Plenary, this metadata will be published on the ISC researcher's website by August 31, 2021. For 2021-2022, the DA will continue to distribute the WG member's new metadata by March 30, 2022. The Data Correspondents will review and update their new metadata by July 1, 2022 prior to the ISC22 Plenary, and this new metadata will be published on the ISC researcher's website by August 31, 2022.
4. The DA will revise and update the User's Guide for Online Data Submission with the rules for using the data share space on the ISC collaborative research project database and research website. This revised information will be distributed to the Data Correspondents and WG Chairs by December 31, 2021. The DA will conduct training as necessary.
5. The DA and the Chair of the STATWG will annually review the responsibilities, duties and deliverables of the DA to ensure that they are accurate and practical, and revise them as necessary.
6. The DA and Chair of the STATWG will develop error-checking protocols to be used to post-data submission by Data Correspondents to confirm the quality of the data in the

database. This protocol will be reviewed by the STATWG at ISC22.

7. The STATWG will pursue harmonizing the ISC data submission formats with those used by the WCPFC and the IATTC.
8. The STATWG Steering Group will hold an intersessional meeting or conference call/webinar January 2022 to conduct work to complete this work plan.
9. The STATWG Chair, Vice-Chair and other interested parties will continue to develop a NDA for data sharing requests. This NDA will incorporate comments from ISC21 and will be reviewed at the next STATWG meeting. A standard operating protocol will be developed to handle data sharing requests, which will include ISC point of contact information.

Discussion

The Plenary thanked Jon Brodziak for his service as interim Chair of the STATWG, Sung-II Lee for serving as Vice Chair, and Felipe Carvalho for assuming the role of Chair for the current term.

An interest in harmonizing the data submission formats with those used by WCPFC and IATTC was noted. The Plenary requested the STATWG report back at ISC22 on the use of Category II and III data, including the nature of data requests and usage by both ISC working groups and external parties. In the coming year, the STATWG Chair will formally assess data use.

With reference to the NDA for sharing stock assessment data files (discussed further under agenda item 6.2), currently in development, the Plenary confirmed that in the interim WG chairs who field requests for stock assessment data will consult with the ISC Chair on such decisions.

The Plenary endorsed the STATWG's proposed workplan and the data revision to SMA catches provided by Japan.

4.2 Total catch tables

K. Nishikawa, the Database Administrator, presented the annual catch tables for ISC Member countries for 2019-2020. The catch tables were prepared for the following ISC species of interest: albacore, Pacific Bluefin tuna, swordfish, striped marlin, blue marlin, blue shark, and shortfin mako shark. 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 five years. The complete catch tables are included in the ISC Plenary Report in Section 9 and serve as the official ISC catch tables.

5 REVIEW OF MEETING SCHEDULE

5.1 Time and Place of ISC22

The U.S.A. offered to host ISC22, 12-18 July 2022, as an in-person meeting in Kona, Hawaii. Associated WG meetings would be held beginning 8 July. The U.S.A. is exploring the possibility of accommodating a hybrid meeting format (where some Members could join remotely) to address any continuing travel restrictions on Members.

5.2 Time and Place of Working Group Intersessional Meetings

A draft schedule of proposed intersessional meetings was reviewed and amended. Proposed ISC WG and RFMO meetings are shown in the table below. Although some WG meetings are proposed to be in person, they may be switched to an online format due to continuing travel restrictions related to the COVID-19 pandemic. WG Chairs were asked to confirm with the ISC Chair the dates for their proposed meetings as soon as possible so the information can be posted on the ISC website.

ISC21 FINAL

	Month	ALBWG	BILLWG	PBFWG	SHARKWG	STATWG	PLENARY	WCPFC	IATTC
2021	July							JWG PBF July 26-28 (EPO) July 27-29 (WPO) Online	
	Aug							SC17 Aug 11-19 Online	98 th Meeting, Aug 23-27 Managua, Nicaragua
	Sept								
	Oct							NC17 5-7 Oct Japan	
	Nov			PBF Data Prep WKSHP Webinar/Dates TBD	BSH Data Prep WKSHP Webinar/Dates TBD				
	Dec			MLS Data Prep WKSHP Webinar/Date TBD					WCPFC18 Online

	Month	ALBWG	BILLWG	PBFWG	SHARKWG	STATWG	PLENARY	WCPFC	IATTC
2022	Jan					Steering Comm Location/Dates TBD			
	Feb			PBF Assessment WKSHP Location/Date TBD	BSH Pre- assessment WKSHP Webinar/Dates TBD				
	Mar	Assessment Improvements Meeting Date/Location TBD	MLS Stock Assessment WKSHP Location/Date TBD						
	Apr		MLS Rebuilding Plan WKSHP Location/Date TBD		BSH Assessment WKSHP La Jolla/Dates TBD				
	May								13 th SAC Meeting Dates TBD
	June								
	July						July 1.5 d in advance of Plenary	July 12-18 July 11 (HOD + Chairs)	

6 ADMINISTRATIVE MATTERS

6.1 ISC Stock Assessment Review Proposal

The U.S.A. presented information on their proposal for advancing additional peer reviews of ISC stock assessments.

In the 2013 review of ISC's function, additional independent reviews of stock assessments were recommended. In 2018 the review of ISC's assessment review process provided recommendations for an additional review process. The purpose of this would be to increase transparency and improve the science. It was noted that the USA supports rigorous peer reviews and values external perspectives to improve science. ISC stock assessments are conducted by groups of highly trained, quantitative scientists. An additional level of independent review would serve to validate methods and approaches the Working Groups have taken, and occasionally identify additional issues of importance.

At ISC19, the Plenary agreed that alternative ways to integrate peer reviews into the stock assessment process and that associated costs should be identified. Following that meeting, the USA worked with the ALBWG Chair and Vice-Chair and the ISC Chair to develop a terms of reference for the review of the ALB assessment prior to ISC20, but the challenges of timing and structuring the review quickly became apparent and a review could not be organized prior to ISC20, given the timing of the albacore assessment.

The U.S.A. proposal identified those challenges, and the pros/cons of two approaches that were considered in the process. It was noted that the current review of ISC assessments is similar to the review processes used by other organizations who assess HMS stocks. Two scenarios presented for review, which have different purposes and differing timing. Scenario 1 was to conduct an additional review after an assessment is complete and prior to Plenary and would provide information on the quality of the assessment before it is considered by management. Scenario 2 is to conduct an additional review after an assessment is complete and following ISC Plenary and would provide information on how to improve the assessment in the future.

Not all assessments would be reviewed. It was noted that ISC could selectively choose which assessments to have reviewed based on a variety of factors, including time lapses since the last review, potential for science to result in new or significant management changes, economic impact, controversy, potential for precedent, and new or innovative research.

The U.S. concluded the presentation by posing several questions to Plenary: Do the 'pros' of an additional review process outweigh the 'cons'? If yes, which scenario would ISC members prefer?

Discussion

The ISC Chair noted that the two scenarios described in the U.S. proposal have different objectives. Scenario 1 is intended to certify a stock assessment as the best available scientific information before consideration for management while Scenario 2 would identify improvements in the methodology that could be incorporated into a future stock assessment.

The Plenary discussed the two approaches but did not reach clear consensus on a preferred process, although the balance of the discussion favored the second scenario where peer review would occur after the Plenary meeting.

The Plenary clarified that the process for selecting a review panel would entail voting on candidates within the slates put forward by each Member funding a panel member rather than across all candidates. This approach is more feasible given the barriers to Member governments funding non-resident personnel.

The Plenary agreed that Members should continue to review the U.S. proposal and consider how to integrate stock assessment peer reviews into the ISC process. Members may further discuss a potential process administratively by email intersessionally. Over the next year the ISC Chair, in consultation with the U.S.A., will further develop the details of the Scenario 2 process, given stronger support for that approach in discussion. The Plenary will resume the discussion at ISC22 with the aim of agreeing on a preferred process.

6.2 Data Sharing Agreement

It was noted that the Plenary discussed this topic at ISC20 without reaching a resolution. A full draft of an NDA and related description of the process for determining access to stock assessment data was not available for review at ISC21 so a Plenary decision was deferred to ISC22. The Chair encouraged members to further consider the issue intersessionally so that substantial progress can be made at ISC22.

The STATWG Chair will investigate procedures used in other RFMOs along with further developing a draft NDA and report back at ISC22.

It was noted that an NDA is usually only required for access to confidential data. The presence of confidential data in stock assessment data files should be confirmed as part of further development of the NDA.

It was also noted that the ISC Operations Manual does not specify a process for sharing confidential stock assessment data and files. The ISC Chair indicated that he would be reviewing the Operations Manual and would bring forward a proposed process at ISC22.

6.3 Working Group Election results

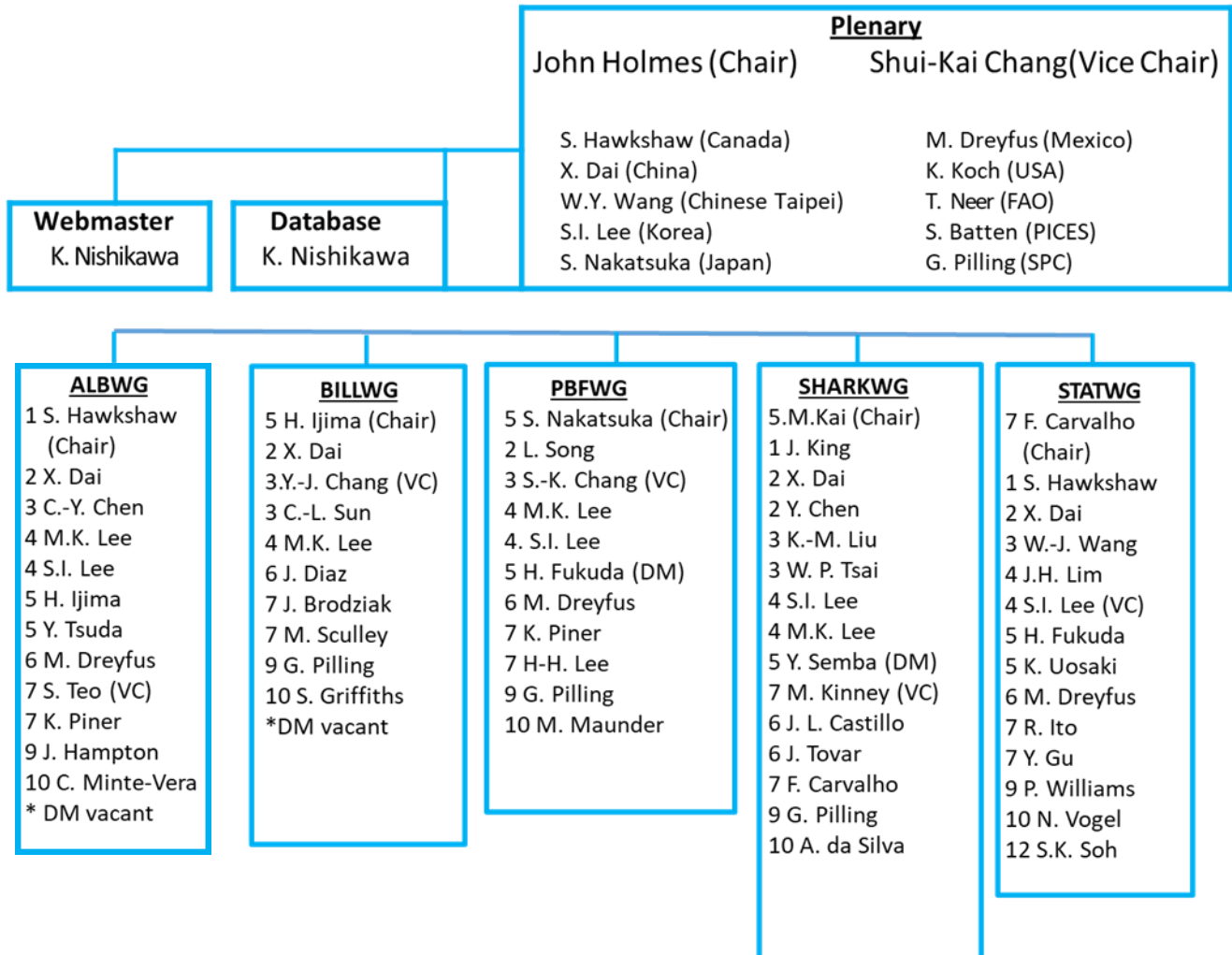
The Plenary reviewed the current WG chair and Vice Chair terms as shown below. It was noted that Sarah Hawkshaw was elected Chair of the ALBWG and Felipe Carvalho was elected STATWG Chair. Mikihiko Kai was elected to a second term as SHARKWG Chair and Michael Kinney to a second term as Vice Chair.

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 Chang	Jul-17	2017-2020	Jul-20	2020-2023
ALBWG Chair	Sarah Hawkshaw	May-21	2021-2024		
ALBWG Vice-Chair	Steve Teo	Jul-17	2017-2020	Apr-20	2020-2023
BILLWG Chair	Hirofuka 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	Jul-20	2021-2024
SHARKWG Vice-Chair	Michael Kinney	Apr-18	2018-2021	Jul-20	2021-2024
STATWG Chair	Felipe Carvalho	Jun-21	2021-2024		
STATWG Vice-Chair	Sung Il Lee	Jul-20	2020-2023		

6.4 ISC Organizational Chart

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

ISC Organizational Chart (July 2021)



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.

6.5 Other Matters

The ISC Chair thanked the WG Chairs and Vice-Chairs for their leadership and diligent work in advancing the goals of the ISC since ISC20. The quality of the work and science information and advice forwarded to the IATTC and WCPFC-NC by the ISC remains high. It is clear that the WGs have adapted to new methods of working virtually since none have requested sessions in advance of ISC22.

The ISC Chair also noted that he will be focusing on initiatives to move the ISC forward as an organization in 2021-22, including a review of the ISC Operations Manual to improve transparency and accountability, further development of the non-disclosure agreement for confidential stock assessment data and files, and developing more detailed proposals for the external review of ISC stock assessments. All of these proposals will be brought to ISC22 where they will be the subject of vigorous debate.

7 ADOPTION OF REPORT

The Report of the Meeting was adopted.

8 CLOSE OF MEETING

The meeting was closed at 8:30 PM PDT 19 July 2021.

Table 5. Continued.

Catch disposition	Year	TWN					TWN Total	U S A								USA Total	Total	
		Set-net	Gill-net (not specified)	Longline	Others	Purse seine		Drift gill-net	Handline	Longline	Pole and line	Troll	Others	Purse seine	Sport			
Retain	1936													442		442	442	
	1937													1,681		1,681	1,681	
	1938													8,594		8,594	8,594	
	1939													8,586		8,586	8,715	
	1940													6,603		6,603	6,605	
	1941													5,412		5,412	5,447	
	1942													10,678		10,678	10,678	
	1943													17,071		17,071	17,084	
	1944													23,957		23,957	24,167	
	1945													17,886		17,886	18,534	
	1946													10,955		10,955	11,151	
	1947													12,235		12,235	12,271	
	1948								45					22,457		22,502	23,486	
	1949								33					24,901		24,934	26,946	
	1950								27					32,746		32,773	33,734	
	1951								24					15,629		15,663	15,739	
	1952								46					23,843		25,262	94,253	
	1953								23					15,740		15,934	76,895	
	1954								13					12,246		12,406	61,500	
	1955								9					13,264		13,850	54,535	
	1956								6					18,751		19,239	76,640	
	1957								4					21,165		21,473	92,353	
	1958								7					14,855		14,910	55,704	
	1959								5					20,990		20,995	51,172	
	1960								4					20,100		20,661	63,359	
	1961								5	2,837				12,055	1	1,355	16,253	
	1962								7	1,085				19,752	1	1,681	22,626	
	1963								7	2,432				25,140		1,161	28,740	
	1964								4	3,411				18,388		824	22,627	
	1965								3	417				16,542	1	731	17,694	
	1966								8	1,600				15,333		588	17,529	
	1967	-	-	330	189	519			12	4,113				17,814		707	22,646	
	1968	-	-	216	283	499			11	4,906				20,434		951	26,302	
	1969	-	-	65	423	488			14	2,996				18,827		368	22,195	
	1970	-	-	34	59	93			9	4,416				21,032		822	26,279	
	1971	-	-	20	52	72			11	2,071				20,526		1,175	23,783	
	1972	-	-	187	-	187			8	3,750				23,600		637	27,995	
	1973	-	-	-	-	-			14	2,236				15,653		84	17,987	
	1974	-	-	486	-	486			9	4,777				20,178		94	25,058	
	1975	-	-	1,240	-	1,240			33	3,243				18,932	10	640	22,858	
	1976	-	-	686	-	686			23	2,700				15,905	4	713	19,345	
	1977	-	-	572	-	572			37	1,497				9,969		537	12,040	
	1978	-	-	6	-	6			54	950				16,613	15	810	18,442	
	1979	-	-	81	-	81				303				6,781		74	7,158	
	1980	-	1	249	20	270				382				7,556		188	8,106	
	1981	1	-	143	12	156				25	748			12,637		195	13,605	
	1982	-	-	38	9	47				105	425			6,609	21	257	7,417	
	1983	-	-	8	1	9				6	607			9,359		87	10,059	
	1984	-	1	-	-	1				2	1,030			9,304	3,728	1,427	15,491	
	1985	1	-	-	2	3					6,422	118		26		1,176	7,744	
	1986	-	-	-	-	-				3	4,713			66	47	196	5,025	
	1987	2	2,514	-	-	2,516				5	150			2,772	139	1	74	3,141
	1988	6	7,389	-	-	7,395				15	307			4,221	76	17	64	4,700
	1989	-	8,350	40	-	8,390				4	248			1,896	10	1	160	2,319
	1990	-	16,701	4	39	16,744				29	177			2,733	20	71	24	3,054
	1991	-	3,398	12	-	3,410				17	312			1,917	20		6	2,272
	1992	-	7,866	-	-	7,866					334			4,626	40		2	5,002
	1993	-	-	5	-	5					438			6,325	194		25	6,982
	1994	-	-	83	-	83				38	544			11,068	66		108	11,822
	1995	-	-	4,280	-	4,280				52	882			8,302	4		102	9,342
	1996	-	-	7,596	-	7,596				83	1,185			17,150	10	11	88	18,627
	1997	-	-	9,456	-	9,456				60	1,653			14,458	12	2	1,018	17,203
	1998	-	-	8,810	-	8,810					1,120			14,577	15	33	1,208	17,033
	1999	-	-	8,393	-	8,393				149	1,542			10,451	61	48	3,621	15,872
	2000	-	-	8,842	-	8,842					940			9,834	24	4	1,798	12,665
	2001	-	1	8,684	+	8,685				94	1,295			11,543	39	51	1,635	14,667
	2002	-	-	7,965	-	7,965				30	525			11,003	13	4	2,367	13,932
	2003	-	-	7,166	-	7,166				16	524			14,246	8	44	2,214	17,052
	2004	-	-	4,988	-	4,988				12	361			13,630	3	1	1,506	15,513
	2005	-	-	4,472	-	4,472				20	296			8,654	1		1,719	10,680
	2006	-	-	4,317	-	4,317				3	270			12,642	+		385	13,300
	2007	-	+	2,916	-	2,916				4	94			11,911	+	77	461	12,797
	2008	-	-	3,069	-	3,069				1	28			11,762	+		418	12,563
	2009	-	-	2,378	-	2,378				4	97			12,343	+	31	944	13,622
	2010	+	-	2,818	-	2,818				5	53			11,691	0		862	13,032
	2011	+	1	3,434	2	3,437				5	84			10,147	0		421	11,365
	2012	2	2	2,643	-	2,647				8	263			680	2		1,212	16,287
	2013	1	+	4,427	-	4,428				5	46			317			838	13,519
	2014	1	1	2,617	+	2,619				0	49			209			1,042	14,701
	2015	1	2	3,020	4	3,027				1	62			227			932	12,820
	2016	+	+	3,406	-	3,406				1	24			248			675	11,708
	2017	-	5	4,333	-	4,338				0	35			96			372	7,947
	2018	-	-	4,514	+	4,514					20			87			381	8,218
	2019	-	5	5,454	+	5,460					10			104			1,364	9,249
	2020	-	5	3,809	+	3,814					3			163			260	7,751
Retain catch total		15	46,242	138,312	1,095	185,665			801	859	17,801	52,932	1,103,229	1,023	4,197	49,401	1,230,241	
Release	2013																	1
	2014																	7
	2015																	14
	2016																	2
	2017																	2
	2018																	18
	2019																	13
	2020																	2
Release total																		59
Total		15	46,242	138,312	1,095	185,665			801	859	17,801	52,932	1,103,229	1,023	4,197	49,401	1,230,241	5,182,436

Table 6. Pacific bluefin tuna (*Thunnus orientalis*) catches (in metric tons) by ISC member fisheries, 1952-2018. "0" - Fishing effort was reported but no catch; "+" - Below 499kg catch; "-" - Unreported catch or catch information not available. * - Data from the most recent years are provisional.

Catch disposition	Year	JPN						JPN Total	KOR					KOR Total ²	MEX		MEX Total	
		Set-net	Longline	Pole and line	Troll ¹	Others	Purse seine		Set-net	Longline	Purse seine	Trawl	Troll		Others	Purse seine		
Retain	1952	2,145	2,694	2,198	667	1,700	7,680	17,084							-	-	0	
	1953	2,335	3,040	3,052	1,472	160	5,570	15,629							-	-	0	
	1954	5,579	3,088	3,044	1,656	266	5,366	18,999							-	-	0	
	1955	3,256	2,951	2,841	1,507	1,151	14,016	25,722							-	-	0	
	1956	4,170	2,672	4,060	1,763	385	20,979	34,029							-	-	0	
	1957	2,822	1,685	1,795	2,392	414	18,147	27,255							-	-	0	
	1958	1,187	818	2,337	1,497	215	8,586	14,640							-	-	0	
	1959	1,575	3,136	586	736	167	9,996	16,196						32	171	203		
	1960	2,032	5,910	600	1,885	369	10,541	21,337							-	-	0	
	1961	2,710	6,364	662	3,193	599	9,124	22,652							-	130	130	
	1962	2,545	5,769	747	1,683	293	10,657	21,694							-	294	294	
	1963	2,797	6,077	1,256	2,542	294	9,786	22,752							-	412	412	
	1964	1,475	3,140	1,037	2,784	1,884	8,973	19,293							-	131	131	
	1965	2,121	2,569	831	1,963	1,106	11,496	20,086							-	289	289	
	1966	1,261	1,370	613	1,614	129	10,082	15,069							-	435	435	
	1967	2,603	878	1,210	3,273	302	6,462	14,728							-	371	371	
	1968	3,058	500	983	1,568	217	9,268	15,594							-	195	195	
	1969	2,187	878	721	2,219	195	3,236	9,436							-	260	260	
	1970	1,779	607	723	1,198	224	2,907	7,438							-	92	92	
	1971	1,555	697	938	1,492	317	3,721	8,720							-	555	555	
	1972	1,107	512	944	842	197	4,212	7,814			0				-	1,646	1,646	
	1973	2,351	838	526	2,108	636	2,266	8,725			0				-	1,084	1,084	
	1974	6,019	1,177	1,192	1,656	754	4,106	14,904			0				-	344	344	
	1975	2,433	1,061	1,401	1,031	808	4,491	11,225			3				-	2,145	2,145	
	1976	2,996	320	1,082	830	1,237	2,148	8,613			5				-	1,968	1,968	
	1977	2,257	338	2,256	2,166	1,052	5,110	13,179			0				-	2,186	2,186	
	1978	2,546	648	1,154	4,517	2,276	10,427	21,568			3				-	545	545	
	1979	4,558	729	1,250	2,655	2,429	13,881	25,502			0				-	213	213	
	1980	2,521	811	1,392	1,531	1,953	11,327	19,535			0				-	582	582	
	1981	2,129	590	754	1,777	2,653	25,422	33,325			0				-	218	218	
	1982	1,667	718	1,777	864	1,709	19,234	25,969			0	31			-	506	506	
	1983	972	217	356	2,028	1,117	14,774	19,464			0	13			-	214	214	
	1984	2,234	142	587	1,874	868	4,433	10,138			1	4			-	166	166	
	1985	2,562	105	1,817	1,850	1,175	4,154	11,663			0	1			-	676	676	
	1986	2,914	102	1,086	1,467	719	7,412	13,700			0	344			-	189	189	
	1987	2,198	211	1,565	880	445	8,653	13,952			13	89			-	119	119	
	1988	843	157	907	1,124	498	3,605	7,134			0	32			-	447	448	
	1989	748	209	754	903	283	6,190	9,087			0	71			-	57	57	
	1990	716	267	536	1,250	455	2,989	6,213			0	132			-	50	50	
	1991	1,485	218	286	2,069	650	9,808	14,516			0	265			-	9	9	
	1992	1,208	513	166	915	1,081	7,162	11,045			0	288			-	0	0	
	1993	848	812	129	546	365	6,600	9,300			0	40			-	0	0	
	1994	1,158	1,206	162	4,111	398	8,131	15,166			0	50			-	63	65	
	1995	1,859	678	270	4,778	586	18,909	27,080			0	821			-	11	11	
	1996	1,149	901	94	3,640	570	7,644	13,998			0	102			-	3,700	3,700	
	1997	803	1,300	34	2,740	811	13,152	18,840			0	1,054			-	367	367	
	1998	874	1,255	85	2,876	700	5,391	11,181			0	188			-	1	1	
	1999	1,097	1,157	35	3,440	709	16,173	22,611			0	256			-	2,369	2,404	
	2000	1,125	953	102	5,217	689	16,486	24,572			0	2,401			-	3,019	3,118	
	2001	1,366	791	180	3,466	782	7,620	14,205			0	1,176			-	863	863	
	2002	1,100	841	99	2,607	631	8,903	14,181			0	932			-	1,708	1,710	
	2003	839	1,237	44	2,060	446	5,768	10,394			0	2,601			-	3,211	3,254	
	2004	896	1,847	132	2,445	514	8,257	14,091			0	773			-	8,880	8,894	
	2005	2,182	1,925	549	3,633	548	12,817	21,654			0	1,318			-	4,542	4,542	
	2006	1,421	1,121	108	1,860	777	8,880	14,167			0	1,012			-	9,806	9,806	
	2007	1,503	1,762	236	2,823	657	6,840	13,821			0	1,281			-	4,147	4,147	
	2008	2,358	1,390	64	2,377	770	10,221	17,180			0	1,866			-	4,407	4,422	
	2009	2,236	1,080	50	2,003	575	8,077	14,021			0	936			-	3,019	3,019	
	2010	1,603	890	83	1,583	495	3,742	8,396			0	1,196			-	7,746	7,746	
	2011	1,651	837	63	1,820	283	8,340	12,993			0	670			-	2,731	2,732	
	2012	1,932	673	113	570	343	2,462	6,093			0	1,421			-	6,668	6,669	
	2013	1,415	784	8	904	529	2,771	6,411			1	-			-	3,154	3,154	
	2014	1,907	683	5	1,023	499	5,456	9,573			6	-			-	4,862	4,862	
	2015	1,242	648	8	413	431	3,645	6,386			1	-			-	3,082	3,082	
	2016	1,228	691	54	778	508	5,095	8,354			3	-			-	2,709	2,709	
	2017	2,221	913	49	605	665	4,540	8,993			3	-			-	3,643	3,643	
	2018	645	700	9	371	431	4,050	6,206			7	-			-	2,482	2,482	
	2019	941	1,002 ³	+	720	372	4,464	7,499			36	-			-	2,249	2,249	
	2020	1,234	1,416	1	760	502	3,960	7,873			35	-			-	3,266	3,266	
Retain catch total		134,489	94,219	54,787	131,609	48,969	576,790	1,040,863			93	25	27,339	92	27,548	245	109,404	109,649
Total		134,489	94,219	54,787	131,609	48,969	576,790	1,040,863			93	25	27,339	92	27,548	245	109,404	109,649

Table 6. Continued.

Catch disposition	Year	TWN						TWN Total	USA							USA Total ⁴	Total				
		Set-net	Gill-net (not specific d)	Drift gill-net	Longline	Others	Purse seine		Drift gill-net	Longline	Pole and line	Troll	Hook and Line	Others	Purse seine			Sport			
Retain	1952												2,076	2	2,078	19,162					
	1953												4,433	48	4,481	20,110					
	1954												9,537	11	9,548	28,547					
	1955												6,173	93	6,266	31,988					
	1956												5,727	388	6,115	40,144					
	1957												9,215	73	9,288	36,543					
	1958												13,934	10	13,944	28,584					
	1959												3,506	13	3,575	19,974					
	1960												4,547	1	4,548	25,885					
	1961												16		7,989	23	8,028	30,810			
	1962												+		10,769	25	10,794	32,782			
	1963												28		11,832	7	11,867	35,031			
	1964												39		9,047	7	9,093	28,517			
	1965				54		54						11	+	66	6,523	1	6,601	27,030		
	1966				-		0						12		15,450	20	15,482	30,986			
	1967				53		53						+		5,517	32	5,549	20,701			
	1968				33		33						8		5,773	12	5,793	21,615			
	1969				23		23						9		6,657	15	6,681	16,400			
	1970				-		0						+		3,873	19	3,892	11,422			
	1971				1		1						+		7,804	8	7,812	17,088			
	1972				14		14						3		42	11,656	15	11,716	21,190		
	1973				33		33						5	+	20	9,639	54	9,718	19,560		
	1974				47	15	62						+	+	30	5,243	58	5,331	20,641		
	1975				61	5	66						83		1	7,353	34	7,471	20,910		
	1976				17	2	19						22	+	3	8,652	21	8,698	19,303		
	1977				131	2	133						10		3	3,259	19	3,291	18,789		
	1978				66	2	68						4		2	4,663	5	4,674	26,858		
	1979				58	-	58						5		1	5,889	11	5,906	31,679		
	1980				114	5	119						+		24	2,327	7	2,358	22,594		
	1981				179	-	179						4	+	10	867	9	890	34,612		
	1982				2	207	209						9		1	2,639	11	2,660	29,375		
	1983				2	175	186						31		59	629	33	754	20,631		
	1984				-	477	8	5	490				6	1	5	18	673	49	752	11,551	
	1985				11	210	301						8		20	3,320	89	3,437	16,078		
	1986				13	70	99						16		41	4,851	12	4,920	19,252		
	1987				14	365	400						2		18	861	34	915	15,488		
	1988				37	108	367						4		46	923	6	979	8,960		
	1989				51	205	518						3		18	1,046	112	1,179	10,912		
	1990				299	189	653						11		81	1,380	65	1,537	8,585		
	1991				107	342	461						4	2	+	410	92	508	15,759		
	1992				3	464	545						9	38	14	1,928	110	2,099	13,977		
	1993				471	3	475						32	42	29	580	283	966	10,781		
	1994				559	-	559						28	30	1	906	86	1,051	16,891		
	1995				335	2	337						20	29	+	657	245	951	29,200		
	1996				956	-	956						43	25	2	4,639	40	4,749	23,505		
	1997				-	-	1,814						58	26	1	2,240	131	2,504	24,579		
	1998				-	-	1,910						40	54	128	1,771	422	2,474	15,754		
	1999				-	-	3,089						22	54	20	88	184	408	776	29,136	
	2000				-	1	2,780						30	19	1	11	693	319	1,073	33,946	
	2001				-	2	1,839						35	6	6	1	292	344	684	18,781	
	2002				-	3	1,523						7	2	1	2	50	613	675	19,026	
	2003				-	10	1,863						14	1	3	22	355	395	18,528		
	2004				-	1	1,714						10	1	+		50	61	25,536		
	2005				1	-	1,368						5	1	1	201	73	281	29,174		
	2006				1	-	1,149						1	1	+		94	96	26,234		
	2007				2	8	1,401						2	+	+	42	12	56	20,720		
	2008				1	1	979						1	+	+		63	64	24,523		
	2009				1	10	877						3	1	0	2	410	156	572	19,440	
	2010				29	7	373						1	0	0	0	88	89	17,852		
	2011				16	7	292						18	0	0	100	225	343	17,068		
	2012				2	-	210						4	0	0	38	400	442	14,841		
	2013				2	1	331						7	1	0	3	809	820	11,324		
	2014				38	4	483						5	0	+	2	401	420	828	17,099	
	2015				25	1	552						4	0	-	7	86	400	499	11,221	
	2016				-	+	454						9	1	0	31	316	372	728	13,275	
	2017				-	-	415						1	1	0	18	466	451	938	14,732	
	2018				+	3	381						18	1	-	31	4	12	513	10,186	
	2019				+	3	486						10	2	1	36	1	226	462	737	11,557
	2020				1	+	1,148						28	2	-	87	1	116	651	884	13,779
Retain catch total		121	61	539	33,448	131	810	35,110	563	340	376	170	212	843	242,901	10,138	255,543	1,468,713			
Total		121	61	539	33,448	131	810	35,110	563	340	376	170	212	843	242,901	10,138	255,543	1,468,713			

Numbers in parenthesis are provisional.

1) Japanese troll catch since 1998 includes catch from farming.

2) Catch statistics of Korea were derived from Japanese Import statistics for 1982-1999.

3) Catch of Japanese coastal longline in 2019 is provisional value.

4) USA in 1952-1958 contains catch from other countries - primarily Mexico. Other includes catches from gillnet, troll, pole-and-line, and longline.

Table 7. Annual catch of swordfish (*Xiphias gladius*) in metric tons for fisheries monitored by ISC member countries for assessments of North Pacific Ocean stocks, 1951-2018. “0”; Fishing effort was reported but no catch. “0” - Fishing effort was reported but no catch; “+” - Below 499kg catch; “-“ - Unreported catch or catch information not available. * - Data from the most recent years are provisional.

Catch disposition	Year	JPN					JPN Total	KOR		MEX			TWN					TWN Total	USA									USA Total	Total
		Set-net	Drift gill-net	Longline	Others	Not specified		Longline	KOR Total	Others	Sport	MEX Total	Set-net	Gill-net (not specified)	Harpoon	Longline	Others		Purse seine	Drift gill-net	Harpoon	Handline	Longline	Pole and line	Troll	Hook-and-line	Other		
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																					12,408	
	1954	18	-	12,659	813	121	13,611																					13,611	
	1955	37	-	13,093	821	160	14,111																					14,111	
	1956	31	-	14,606	775	73	15,485																					15,485	
	1957	18	-	14,305	858	70	15,251																					15,251	
	1958	31	-	18,567	1,069	67	19,734																					19,734	
	1959	31	-	17,302	891	44	18,268																					18,268	
	1960	67	1	20,109	1,191	30	21,398																					21,398	
	1961	15	2	19,766	1,335	30	21,148																					21,148	
	1962	15	-	10,685	1,371	44	12,115																					12,115	
	1963	17	-	10,420	747	59	11,243																					11,243	
	1964	16	4	7,760	1,006	66	8,852																					8,852	
	1965	14	-	8,861	1,908	208	10,991																					10,991	
	1966	11	-	9,979	1,728	45	11,763																					11,763	
	1967	12	-	11,067	891	38	12,008																					12,008	
	1968	14	-	10,046	1,539	50	11,649																					11,649	
	1969	11	-	9,712	1,557	56	11,336																					11,336	
	1970	9	-	7,751	1,748	39	9,547																					9,547	
	1971	37	1	7,387	473	48	7,946	0	0																			7,946	
	1972	1	55	7,327	282	22	7,687	0	0																			7,687	
	1973	23	720	7,574	121	29	8,467	0	0																			8,467	
	1974	16	1,304	6,669	190	29	8,208	0	0																			8,208	
	1975	18	2,672	7,677	205	60	10,632	0	0																			10,632	
	1976	14	3,488	8,845	313	182	12,842	0	0																			12,842	
	1977	7	2,344	9,301	201	73	11,926	0	0																			11,926	
	1978	22	2,475	9,069	130	111	11,807	0	0																			11,807	
	1979	15	983	9,692	161	49	10,900	0	0																			10,900	
	1980	15	1,746	6,898	398	30	9,087	135	135																			9,087	
	1981	9	1,848	7,841	129	61	9,888	0	0																			9,888	
	1982	7	1,257	6,998	195	59	8,516	166	166																			8,516	
	1983	9	1,033	8,752	166	32	9,992	47	47																			9,992	
	1984	13	1,053	8,411	117	98	9,692	27	27																			9,692	
	1985	10	1,133	10,387	191	69	11,790	12	12																			11,790	
	1986	9	1,264	9,815	123	47	11,258	18	18																			11,258	
	1987	11	1,051	10,411	87	45	11,605	50	50																			11,605	
	1988	8	1,234	9,317	173	19	10,751	27	27																			10,751	
	1989	10	1,596	7,492	362	21	9,481	7	7																			9,481	
	1990	4	1,074	6,598	128	13	7,817	46	46																			7,817	
	1991	5	498	5,690	153	20	6,366	37	37																			6,366	
	1992	6	887	8,505	381	16	9,795	32	32																			9,795	
	1993	4	292	9,777	309	44	10,426	27	27																			10,426	
	1994	4	421	8,723	308	37	9,493	4	4																			9,493	
	1995	7	561	7,809	423	34	8,834	9	9																			8,834	
	1996	4	428	7,983	597	45	9,057	15	15																			9,057	
	1997	5	365	8,216	346	62	8,994	99	99																			8,994	
	1998	2	471	7,423	476	68	8,440	153	153																			8,440	
	1999	5	724	6,606	416	47	7,798	131	131																			7,798	

Table 7. Continued.

Catch disposition	Year	JPN					KOR		MEX			TWN						USA									USA Total	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
Retain	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		1,735	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	993	993	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	5,605	169	256	6,335	582	582	-	-	-	2	3	+	2,054	+	-	2,059	183	26	4	1,092				1	1,348	8,265	
	2017	3	291	4,837	274	289	5,694	583	583	-	-	-	+	3	-	2,194	+	+	2,197	180	28	6	1,618				1	1,876	10,350	
	2018	5	230	5,015	480	267	5,997	664	664	-	-	-	1	+	-	2,124	+	-	2,125	148	10	3	1,053	1	1	67	1,281	10,068		
	2019	6	242	3,956	339	210	4,753	468	468	-	-	-	2	+	-	2,113	+	-	2,115	52	12	3	733				2	986	8,323	
	2020	6	242	4,739	339	210	5,536	392	392	-	-	-	2	+	-	1,868	+	-	1,870	35	6	2	541				1	710	8,508	
		952	45,072	602,836	40,327	7,545	696,732	13,732	13,732	3,430	-	3,430	319	220	3,545	106,515	911	-	111,510	29,290	8,630	171	74,102	56	16	5	1,521	27	113,818	939,222
	2010																										0	0	0	
	2011																										0	0	0	
	2018							+	+																				+	
	2019							+	+																				+	
	2020							+	+																				+	
		952	45,072	602,836	40,327	7,545	696,732	13,732	13,732	3,430	0	3,430	319	220	3,545	106,515	911	0	111,510	29,290	8,630	171	74,102	56	16	5	1,521	27	113,818	939,223

Table 8. Annual catch of striped marlin (*Kajikia audax*) in metric tons for fisheries monitored by ISC member countries for assessments of North Pacific Ocean stocks, 1951-2018. “0” - Fishing effort was reported but no catch; “+” - Below 499kg catch; “-” - Unreported catch or catch information not available. * - Data from the most recent years are provisional.

Catch disposition	Year	JPN					JPN Total	KOR			MEX	
		Set-net	Drift gill-net	Longline	Others	Not specified		Longline	Purse seine	KOR Total	Sport	MEX Total
Retain	1951	92	-	3,167	1,149	39	4,447					
	1952	203	-	3,623	1,321	40	5,187					
	1953	126	-	2,185	793	36	3,140					
	1954	82	-	3,120	938	67	4,207					
	1955	106	-	3,110	850	82	4,148					
	1956	133	-	3,788	1,822	41	5,784					
	1957	71	-	3,308	2,312	76	5,767					
	1958	82	3	4,383	2,704	127	7,299					
	1959	87	2	4,308	2,905	200	7,502					
	1960	161	4	3,963	1,689	87	5,904					
	1961	161	2	4,589	1,538	98	6,388					
	1962	197	8	5,849	1,607	108	7,769					
	1963	92	17	6,197	1,527	292	8,125					
	1964	81	2	14,346	2,223	41	16,693					
	1965	81	1	11,621	2,640	73	14,416					
	1966	226	2	8,531	1,313	31	10,103					
	1967	82	3	11,825	1,394	75	13,379					
	1968	71	0	16,143	914	58	17,186					
	1969	71	3	9,147	2,516	81	11,818					
	1970	55	3	13,867	824	153	14,902					
	1971	61	10	11,891	1,674	307	13,943	0		0		
	1972	72	243	7,988	827	94	9,224	0		0		
	1973	80	3,265	7,107	476	146	11,074	0		0		
	1974	90	3,112	7,076	581	104	10,963	0		0		
	1975	105	6,534	5,605	492	89	12,825	0		0		
	1976	37	3,561	5,414	441	107	9,560	0		0		
	1977	103	4,424	3,290	337	107	8,261	0		0		
	1978	93	5,593	4,227	210	243	10,366	0		0		
	1979	66	2,532	5,948	327	133	9,006	0		0		
	1980	80	3,467	6,990	397	59	10,993	73		73		
	1981	88	3,866	4,377	385	69	8,785	0		0		
	1982	52	2,351	5,666	476	128	8,673	102		102		
	1983	124	1,867	4,052	547	156	6,746	49		49		
	1984	144	2,333	3,901	398	177	6,953	39		39		
	1985	81	2,363	4,632	499	153	7,728	13		13		
	1986	131	3,584	7,336	343	103	11,497	14		14		
	1987	102	1,888	8,731	244	167	11,132	15		15		
	1988	63	2,211	7,030	400	205	9,909	16		16		
	1989	47	1,664	5,834	345	145	8,035	24		24		
	1990	65	1,945	3,496	287	193	5,986	1		1		
	1991	56	1,329	4,045	320	131	5,881	7		7		
	1992	71	1,204	4,212	137	95	5,719	53		53		
	1993	27	828	5,200	308	373	6,736	568		568		
	1994	73	1,443	4,196	218	92	6,022	556		556		
	1995	58	970	5,337	139	86	6,590	307		307		
	1996	39	703	3,791	25	88	4,646	429		429		
	1997	34	813	3,523	61	68	4,499	1,017		1,017		
	1998	34	1,092	3,761	123	147	5,157	635		635		
	1999	28	1,126	3,163	66	90	4,473	433		433		
	2000	41	1,062	2,269	165	91	3,628	536		536		
	2001	51	1,077	2,322	150	36	3,636	253		253		
	2002	80	1,264	1,565	182	28	3,119	187		187		
	2003	41	1,064	1,858	135	27	3,125	205		205		
	2004	23	1,339	1,701	33	34	3,130	75		75		
	2005	28	1,214	1,231	35	35	2,543	136		136		
	2006	30	1,190	1,162	33	32	2,447	55		55		
	2007	21	970	1,171	20	38	2,220	46		46		
	2008	26	1,302	1,009	43	28	2,408	29		29		
	2009	17	821	809	34	39	1,720	22		22		
	2010	20	913	1,061	26	36	2,056	18		18		
	2011	30	347	1,306	32	26	1,741	48		48		
	2012	52	597	1,336	33	34	2,052	33		33		
	2013	39	336	1,496	19	34	1,924	65		65		
	2014	35	173	1,155	0	22	1,385	82		82		
	2015	37	287	1,441	37	27	1,829	44		44		
	2016	25	308	1,056	41	32	1,462	61		61		
	2017	28	241	977	23	28	1,297	81		81		
	2018	28	278	886	52	36	1,280	70		70		
	2019	29	241	1,268	61	39	1,638	48		48		
	2020	29	241	1,267	61	39	1,637	74		74		
Retain catch total		5,074	81,636	323,234	45,277	6,601	461,822	6,496		6,496	0	0
Release	2010											
	2011											
	2016											
	2018							0	+	2		
	2019											
	2020											
Release total								0	2	2		
Total		5,074	81,636	323,234	45,277	6,601	461,822	6,496	2	6,497	0	0

Numbers in paranthesis are provisional.

Table 8. Continued.

Catch disposition	Year	TWN						TWN Total	USA						USA Total	Total	
		Set-net	Gill-net (not specified)	Harpoon	Longline	Others	Purse seine		Handline	Longline	Troll	Others	Purse seine	Sport			
Retain	1951														23	23	4,447
	1952														5	5	5,210
	1953						0	0							16	5	3,145
	1954						0	0							5	16	4,223
	1955						0	0							34	5	4,153
	1956						0	0							42	34	5,818
	1957						0	0							59	42	5,809
	1958					543	387	930							65	59	8,288
	1959					391	354	745							65	65	8,312
	1960					398	350	748							30	30	6,682
	1961					306	342	648							24	24	7,060
	1962					332	211	543							5	5	8,317
	1963					560	199	759							68	68	8,952
	1964					392	175	567							58	58	17,318
	1965					355	157	512							23	23	14,951
	1966					370	180	550							36	36	10,689
	1967	-	0	141	387	63		591							49	49	14,019
	1968	-	40	134	333	34		541							51	51	17,778
	1969	-	5	159	573	28		765							30	30	12,613
	1970	-	8	175	495	6		684							18	18	15,604
	1971	-	16	101	449	18		584							17	17	14,544
	1972	-	1	124	389	1		515							21	21	9,760
	1973	-	4	115	569	20		708							9	9	11,791
	1974	-	7	53	674	58		792							55	55	11,810
	1975	-	7	86	796	3		892							27	27	13,744
	1976	-	9	61	379	70		519							31	31	10,110
	1977	-	9	207	541	3		760							41	41	9,062
	1978	-	7	70	618	1		696							37	37	11,099
	1979	2	18	104	458	0		582							36	36	9,624
	1980	-	39	92	284	1		416							33	33	11,515
	1981	-	25	70	508	0		603							60	60	9,448
	1982	-	26	112	404	0		542							41	41	9,358
	1983	-	31	144	555	39		769							39	39	7,603
	1984	-	16	314	965	0		1,295							36	36	8,323
	1985	1	6	152	513	23		695			18				42	60	8,496
	1986	-	13	119	179	16		327			19				19	38	11,876
	1987	1	2	132	414	16		565	1	272	29				28	330	12,042
	1988	7	12	70	464	80		633		504	54				30	588	11,146
	1989	-	23	124	192	10		349	+	612	24				52	688	9,096
	1990	12	16	207	139	21		395	+	538	27				23	588	6,970
	1991	-	81	173	290	32		576	+	663	41				12	716	7,180
	1992	-	11	163	220	24		418	1	459	37				25	522	6,712
	1993	3	7	132	226	0		368	1	471	67				11	550	8,222
	1994	4	5	176	138	11		334	+	326	35				17	378	7,290
	1995	4	5	67	110	6		192	+	543	52				14	609	7,698
	1996	3	8	30	188	6		235	1	418	53				20	492	5,802
	1997	3	9	33	351	0		396	1	352	37				21	411	6,323
	1998	6	16	19	304	0		345	+	378	26				23	427	6,564
	1999	5	8	26	197	0		236	1	364	27				12	404	5,546
	2000	6	18	29	315	1		369		200	15				10	225	4,758
	2001	5	16	30	250	0		301		351	44				+	395	4,585
	2002	8	15	6	477	0		506	+	226	30				+	256	4,068
	2003	5	27	11	922	0		965	+	538	29				+	567	4,862
	2004	5	10	7	522	2		546	2	376	31				+	409	4,160
	2005	9	9	5	783	9		815	+	511	20				+	531	4,025
	2006	-	30	117	741	0		888	+	611	21				+	632	4,022
	2007	-	29	141	301	0		471		276	13				+	289	3,026
	2008	-	43	168	270	2		483		427	14					441	3,361
	2009	-	46	92	262	0		400		258	10					268	2,410
	2010	-	42	131	253	3		429		165	19					184	2,687
	2011	1	27	95	343	4	0	470		362	16					378	2,637
	2012	-	34	114	443	1	+	592		282	11					293	2,970
	2013	+	24	197	372	+	+	593		398	8					406	2,988
	2014	+	5	64	140	+	1	210		426	12			1		439	2,116
	2015	1	4	28	228	+		261		493	11	0				504	2,638
	2016	-	3	21	214	+	1	239	-	390	12					402	2,165
	2017	+	7	41	389	-		437		406	6					413	2,227
	2018	+	5	27	330	-	+	362		465	12					477	2,189
	2019	-	8	26	373	-	+	407		545	13			1		559	2,652
	2020	-	8	26	353	-	-	387		336	10					345	2,443
Retain catch total		91	900	5,261	25,230	2,967	2	34,451	8	13,941	903	0	1	1,484	16,338	519,106	
Release	2010												1		1	1	
	2011												0		0	0	
	2016						1	1								1	
	2018						+	+								2	
	2019						1	1								1	
	2020						0	0								0	
Release total							2	2					1		1	5	
Total		91	900	5,261	25,230	2,967	4	34,453	8	13,941	903	0	2	1,484	16,339	519,111	

Numbers in paranthesis are provisional.

Table 10. Retained catches (metric tons, whole weight) by ISC Member countries of blue sharks (*Prionace glauca*) by fishery in the North Pacific Ocean, north of the equator, 1985-2020. “0” - Fishing effort was reported but no catch; “+” - Below 499kg catch; “-” - Unreported catch or catch information not available. * - Data from the most recent years are provisional.

Catch disposition	Year	JPN					JPN Total	KOR		MEX		TWN		USA					USA Total	Total									
		Set-net	Drift gill-net	Longline	Others	Not specified		Longline	KOR Total	Others	MEX Total	Longline	TWN Total	Drift gill-net	Longline	Troll	Others	Sport											
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		-	1,321	29,482	13	2	30,818														0	33,539							
2006		5	1,204	25,106	2	2	26,319														0	29,084							
2007		5	1,323	23,725	19	2	25,074							9	8						17	28,415							
2008		-	944	20,115	14	1	21,074								7						7	25,436							
2009		-	1,208	19,330	4	1	20,543								4,423	4,423	11,541	11,541	1	9	1	36,518							
2010		4	963	22,608	9	1	23,585								4,469	4,469	7,670	7,670	-	7	0	35,731							
2011		7	765	20,231	1	3	21,007								3,719	3,719	13,117	13,117		13	0	37,856							
2012		2	1,076	13,892	3	3	14,975								4,108	4,108	10,606	10,606		16	0	29,705							
2013		6	1,103	17,203	4	2	18,319								4,494	4,494	6,321	6,321		1	0	29,210							
2014		4	1,060	16,241	0	2	17,306								100	100	8,151	8,151		0	-	31,059							
2015		21	1,080	12,470	-	2	13,573								53	53	8,551	8,551		-	-	22,177							
2016		26	1,832	14,483	1	2	16,343										8,563	8,563				24,906							
2017		4	1,366	14,787	-	1	16,158									8	8	11,121	11,121		1	-	27,287						
2018		40	1,236	10,921	-	1	12,198									2	2	11,761	11,761		1	0	23,962						
2019		28	1,052	5,793	-	1	6,874									4	4	18,165	18,165		-	11	25,053						
2020		28	1,052	5,793	-	1	6,874									0	0	15,540	15,540		-	-	22,415						
Retain catch total		264	26935	601294	192	61	628746								242	242	39880	39880		131107	131107	13	61	0	66	1	141	800115	
Release	2015																												0
	2016																												8
	2017																												11
	2018																												58
	2019																												12
2020																												22	
Release catch total																													112
Total		264	26,935	601,294	192	61	628,746								355	355	39,880	39,880		131,107	131,107	13	61	0	66	1	141	800,229	

Table 11. Retained catches (metric tons, whole weight) by ISC Member countries of shortfin mako sharks (*Isurus oxyrinchus*) by fishery in the North Pacific Ocean, north of the equator, 1985-2020. "0" - Fishing effort was reported but no catch; "+" - Below 499kg catch; "-"- Unreported catch or catch information not available. * - Data from the most recent years are provisional.

Catch disposition	Year	JPN			KOR		MEX		TWN			USA								USA Total	Total		
		Drift gill-net	Longline	Others	Total	Longline	KOR Total	Others	MEX Total	Longline	Purse seine	Total	Drift gill-net	Harpoon	Handline	Longline	Troll	hook and lin	Others			Purse-sein	Sport
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	975	21	1,119			336	336			80	1						46			127	1,582
	1995	103	958	15	1,075			333	333			79	1						14			94	1,502
	1996	101	1,149	17	1,268			413	413			85	1						9			95	1,776
	1997	127	1,044	16	1,187			401	401			118	3						11			132	1,720
	1998	130	920	13	1,063			386	386			85	1						12			98	1,547
	1999	176	1,374	14	1,564			439	439			52	0						9			61	2,064
	2000	156	1,107	15	1,278			539	539			64	+						12			76	1,893
	2001	156	1,154	15	1,325			491	491			30	1						10			41	1,857
	2002	122	964	5	1,090			488	488			69	+						12			81	1,659
	2003	229	971	6	1,205			471	471			57	+						9			66	1,742
	2004	134	927	1	1,062			865	865			38	1						13			52	1,979
	2005	155	1,022	43	1,219			609	609			25	1						8			34	1,862
	2006	178	1,062	6	1,246			641	641			38	+						7			45	1,932
	2007	244	1,187	15	1,446			689	689			37	+						6			43	2,178
	2008	212	1,017	14	1,243			609	609			27	1						5			33	1,885
	2009	294	1,231	1	1,527	-	-	653	653	78	78	21	1			0			7			29	2,287
	2010	272	981	20	1,273	-	-	760	760	54	54	10	0						10			20	2,107
	2011	163	717	11	891	-	-	758	758	208	208	8	0						8			16	1,873
	2012	229	706	2	938	-	-	715	715	74	74	9	0			0			11			20	1,747
	2013	345	743	9	1,097	8	8	711	711	107	107	16	0						12			28	1,951
	2014	263	755	3	1,021	8	8	-	-	119	119	7	0			53	+	3	6		9	78	1,218
	2015	334	847	11	1,193					322	322	7				58		1	4			71	1,585
	2016	446	987	16	1,448	+	0			220	220	12	0	1		70		1	4		0	89	1,757
	2017	271	674	10	955	+	+			187	187	13	0			71		1	5			90	1,232
	2018	223	839	28	1,090	+	+			265	265	11				60		1	5			78	1,433
	2019	195	790	2	988	+	+			273	273	7 #				47 #		1 #	21 #			75	1,336
	2020	195	790	2	988	+	+			248	248	3	1			16		1	3			23	1,259
Retain catch total		5,577	25,892	328	31,798	16	16	13,348	13,348	2,155	2,155	2,377	30	1	375	1	9	1,178	0	9	3,980	51,297	
Release	2011																		0			0	0
	2012																						0
	2016					1	1																1
	2018					1	1																1
	2019					1	1																1
	2020					1	1																1
Release catch total						3	3																3
Total		5,577	25,892	328	31,798	19	19	13,348	13,348	2,155	2,155	2,377	30	1	375	1	9	1,178	0	9	3,980	51,300	

Numbers in paranthesis 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).