INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

EIGHTH MEETING

La Jolla, California (USA)
8-12 May 2017

REPORT OF THE MEETING

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1. OPENING OF THE MEETING

The Director and Chairman, Guillermo Compeán, welcomed the participants, and noted that a quorum had been achieved for the meeting.

Diana Barahona and Celina De Paz agreed to serve as rapporteurs for the meeting.

2. ADOPTION OF AGENDA

The following additional issues were identified for consideration within the agenda as adopted:
1. Update on active capacity and status of catch limits as part of discussion of the fishery in 2016
2. Update from the ISC[1] and Tokyo stakeholders meeting on new harvest strategies for Pacific bluefin
3. Documents that are not part of the IATTC to be reported as external documents
4. A presentation on the report of the bycatch working group by its Chair
5. A presentation on the report of the *ad hoc* working group on FADs by its Chair
6. Consideration of methods to reinforce and enhance the role of the SAC
7. A review of the IATTC Performance Review recommendations relevant to the SAC

3. THE FISHERY:

3.1. The fishery in 2016

Nick Vogel presented SAC-08-03a, The Fishery for Tunas and Billfishes in the Eastern Pacific Ocean in 2016. The report provides a summary of the fishery for tunas in the eastern Pacific Ocean (EPO), and an evaluation of the pelagic ecosystem in the EPO, in 2016. He discussed EPO tuna catch statistics, including total catches by gear, species and flag, purse-seine catch distributions for yellowfin, skipjack and bigeye, and size compositions of the three species. The catches of yellowfin, skipjack, bigeye, and Pacific bluefin tunas by purse-seine, pole-and-line, and recreational gear in 2016 of 637,000 metric tons (t) were about 12% higher than the average of catches for the previous 15 years.

Most of the yellowfin catches in 2016 were taken near the coast of the Americas in sets associated with dolphins, and to a lesser extent in unassociated sets. These sets occurred in two main areas; a northern area off the coast of Baja California, Mexico, and a southern area east of 95°W and north of 5°*S*. The total yellowfin catch of 240,000 t in 2016 was 9% higher than the average of the previous 5 years.

Most of the skipjack catch in 2016 was taken in sets associated with floating objects, with lesser amounts taken in unassociated sets near the coast of Peru and far offshore between 140° and 150°W. Skipjack catches

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

were more northerly than the previous 5-year average, with significant catches throughout the EPO between the equator and 10°N. The total skipjack catch of 337,000 t in 2016 was 19% higher than the average of the previous 5 years.

The bigeye catch distributions in 2016 were very similar to the average annual distributions for 2011-2015 throughout the EPO. Most of the bigeye catches occurred between 10°N and 15°S in sets on floating objects. The total bigeye catch of 56,000 t in 2016 was 5% lower than the average of the previous 5 years.

The length-frequency and species-composition sampling program was reviewed. Of the 946 wells sampled in 2016, 774 contained yellowfin, 631 contained skipjack, and 246 contained bigeye. The decline in the average weight of yellowfin continued, with a six-year low of 6.2 kg in 2016. The average weight of skipjack in 2016 of 1.8 kg was also lower than any of the previous 5 years. The average weight of bigeye in 2016 rose slightly from the previous year, at 5.0 kg *vs* 4.7 kg in 2015.

Catches of Pacific bluefin tuna by purse-seine vessels in the EPO in 2016 were 3,243 t. The catch is closely monitored in near-real time through at-sea reporting by on-board observers, to avoid catches exceeding established yearly limits.

Discussion

A participant asked why there has been difficulty in obtaining size samples of Pacific bluefin from purse-seine vessels in recent years, and inquired about options for correcting this problem. Nick Vogel explained that in recent years, the entire Pacific bluefin catch goes directly into fattening pens. Although some fish die during the transfer from the towing pens to the fattening pens and are available for measuring by observers, there are concerns that these samples are not representative of the catches (smaller, weaker fish die during the transfer). The IATTC staff has obtained size data through port sampling of the U.*S*. sportfishing fleet, but the staff member who conducted that sampling has recently retired. Since then, sampling of the sport fishery for bluefin has been taken over by the US National Marine Fisheries Service (NMFS). Alexandre Aires-da-Silva indicated that the IATTC is working with pen owners in Mexico and Mexican scientists to obtain reliable size data on Pacific bluefin from stereoscopic cameras that collect size data as the fish are transferred from towing pens to fattening pens. This was confirmed by another participant who noted that the data are being reported to the ISC and the IATTC. Cleridy Lennert-Cody explained that this issue was complex, and also involved developing the right experimental design for collecting the size data.

A participant inquired about the possibility that juvenile bigeye and yellowfin are not being sorted properly due to misidentification. Guillermo Compeán explained that the IATTC has a process for correcting the identification data using port sampling data.

A participant noted that swordfish catches have doubled in recent years compared to the 2009-2010 period, and asked if the IATTC planned to do an updated assessment for swordfish. Mark Maunder indicated that there were no plans for such an assessment , since the billfish assessment scientist on staff had retired. The staff plans to focus on developing indicators for billfishes.

3.2. Catches of tropical tunas in the framework of Resolution C-17-01

Marlon Roman presented a summary of yellowfin and bigeye catches in 2016, and in 2017 through 30 April. The fisheries on dolphins and floating objects have reached 26.3% and 40.6% of their respective limits in 2017. Pursuant to Section 5 of Resolution C-17-01, the Director is required to inform CPCs when the catch reaches 80% of the catch limit, and at 90% to provide an estimate of the projected closure date. A bi-weekly report is elaborated to inform the Director about the status of yellowfin and bigeye catches in such sets.

Discussion:

A participant asked if there is a significant increase in total catch if discards are included. Guillermo Compeán indicated that the discard amounts are typically small, but that they could form a significant

cumulative total by the end of the year. Another participant inquired about the percentage of catches for vessels not carrying observers, and noted that those data are not obtained in real time, thus creating a time lag in analysis. Guillermo Compeán explained that the Resolution provides an expectation that CPCs are obligated to provide this information, and that it is not just the responsibility of the staff to obtain the data.

A participant asked about the analysis of catch by set type, and whether weekly reports could be generated distinguishing catches by set type. Guillermo Compeán noted that the staff has received several requests for this type of analysis, but that there are limitations to this analysis since it is dependent on logbook data, which requires that staff are in place to collect the data. It appears that there has been an acceleration of fishing in the EPO due to this Resolution which should be recognized by the Members.

A participant noted that there are data collection limitations within this framework that will be an issue for the IATTC Annual Meeting in July, and suggested that further reports describing the procedure used to collect data be prepared for the July meetings. Guillermo Compeán agreed, and indicated that two additional reports on the implementation of the resolution will be prepared.

Another participant noted the problems in processing data from total catch only, and suggested that more detailed data be collected, including catch by set type. Guillermo Compeán explained that the limitations to the analysis are set by the information provided by CPCs, and that if the data are not provided, the staff cannot generate the expected interpretation of the data.

A participant noted that Ecuador has an observer program that covers about 30% of the fleet of smaller vessels. The data obtained from this program are provided to the IATTC staff, and this information should be useful in extrapolating trends in the data. Guillermo Compeán confirmed that these data are being utilized by the staff.

3.3. Update on active fleet capacity

Mark Maunder presented an update on active fleet capacity in the EPO. There are several methods to calculate the capacity of the fleet. The capacity weighted by days fished and the capacity that fished were compared with the capacity measure in Table A10 of SAC-08-03ª, for the entire fleet and for vessels with and without DMLs. The changes in capacity over time differ among methods and between DML and non-DML vessels, but they all show a general increase in recent years. The capacity was also compared to the fishing mortality estimated by the stock assessments for yellowfin in the dolphin-associated fishery and bigeye in the floating-object fishery. In general, fishing mortality follows capacity, but there is a substantial variability in the relationship.

Discussion:

A participant asked why the change in capacity between 2015 and 2016 presented was different than that presented at the IATTC meeting in February. Mark Maunder explained that the number presented in February was based on days at sea because at that time complete logbook data were not available for 2016, whereas the numbers presented at this meeting were based on days fished, which is a better measure of capacity.

A participant noted that after 1993, there was a weaker correlation between increased capacity and catches. It was proposed that, for conservation measures, a greater focus should be placed on fishing mortality and the underlying mechanisms affecting increases in fishing mortality. Another participant agreed and indicated that the correlations between capacity and catches are low because capacity is not a good indicator of the impact of the fishery, due to the lack of linearity between capacity and catches.

A participant noted that for the analysis of capacity, it is necessary to define units of capacity. However, over time there has been an evolution in effectiveness of capacity, so there should not be an expectation of a linear relationship between capacity and catches.

3.4. National reports

Guillermo Compeán noted that the 10 national reports submitted to date by CPCs, mainly on their longline observer programs, are available on the meeting web page.

Discussion:

A participant suggested that a standardized report format be used for both national reports and longline observer program summaries. Guillermo Compeán indicated that it had been suggested at previous meetings that the ICCAT form be used for national reports, and suggested that the SAC could consider this issue during this meeting, and possibly develop some recommendations for the report.

3.5. The fishery on FADs in the eastern Pacific Ocean

Martín Hall presented Document SAC-08-03e on the FAD fishery in the EPO, an update and extension of Documents SAC-05-04a and SAC-07-03a, presented at the meetings of the SAC in 2014 and 2016, respectively. The presentation summarized FAD characteristics and dynamics, patterns of FAD distribution in the EPO, species compositions of captures in FAD sets, bycatches, and the number of FADs deployed by region versus capture per positive set (CPPS).

Discussion:

A participant noted that one of the main conclusions from this presentation is the need for more information on the density of FADs, and suggested that the SAC should reinforce this message and consider the determination of FAD density as a priority. Martín Hall agreed, explaining that the number of FADs is not a good indicator of effort, due to factors such as speed and location of currents, and that optimal utilization of FADs is an important consideration in the analysis.

Another participant noted that during the Joint Meeting of Tuna RFMOs on FADs in February 2017 in Madrid, one of the highlighted topics of study was the lack of information on the number of FADs in the EPO. Other RFMOs impose limits on the number of FADs deployed, and it was suggested that the SAC should consider the number of FADs that can be deployed per vessel in the EPO.

4. STOCK ASSESSMENTS:

4.1. Bigeye tuna assessment for 2016

Alexandre Aires-da-Silva presented SAC-08-04a, the key results of an update stock assessment of bigeye tuna in the EPO in 2016. The assessment indicates a general recovering trend during 2005-2009, subsequent to IATTC tuna conservation resolutions initiated in 2004, but not during 2010-2013, most likely related to poor recruitments in 2007 and 2008. More recently, the spawning biomass ratio (SBR) is estimated to have increased greatly, from a low of 0.16 in 2013 to 0.26 at the start of 2017; in the model, this increase is driven mainly by the recent increase in the CPUE of the longline fisheries that catch adult bigeye, which can be attributed to the strong recruitment in 2012. According to the base case assessment, recent fishing mortality rates (F) are below the level corresponding to MSY (F_{MSY}), whereas recent spawning biomasses are above that level. These interpretations are subject to uncertainty, but do not exceed the limit reference points.

Discussion:

A participant noted that the analysis is based on the CPUE data from the Japanese longline fishery and the main index of abundance for bigeye. While that has proven consistent, data from other longline fisheries, such as Korea or Chinese Taipei, could be incorporated. Alexandre Aires-da-Silva indicated that the CPUE data from the Japanese longline fishery are the most complete, date back to 1975, and include the minimum operational data (including hooks/basket) for standardization. Catch and effort data from other CPCs have improved, so might be used to examine trends in CPUE and selectivity. Representatives from Chinese Taipei and Korea confirmed that such data are available for certain time periods, and Alexandre Aires-da-Silva indicated that they could be incorporated in future bigeye assessments. IATTC staff and scientists

from Japan are collaborating on standardizing tropical tuna CPUE, and this work could benefit from expanding the collaboration to scientists from Chinese Taipei and Korea.

A participant noted that the strong bigeye recruitment in 2012 was not apparent in the 2015 assessment, and asked what data had such a strong influence to make the recruitment surge appear in the 2016 assessment. Alexandre Aires-da-Silva explained that there were signs of an above-average 2012 recruitment in the 2015 assessment, but the estimate was not as strong as in the 2016 assessment. The model increased this recruitment estimate to explain the large increase in larger fish in the recent CPUE data. The high recruitment estimate is also consistent with the large proportions of smaller fish observed in the size-composition data of the southern floating-object fishery in 2012.

A participant noted that the fishing mortality from the fishery on FADs is influencing the bigeye resource and must be taken into account in conservation measures. Another participant questioned the relationship between spawning biomass and recruitment of bigeye. Alexandre Aires-da-Silva indicated that there is no evidence for the existence of such a relationship, but when a large recruitment occurs, it will influence the spawning stock biomass as it moves through age classes. The assessment assumes that stock size is being driven by recruitment, not vice versa.

A participant asked for clarification on the need for more flexibility in the growth curve model used in the assessment. Alexandre Aires-da-Silva indicated that the current growth curve for bigeye is a Richards model, which fits simultaneously to otolith age-at-length readings for young fish and tagging length-increment data for older fish. However, the data show a general growth cessation around age-at-maturity, which may require a more flexible growth curve than the Richards model. Some exploratory work with a more flexible growth model has already been initiated for bigeye (SAC-08-09b).

A participant noted the sources of uncertainty (parameter and structural) discussed in the bigeye presentation, and asked if the staff has any specific recommendations to address uncertainty. Alexandre Aires-da-Silva indicated that some approaches to address uncertainty in the assessments are to be covered later in the meeting in the presentation on staff research plans. For example, the staff is starting to incorporate spatial structure into the bigeye stock assessment.

4.2. Yellowfin tuna assessment for 2016

Carolina Minte-Vera presented SAC-08-04b, the key results of an update stock assessment of yellowfin tuna in the EPO in 2016. In general, there is uncertainty about recent and future levels of recruitment and biomass. There have possibly been three different productivity regimes since 1975, and the levels of MSY and the biomasses corresponding to the MSY may differ among the regimes. The recruitment was below average until 1982, mostly above average from 1983 to 2002, and then mostly below average until 2014. The annual recruitments for 2015 and 2016 were estimated to be above average. The spawning biomass ratio (SBR) has been average or below average since 2006, except during 2008-2010. Under the current (2014-2016 average) fishing mortality, the SBR is predicted to increase in the next two years because of the large recent recruitments, and level off at about the MSY level if recruitment is average. The recent fishing mortality (F) is slightly below the MSY level (F multiplier = 1.03), and the current spawning biomass (S) is estimated to be below that level ($S_{recent}/S_{MSY} = 0.86$).

Discussion:

A participant asked about the term S_{MSY} and its components. Carolina Minte-Vera indicated that S_{MSY} is a spawning potential index; it incorporates everything known about reproductive parameters such as frequency of spawning, fecundity, and maturity. A participant asked which of the two Kobe plots presented for the analysis is used for management advice. Carolina Minte-Vera explained that the staff's advice is based on the F multiplier and its corresponding spawning biomass, therefore the Kobe plot that depicts the relative spawning potential index (S/S_{MSY}) should be used for management, with the goal of staying within the bounds of the limit reference points. A participant suggested that the yellowfin stock should be managed to higher, safer levels of biomass rather than borderline levels, to take advantage of recent high recruitment.

A participant asked about the relatively stable impact of the floating-object fishery in the fishery impact analysis: in recent years juvenile mortality had increased substantially, yet the relative impact of this mortality was not reflected in the fishery impact plot. Carolina Minte-Vera replied that the young fish have a very high rate of natural mortality, and that increased recruitment is not yet reflected in an increase in spawning biomass and would not be seen in the fishery impact analysis for another1-2 years.

Another participant noted that there is uncertainty in predicting the impact of increased F on juveniles, and asked about the uncertainty margins in the analysis. Carolina Minte-Vera agreed about the need to consider uncertainty in the analysis, and said that the effect of the increase in juvenile F can be seen through its effects on recent summary biomass and on spawning biomass in later years, and consequent uncertainty estimates around those estimates. The estimates of summary biomass (which mostly indicate recent recruitment, as they based on fish aged 3+ quarters) for 2017 are fairly high, and the spawning biomass index is estimated to increase in the near future to the MSY level and then decrease. However, there is uncertainty in the structural terms of the model as well as in the future projections of recruitment, which are not included in those projections, so caution should be used when using the results of this analysis. She added that the increased recruitment partially offset the increase in fishing capacity for yellowfin.

A discussion developed regarding the use of environmental factors such as oceanographic conditions in the yellowfin assessment. A participant suggested that models that analyze oceanographic conditions should be developed for all three tropical tuna species. Mark Maunder explained that the staff has incorporated environmental variables in past assessments with varying degrees of success. In general, environmental data can predict recruitment but do not improve the assessments from a historical perspective, but the staff considers environmental data as a possible complementary source of analysis.

4.3. Skipjack tuna: indicators of stock status

Mark Maunder presented SAC-08-04c, an update for indicators of stock status of skipjack up to 2016. Since stock assessments and reference points for skipjack in the EPO are very uncertain, in 2007 the staff began to investigate some simple indicators of stock status based on relative values of indicators compared to their historical values, using data from the purse-seine fisheries on unassociated schools and on floating objects. The purse-seine catch started increasing substantially in the mid-1990s, and has fluctuated around the upper reference level since 2003. The catch in 2015 and 2016 is at the highest levels seen historically and exceeded the upper reference level. The main concern is that the average weight of skipjack has been declining since 2000, and in 2015 and 2016 was below the lower reference level. This could be due to higher exploitation rates, but is likely related to high recruitments in recent years. Biomass and recruitment have been increasing over the past 20 years, and were above the upper reference level in 2016. Skipjack biomass is assumed to be above the MSY level, based on comparisons with bigeye.

Discussion:

A participant noted that catch per day's fishing (CPDF) is not a good indicator for the fishery, but that it is the best information currently available. The skipjack catch is dominated by the FAD fishery, and a better indicator must be developed. Mark Maunder agreed on the need for a better indicator , noting that CPDF is an index of catch per set because most vessels make only one set per day. He also explained that CPDF is often more associated with size of schools caught, and for that reason, the CPDF for the unassociated fishery is also included in the analysis.

Another participant suggested that an assessment model is needed for skipjack, like those for yellowfin and bigeye, that incorporates new information from acoustic buoys and/or tagging, and will hopefully be integrated with environmental parameters. Mark Maunder explained that assessment methods similar to those for yellowfin and bigeye have been applied to skipjack in the past, but that the results were not satisfactory for making management decisions. Reliable indices of abundance based on CPUE data are needed, or perhaps an approach that incorporates acoustic buoy information or, ideally, data from tagging programs like those used in the Western and Central Pacific. He also reiterated that environmental data can

predict recruitment but do not improve assessment models from a historical perspective.

Another participant noted that it is instructive to consider the possible effects of oceanographic variables on recruitment, catch, and the weight of skipjack in the catch. El Niño and La Niña events have an influence on ocean temperatures and potentially available forage for skipjack, ultimately affecting both growth and recruitment.

4.4. Pacific bluefin tuna: update on indices and evaluation of new harvest strategies

4.4.1. Report of the ISC Bluefin Tuna Working Group

Hiromu Fukuda presented SAC-08 INF E(a), *Pacific Bluefin Tuna: Update on Indices and Other Activities by the ISC PBFWG*. Since the ISC performs a full assessment of Pacific bluefin every two years, and the last assessment was performed in 2016, a full assessment was not conducted this year. Instead, the ISC has updated abundance indices to monitor the most recent trends in spawning stock and recruitment. Analysis of the CPUEs from the Japanese and Taiwanese longline fleets shows a slow but consistent increase in the abundance of larger spawning fish, while the catch-at-length data indicate a new mode of smaller fish in the catch. These results are viewed as positive developments for the stock. The updated standardized CPUE from the Japanese troll fleet, which represents the relative abundance of age-0 recruits, shows a slight increase from 2014 to 2016. Results were shown of projections requested by the WCPFC-IATTC Joint Meeting, that summarized performance measures for Pacific bluefin under multiple harvesting scenarios. Trajectories of spawning stock biomass and total yield during 2015-2035 were shown.

Discussion:

One participant congratulated the ISC Working Group on this important work, noting that all the scenarios for Pacific bluefin requested by the WCPFC had been included in the analysis, and that it was encouraging that some of these scenarios indicate that achieving the rebuilding objectives is possible.

Another participant asked why, in the projections for different management scenarios, *F* was limited rather than using the catch limits adopted by the WCPFC and the IATTC. Hiromu Fukuda explained that the analysis was designed to address both effort control and catch control.

4.4.2. Summary of the ISC Pacific bluefin international stakeholders meeting

Gerard DiNardo presented a summary of the ISC Pacific bluefin international stakeholders meeting. In 2016, the WCPFC and IATTC had asked ISC to evaluate the performance of various harvest scenarios relative to six candidate rebuilding targets and performance metrics, under a range of assumptions regarding future recruitment, and to present the results at the ISC Pacific Bluefin Tuna Stakeholders Meeting in April 2017. No clear consensus on future rebuilding targets emerged from the meeting, but there was a general commitment to the earliest feasible recovery and a recognition that restructuring of the fisheries towards larger fish would be beneficial. Catch limits should be raised when stocks have rebuilt to a yet-undetermined level. Uncertainty in the analysis is high, and precautionary approaches are recommended. There is potential support for 20% SSB_0 as the next rebuilding target. The next step is continued discussions among stakeholders leading up to the 2nd Joint IATTC-WCPFC-Northern Committee Workshop in August-September 2017.

Discussion:

There was no discussion on the presentation.

4.4.3. Developing a rebuilding target and harvest strategy for Pacific bluefin tuna

Mark Maunder presented**, "**Developing a rebuilding target and harvest strategy for Pacific bluefin tuna." Pacific bluefin tuna has been depleted to a very low level, and needs to be rebuilt to avoid recruitment failure and stock collapse, and to increase yields. A series of management actions have been introduced, and an interim rebuilding target was established, but no reference points have been agreed upon. It is estimated that, under the current management regime, the stock will rebuild to the rebuilding target by 2024

with more than a 60% probability, even if a low-recruitment scenario is assumed. However, the stock will still be overfished under commonly-used reference points, and whether overfishing is still occurring has yet to be determined. The initial rebuilding target was designed to get the population out of the immediate risk of recruitment failure and stock collapse. Even though it is estimated that the stock will reach the rebuilding target in the designated number of years under the current management regime, it should be rebuilt further to reduce risk and increase yields. Factors were discussed related to developing the rebuilding target and the associated harvest strategy, and evaluating some example harvest strategies. These rebuilding targets and harvest strategies are only a selected few of the many possibilities; others might be desirable. Additional discussions among the stakeholders are needed to determine the appropriate rebuilding target and the harvest strategy that will achieve the target.

Discussion:

A participant suggested that it would be informative to develop a Kobe plot for this analysis, at least perhaps for 2018. Mark Maunder explained that this is an ISC assessment, so that question would have to be directed to the ISC. Another participant noted that the ISC had considered a Kobe plot, but did not pursue the analysis due to a lack of reference points.

A discussion developed regarding reference points. Mark Maunder noted that the 20% SSB_0 is arbitrary, since we are not yet rebuilding to a specific target reference point. The current target is about getting the population out of the immediate risk of recruitment failure and stock collapse, while the target reference point would be a target for the longer term.

A participant asked about the assumption about steepness of the stock-recruitment relationship and the definition of a "drastic drop" in recruitment in the analysis of harvest strategies. Another participant noted that the ISC, in their analysis, assumed a steepness of 0.999, although a sensitivity analysis was also conducted using a steepness of 0.9. The definition of a "drastic drop" in recruitment is difficult to define, because it depends on the level of SSB. If SSB is high, then one or two years of very low recruitment would be less concerning in terms of impact to the stock. There is also an attempt within the analysis to evaluate the impact to the stock of apparent recent recruitment increases. Mark Maunder explained that if a stock-recruitment relationship is assumed while the stock size is low, then there is a chance that, if incorrect, stock recovery projections could exceed the real levels.

4.5. North Pacific albacore tuna

Steve Teo presented the provisional results of the 2017 north Pacific albacore stock assessment conducted by the ISC Albacore Working Group (ALBWG) during a workshop in April 2017, which was attended by scientists from Canada, China, Chinese Taipei, Japan, the United States of America, and the IATTC.

The north Pacific albacore tuna stock was assessed using a length-based, age-, and sex-structured Stock Synthesis (SS Version 3.24AB) model fitted to time series of standardized CPUE (1996-2015) and size composition data over the 1993 to 2015 time-frame. Sex-specific growth curves from the 2014 assessment were used due to evidence of sexually dimorphic growth, with adult males attaining a larger size-at-age than females. Sex-specific M-at-age vectors were developed from a meta-analysis, with a sex-combined M that scaled with size for ages 0-2, and sex-specific M fixed at 0.48 and 0.39 for age-3+ females and males, respectively. Stock status was analyzed in relation to the limit reference point (LRP) adopted by the WCPFC Northern Committee for the stock and the equivalent fishing mortality. The Kobe plot shows that the stock has never fallen below the LRP since 1993, although there is large uncertainty in the 2015 estimate. Even when alternative hypotheses about key uncertainties such as M and growth are evaluated, the point estimate of female spawning biomass (SSB) does not fall below the LRP, although the risk increases with more extreme assumptions. Female SSB in 2015 (SSB_{2015}) is estimated to have been 80,618 t, 2.47 times greater than the LRP threshold of 34,374 t. Current fishing mortality, $F_{2012-2014}$, estimated as $1-SPR_{2012-2014}$, is lower than potential F-based reference points identified for the north Pacific albacore stock, except $F_{50\%}$. Based on these findings, the ALBWG concluded that the stock is likely not overfished and overfishing is likely

not occurring.

Discussion:

Mark Maunder noted that northern albacore are highly migratory, and asked how migration characteristics come into play, and whether we can gain any insights from the northern albacore analysis and apply them to the bigeye analysis. Steve Teo indicated that there are clear movements of juveniles to the eastern Pacific, but eventually the adults are no longer accounted for, but at some point, there is apparent segregation by sex and size. Many of these stock characteristics that may be related to migration are difficult to uncover.

A participant noted that the albacore analysis involved a reduced time series of the data due to some size anomalies that were not explained, and asked if that was due to the spatial location of the fisheries, for example, any movement in the Hawaiian fishery. Steve Teo indicated that movement of the fisheries was considered by the ALBWG, but the available data are not that convincing. So, it is possibly related to spatial changes in fishery operation, but it could also be due to cohort driven growth. A participant asked whether any research needs for albacore could be addressed by the IATTC. Steve Teo indicated that the ALBWG gets good cooperation from all the ISC countries. For example, Chinese Taipei is collecting fin clips through observers and sending to NOAA for analysis. In the IATTC management zone, most of the fishery is directed at juveniles, mostly by the U.*S*. and Canada, so large numbers of adults are not collected in the eastern Pacific.

Another participant asked about growth differences by sex and sex ratios, and noted that this would be good information to include in the analysis, and asked if any pop-up tagging had been conducted, noting that pop-up tagging has thus far proven to be difficult with albacore in the Mediterranean Sea. Steve Teo indicated that pop-up tagging has been a problem, due to the soft flesh of albacore, and the longest retention time for the tags has been three weeks. A participant asked about joint tuna-RFMO efforts to compare methods across oceans for albacore. Steve Teo indicated that albacore is a good candidate for collaboration, and there has been discussion of an albacore-specific workshop. A participant asked about troll fisheries and whether they could be useful for providing abundance indices. Steve Teo explained that there are problems with the troll indices for the U.*S*. and Canada, and with the pole and line indices in Japan. There are seasonal, annual and spatial changes in those fisheries which create selectivity or catchability changes that the ALBWG cannot explain.

5. MODELLING:

5.1. Effects of decreasing longline effort and changes in species composition on standardized CPUE for tuna in the EPO

Keisuke Satoh presented on this topic. The catch composition of the Japanese longline fishery operating in the Pacific, Atlantic and Indian Oceans has changed since about the 1990s, with typically increasing catches of albacore tuna, and decreasing catches of bigeye and yellowfin tuna. In the eastern Pacific Ocean (EPO), changes of gear configurations (number of hooks between floats, floatline length, branchline length) also have been observed. These changes in species composition and gear configurations appear to be related because shallower gears were fished in areas where albacore and other species (swordfish, marlins) dominated the catch, and deeper gears were fished in areas where bigeye tuna dominated the catch. The higher catch-per-unit-effort (CPUE) of each species in a stratum (year - quarter - fishing location) is assumed to contain useful information on the fishery's targeting practices. The relationship between higher CPUE of each species and factors related to targeting (*i.e*., gear configurations, fishing season and location) was evaluated using a decision tree approach (based on the C.A.R.T. method for classification), applied to operational-level data for 1998-2014. The criterion used to define "higher" CPUE was the 85th percentile of the by-set CPUE values of each species. This criterion was established after comparing decision tree results using criteria of 75th, 85th and 95th CPUE percentiles; the results at the 85th percentile were found to be the most robust with respect to changes in decision tree parameters. From the final decision tree, the proportion of sets targeting a species (the Potential Target Species, PTS), was calculated for each terminal

node of the tree. The difference in the proportion values among terminal nodes was small for terminal nodes that represented tropical areas of the EPO. The stability of the high proportion of sets targeting bigeye tuna across the nodes of the tree that presented tropical areas indicates that, during the period of this study, bigeye was targeted in these more tropical waters of the EPO, regardless of the gear configuration and fishing season. However, even in tropical areas, gear configurations and seasons with a high proportion of sets targeting albacore, yellowfin or swordfish/marlins also were found, indicating that targeting may not lead exclusively to high catches of just one species. Therefore, in order to explore the influence of recent changes in targeting practices on CPUE standardization for the Japanese longline fishery in the EPO, it will useful to compare the results of CPUE standardization for the tropical tuna species using all available data, excluding data for areas/season/gear configurations identified in decision tree analysis as targeting species other than the tropical tunas, and using only data from the areas/seasons/gear configurations identified by the decision tree analysis as targeting tropical tunas.

Discussion:

Carolina Minte-Vera thanked Keisuke Satoh for his work on this important topic, noting that it is of heightened importance because IATTC staff use Japanese longline data CPUE indices in the assessments of both yellowfin and bigeye tuna. She noted that this research begins to shed some light on changes in the fishery since 2010, such a shift in size composition data to larger animals in southern areas, as well as a shift of target species from bigeye tuna to albacore tuna and a change in gear configuration in the central and southern areas. Keisuke Satoh indicated that he did not have available additional details other than what she had described, and noted that due to these changes, the size data in the southern area should probably be examined by each degree of latitude.

Carolina Minte-Vera stated that the Japanese longline data the IATTC currently used for standardization of CPUE includes explanatory variables such as the number of hooks per basket and the number of floats, but that other variables mentioned in his research, such as length of float lines and branch lines, had not been made available to IATTC scientific staff yet. She expressed hope in continuing collaborative work with Japan to use that data, and Keisuke Satoh indicated that should be possible.

Steve Teo also asked when the results of this analysis could be finalized and used to inform IATTC assessments. Keisuke Satoh responded that collaboration was planned immediately following the SAC-08 meeting and again in early 2018, so there was reason to hope that CPUE standardizations can be completed before the 2018 SAC meeting.

Mark Maunder asked whether the available length-frequency data could be associated with individual sets or trips, so that the corresponding gear characteristics could be taken into consideration. Keisuke Satoh said that this was possible in a limited number of cases, noting that the process of linking length frequency data with logbook data was difficult and very time-consuming.

5.2. Can we estimate abundance of yellowfin tuna in the EPO?

Carolina Minte-Vera presented research ([SAC-08-05b](#)) which examines whether current models can provide realistic estimates of the absolute abundance of yellowfin tuna in the EPO. This study looks at the results from various approaches, including the integrated statistical age-structured population dynamics model (IM) currently used in the base-case analysis, an age-structured production model (ASPM), catch-curve analysis, and a depletion model with a monthly time scale.

Carolina Minte-Vera noted that the absolute biomass estimates from the catch-curve analysis were similar to those of the base-case IM. This showed that the signal from the length-composition data is mostly consistent with both the absolute abundance and trends estimated by the IM for most of the series, except for the recent period, when the average size of the fish caught by several fleets increased. This might be an indication of model misspecification at the end of the time series (*e.g.*, temporal changes in selectivity). The age-structured production model was unable to fit the data, unless recruitment deviations were also estimated, which made the uncertainty very large. This led to the conclusion that the abundance

information, both absolute and trends, contained in the indices cannot be interpreted without accounting for fluctuations in recruitment, and the index data used in the stock assessment do not include enough information to estimate absolute abundance precisely. The depletion estimator provided a good fit to the data, and provided estimates of absolute abundances which coincided with those from the base-case IM, increasing the confidence in the stock assessment model currently in use. The good performance of the depletion model, in both this study and in previous work, suggests that the approach should be investigated for improving the assessment of yellowfin in the EPO, for example by changing the IM to a monthly time scale. She also noted that the depletion model could provide "in-season" abundance estimates, which could be important if catch limits are used for management. Finally, Carolina Minte-Vera advised that tagging data could be another important source of information that could be integrated into the models, and that data from a large-scale tagging project could be used to estimate absolute abundance.

Discussion:

One participant commended this work on improving estimates of yellowfin abundance, and noted that some of the results seem to suggest that the yellowfin stock might be in better condition than the current assessment suggests. Carolina Minte-Vera responded that further analysis should be undertaken to clarify this point. She highlighted that the size composition data from the longline fishery in the southern EPO, which is also the fishery associated with the main index of abundance, has a disproportional influence on the results of the assessment model and the resulting estimate of how much the abundance of yellowfin has declined. In recent years, the average size caught by this fishery has increased, while the CPUE has decreased. Investigations are needed to determine whether a change of fishing method, gear, or location resulted in changes in selectivity and thus changes in the component of the population corresponding to the index. However, she also noted that the depletion model examined here, which does not use any longline data, produced very similar results to the integrated model, especially in recent years, indicating that, although the longline data may be overly pessimistic, the integrated model is still able to capture the dynamics of the stock and might be producing reliable estimates of the status of the stock.

Another participant asked about the purpose and usefulness of this work. Carolina Minte-Vera responded that it helps to determine whether: a) the current assessment model is supported by the alternative data sets; b) the appropriate weight is being given to the various data components; and c) any model assumptions (growth curves, for example) are problematic and warrant further investigation. The results suggest that the growth assumptions are reasonable. Although there may be some influential data sets, the assessment model is producing reasonable estimates, highlighted by the agreement of the results from multiple models that use different data sets and assumptions.

Asked whether approaches like the depletion model could be useful for sharks or bycatch species of concern, the staff responded that the depletion model is more suitable for highly-productive, short-lived species such as dorado, and thus is not a good tool for evaluating sharks. However, even in a situation where a species life history might otherwise make a depletion model a reasonable choice, the necessary quantity and detail in available data are lacking for bycatch species, which is why CPUE is frequently the fallback indicator.

Finally, asked whether the concerns about the recent data from the southern longline fishery justified a reconsideration of the most recent assessment, and whether a slightly different model with a time block for the longline fishery should be run, the staff responded that this research was primarily an evaluation tool, and that there are plans for further studies of the longline fisheries issues and for future modifications of the assessment model following the results from this research. A participant cautioned against using a model that has not been thoroughly discussed and evaluated as a basis for management advice.

5.3.   Exploratory spatially-structured assessment model for bigeye tuna

Alexandre Aires-da-Silva presented an update on the ongoing exploratory spatially structured assessment modelling work for bigeye tuna. At this point, the research is aimed at improving the spatial structure

assumptions in the Stock Synthesis (SS) model for bigeye in the EPO. Taking into consideration available tagging data, the spatial model assumes two interacting bigeye sub-stocks in the EPO, split at 120°W. Fishery definitions are based on regression tree analysis on CPUE and size composition data for purse-seine and longline fisheries. One of the expected results of adding spatial structure in the EPO model is to reduce the strong two-regime recruitment pattern that results from upweighting the size-composition data, but so far this has not occurred. . Once a good spatial model for the EPO has been developed and this issue is solved, the western geographical boundary of the assessment can be expanded to develop a Pacific-wide spatially-structured SS model, although there are some remaining issues related to how SS partitions global recruitment among regions that need to be solved. Also, other spatial structure assumptions could be investigated.

Discussion:

The discussion focused on developing a Pacific-wide model for bigeye. There was some discussion of a previous Pacific-wide assessment, the model used, and whether the results indicate that the staff should change the way that it assesses bigeye. Mark Maunder explained that there are differences between MULTIFAN, the model used for the previous assessment and WCPFC assessments, and the Stock Synthesis model used by IATTC staff: each has its benefits and shortcomings, and the staff planned to continue using Stock Synthesis for the foreseeable future. Alexandre Aires-da-Silva noted the general agreement among the results of the Pacific-wide assessment and the assessments conducted for the EPO and WCPO separately. While Pacific-wide collaborative efforts should be continued to develop operational models and help identify improvement to both EPO and WCPO models, in the near term each organization would continue to conduct its own assessment for its own Convention Area, using its preferred model.

Several participants considered that the exploratory work should continue, given the mounting evidence of mixing of bigeye across the Pacific. The staff agreed, but noted that conducting separate assessments for the EPO and WCPO is not causing problems, and should continue as the basis for formulating conservation and management recommendations. Finally, participants and staff agreed that further research into the spatial structure of tunas in the Pacific should include large-scale tagging studies, which would also provide additional data for parameters such as growth rates and natural mortality. Kurt Schaefer noted that an outline for a large-scale tagging program had been prepared previously, but had not led to any action. It was suggested that the staff update the proposal for consideration at the meeting of the Commission in July.

5.4.   Spatial-temporal modelling of CPUE data

Mark Maunder presented document SAC-08-05d, outlining the use of spatiotemporal models for standardizing CPUE and composition data, using North Pacific bluefin tuna as an example. Standardizing for spatiotemporal distribution of the fishing effort has been a main issue in CPUE analysis. Of particular concern is the change in spatial distribution over time due to movement of the stock, recruitment dynamics, or local depletion, which may bias the indices of abundance. In addition, a somewhat overlooked component of using indices of relative abundance in stock assessment models is the component of the population that is represented by the index with respect to age or size. The selectivity curve represents both the catch and the index of abundance. However, "selectivity" in the stock assessment model does not simply represent contact selectivity, but also represents availability, which is a consequence of the spatial structure of the fleet relative to the stock. Therefore, because the index represents abundance in each area and the fishery catch represents catch in each area, and the spatial distribution of the catch is not necessarily proportional to abundance, if the composition differs among areas, then the "selectivity" in the stock assessment differs between the index and the catch. The same spatiotemporal model should be used to derive the index and the composition data.

Discussion:

A participant commended the staff on this research and recommended that the SAC express support for this type of work, which demonstrates that IATTC staff contribute cutting-edge work.

Hiromu Fukuda confirmed that at present it is difficult to associate size-composition data collected at landing with precise locations recorded in logbook entries. He noted that for now, the simplest way to make progress might be to define larger areas (5° x 5°) for associating size composition with CPUE data in order to estimate abundance indices using spatio-temporal models and evaluate how the area-specific size availability affects catchability. Mark Maunder commented that this method had occurred to him as well, and that the best way forward would be to attempt it.

5.5. Research on Management Strategy Evaluation (MSE)

5.5.1. Update on activities and progress

Carolina Minte-Vera presented an overview of the staff's past, current, and planned work on Management Strategy Evaluation (MSE).

Completed work includes preliminary MSE work for bluefin tuna ([SAC-05-10b](#)), bigeye tuna ([SAC-06-10b](#)), and dorado ([SAC-07-06a(ii)](#)). A methodology for using the Stock Synthesis (SS) modelling platform to develop operating models (assumed to represent the underlying true dynamics) based on current assessments was developed. Simulated data are generated, and modified stock assessments are implemented, often including misspecified processes and parameters to represent some of the uncertainty and structural errors of real assessments. The dorado research, partially funded by WWF and conducted in collaboration with an external consultant (Juan Valero), aimed at providing a tool for formally evaluating alternative management strategies and included testing the current management strategy of seasonal closures.

Current activities:
  a. collaborating with the International Scientific Committee (ISC) in the MSE process for North Pacific albacore and Pacific bluefin tunas. Since an initial workshop on MSE for albacore in 2015, an MSE analyst was hired to undertake the modelling, and the prototype operating model will be discussed at the next meeting, in October 2017;
  b. participating in the Joint MSE Technical Working Group to support the implementation of the precautionary approach in tuna fisheries management. The group met in 2016 to: (1) review current MSE practice, successes, failures and potential areas for collaboration; (2) discuss progress on MSE; and (3) identify future actions, focusing on areas for collaboration. The group agreed to work intersessionally on method development and on case studies.

Planned activities (contingent on external funds):
  a. continue the MSE work for dorado;
  b. advance the MSE work for tropical tunas, with emphasis on bigeye (Section 5.5.3).

Funding for current MSE research (sections 5.5.2 and 5.5.3) was provided by the European Union and the International Seafood Sustainability Foundation (ISSF).

Discussion:

A participant complimented the progress made so far, and stated that it was important that the SAC express support for continued MSE work by IATTC staff. When asked whether there were definitive plans to move forward with MSE for tropical tunas, Carolina Minte-Vera indicated that the external funds used to support the work of Juan Valero are limited, and the staff cannot commit to this task without additional resources. The staff is willing to prepare requests for external funding to undertake these tasks.

Gerard DiNardo noted that NOAA has hired a permanent employee who will work on MSE, and that the ISC is planning a 3rd workshop on MSE for albacore tuna in October 2017 in Vancouver, Canada.

Another participant stated that MSE work should proceed with representative participation of scientists from a range of IATTC members.

Finally, a participant noted, regarding the modeling practices used for MSE, that clear guidelines need to

be established to determine whether a possible operating model (scenario) is implausible and should be excluded in the study design. Carolina Minte-Vera agreed that the selection of plausible assumptions will be critical.

5.5.2. Review of limit reference points

Juan Valero presented a summary of SAC-08-05e(ii) "Limit Reference Points in marine resource management and their application for tuna and billfish stocks". Reference points are benchmarks used to determine the status of fishing stocks relative to desirable and undesirable states, they can be operationalized by using Harvest Control Rules (HCRs) that specify management actions depending on the state of the stock relative to them. The presentation covered different reference points by type (target, threshold, limit, rebuilding target) and metric (biomass, fishing mortality, empirical), as well as alternative HCRs and their application by tuna RFMOs and other management bodies. It was found that most limit reference points are arbitrary to some extent, and most stocks recover from low levels if fishing pressure is reduced. There are issues with specifying reference points that may not relate to specific life histories of stocks. Reference points cannot be evaluated in isolation from other elements of the harvest strategy, and which limit reference points and HCRs are appropriate depends on the management action to be applied if the limit is exceeded. Tuna RFMOs differ in approach, rationale, and stage of implementation of reference points and HCRs. Simulation testing work such as MSE can be an effective evaluation approach that is ongoing in some tuna RFMOs. Performance of reference points and HCR remains to be evaluated across tuna RFMOs.

Discussion:

A participant congratulated Juan Valero on the clearest presentation on this topic he had ever seen. Another participant requested that the presentation be made publicly available for potential use in other meetings involving managers (available here). A participant requested consideration of alternative reference points for skipjack tuna, for which only stock status indicators are currently used.

A participant clarified that Nakatsuka's work on limit reference points for Pacific bluefin tuna was to be considered a research paper and that the alternative limit reference point was never proposed to or considered by the ISC.

Mark Maunder commented that the original stated objective of simulation testing of limit reference points is not actually possible, so instead alternative limit reference points were explored and compared, and harvest control rules related to the current limit reference point were tested. In this regard, Mark Maunder noted that the IATTC has been criticized for its limit reference point of 7.7% of virgin biomass, which some consider too low. However, this value is dictated by the corresponding resolution (C-16-02), which mandates a reference point that would produce 50% of the recruitment compared to virgin unfished spawning biomass when using a conservative value of steepness (which determines the shape of the spawning stock-recruitment curve).

5.5.3. MSE for bigeye

Juan Valero presented work on "Simulation testing of reference points for bigeye tuna (*Thunnus obesus*)" in the eastern Pacific Ocean". The MSE for bigeye was used to test the reference points and a simplified interpretation of the current harvest control rule (HCR), using Stock Synthesis (section 5.5.1). Bigeye was chosen because since the 1990s it has dictated management of the purse-seine fishery in the EPO. To make the approach more computationally feasible, the assessment used during the management procedure was simplified by reducing the number of fishing fleets and by using time-varying selectivity for the most recent period only. Alternative scenarios reflected the main uncertainties of the current bigeye assessment, including misspecification of natural mortality, the average length of the oldest fish in the catch, and the shape of the spawning stock-recruitment curve. Performance metrics included the probability of exceeding the limit reference point, because this would require drastic restrictions on catch, and the resulting catches. Results so far indicate that the reference points and HCR seem reasonable, which is consistent with previous

work. The study also highlighted some potential structural issues in the bigeye model that may affect the results of this work, particularly its treatment of recruitment dynamics. The work is ongoing, and its potential extension to a Pacific-wide bigeye model could solve some of the apparent structural issues of the bigeye model used in this work.

Discussion:

A participant asked how changes in operational capacity in the fishery are treated within the model, and whether further work will estimate the likelihood of meeting target reference points. Juan Valero responded that capacity is not explicitly built into this approach, but it is a part of the calculation of F, and thus it is accounted for. There was a discussion on how to incorporate stakeholder input in this work. One approach is to use alternative performance indicators that are of interest to stakeholders, such as how often simulations meet or exceed target or limit reference points; that would be part of the information provided to stakeholders once the work is ready for use in that context.

Another participant asked about the next steps, and suggested that a calendar be presented for the various steps in the process, to allow Members to plan the necessary meetings with their various stakeholders. The staff emphasized that this work was very preliminary and exploratory, and that further development of an MSE model and its implementation would require human and financial resources not currently available. Guillermo Compeán highlighted that the staff's five-year strategic plan, to be considered at the annual meeting in July 2017, included further development of MSE; if endorsed by the Commission, it will allow the staff to include the necessary resources in subsequent budgets. Mark Maunder highlighted that this initial work is simplified, and that the more complex evaluations and simulations that will ultimately be needed will require additional computing resources, either in-house or leased. In the interim, the staff could focus on refining and improving the assessments, because if the assessment results are biased or inaccurate, then the resulting evaluations of strategies based on those assessments will be biased as well.

A participant noted that this early work addressed bigeye only, and asked whether MSE can be done on multi-species fisheries such as those managed by the IATTC. Mark Maunder replied that this is possible, but it would be better to address each species separately first, and then connect the MSE analyses through a common management measure. Once a model is developed for one species of tuna, models for other species should proceed much quicker. Developing the initial MSE for southern bluefin tuna took 6 years, but the staff can also use the results of other MSE efforts to accelerate their work. At this point the staff is developing a basic understanding of the process and model construction. MSEs do not have definitive start and end points: much like stock assessment models, they are continuously developed, improved. and updated over time. Also, the fisheries themselves are constantly changing, and the MSE model must reflect that as well.

5.6. Summary of IATTC dolphin workshop

Cleridy Lennert-Cody presented the results of the IATTC Workshop on Methods for Monitoring the Status of Eastern Tropical Pacific Ocean Dolphin Populations, held in La Jolla in October 2016, with funding from the European Union and the Pacific Alliance for Sustainable Tuna. The goal of the workshop was to identify data types and methods of analysis, both conventional and novel, for monitoring and assessing eastern tropical Pacific Ocean (ETP) dolphin stock status, and it focused on methodologies for fishery-independent data. There were 21 invited participants from six countries (Germany, Japan, Mexico, Norway, the United Kingdom, and the United States), world experts in marine mammal abundance estimation and population modeling or with extensive experience in estimation of dolphin abundance in the ETP. The three background documents prepared to promote discussion at the workshop covered the following topics: data available for assessing dolphin stock status; statistical methods for estimating dolphin abundance; and population dynamics models for cetaceans. The presentations by invited participants covered ship-based survey methods, telemetry, high-resolution digital aerial surveys, mark-recapture, passive acoustics, and population modeling. A report was drafted that summarizes the main discussions, as well as suggestions and recommendations by the invited participants. It was noted that at present ship-based line-transect

surveys, although very costly, are the only reliable means of estimating the abundance of ETP dolphins. However, other options for abundance estimation exist and should be investigated. The background documents and workshop report will be published as IATTC Special Reports or in peer-reviewed journals.

Discussion:

The discussion focused on the possibility of genetic studies of dolphin stocks. The participants discussed their cost and the logistics of obtaining genetic samples in sufficient quantities. Martín Hall noted that the mortality rates of dolphins in the fishery are so low that getting the necessary samples from the 10 dolphin stocks in the region might be problematic. Concerns were expressed about the role of the observers, both in terms of their safety and the compatibility of the task with their core functions. A participant who had worked as an observer stating that collecting the samples aboard can be dangerous, and that observers already collect so much information that they might not be able to complete all these tasks. Cleridy Lennert-Cody Martín mentioned that the workshop discussed taking genetic samples from live dolphins in the net, which could help overcome issues of sample size, but not of observer safety or conflicting duties.

6. FADs:

6.1. Updated indicators for the purse-seine fishery on floating objects

Marlon Roman presented [SAC-08-06a](SAC-08-06a), an updated review of catch and effort data available for small (≤363 t carrying capacity) purse-seine vessels, with emphasis on FADs. Because trips by small vessels are rarely sampled by observer programs, the vessel's logbook and cannery unloading records continue to be the principal sources of data. However, they do not provide information on tuna discards, and, unlike data collected by onboard observers, which are available in near real-time, cannot be obtained until the trip finishes and the vessel unloads. These deficiencies could be problematic in the implementation of Resolution C-17-01, which requires near real-time monitoring of tuna catches, by species. Moreover, information on catches of non-target species is not always recorded in logbooks, which hampers efforts to conduct even data-limited assessments for such species. A formal, full-year observer sampling program would be needed to estimate catches of non-target species, and to obtain a better understanding of the strategies and dynamics of small vessel operations. Electronic Monitoring Systems might be useful for obtaining some of the data that observers collect on large vessels, and for monitoring some aspects of compliance by small vessels, but experiments would be necessary to evaluate their efficacy.

Discussion:

A participant noted that in Peru observers are required on small vessels, and the observers collect biological data, and suggested that this could be extended to the IATTC sampling program. Guillermo Compeán noted that the IATTC would have to first agree a sampling plan for such vessels. Another participant noted that in in 2016 ten small vessels were monitored by the Ecuadorian national program, and that this could be incorporated into a collaborative sampling program with IATTC.

A discussion developed about the fishing effort of large versus small vessels. Marlon Roman noted that in some areas, especially nearshore, small vessels might make more sets than large vessels. A participant suggested that the reported pattern of increased number of FAD sets and reduced catch per set could be related to site-specific density or availability of the target species, and asked if there was any evidence of this in the IATTC data. Marlon Roman indicated that this pattern was general throughout the EPO, and that no spatial stratification of the data had been conducted.

Participants asked about the possibility of greater interactions of small vessels fishing in coastal waters with juvenile tunas and with non-target species such as turtles, It was suggested that the effort and catches of small vessels should be more closely monitored, since they may be significant in certain coastal areas. Marlon Roman explained that sampling on small vessels is voluntary, and does not include a comprehensive sampling design. Guillermo Compeán indicated that at present only unloading and logbook data are available for this analysis, and samples are not stratified, so it is difficult to extrapolate, but starting in 2018

it will be possible to obtain data for the entire year from the ISSF-related program.

In a discussion of the level of fishing effort on FADs by small vessels, some participants argued that the effort is limited because small vessels are limited physically for carrying and deploying FADs, while others pointed out that small vessels can set on FADs in coordination with large vessels, thus contributing significantly to overall effort. There was also variability in the data on sizes of tunas caught by small vessels; some vessels may be catching very small tunas, around 2 kg, which may potentially have a negative effect on spawning biomass. The participants agreed that there is a strong need to fill gaps in the data for small vessels fishing on FADs to protect the tuna resources and, in particular, to manage the fishing mortality of juvenile tunas.

6.2. Performance of shallow-depth non-entangling FADs in the purse-seine fishery in the EPO

Kurt Schaefer presented "Preliminary performance of normal versus shallow non-entangling FADs in the equatorial Eastern Pacific tuna purse-seine fishery."

It has been reported in the scientific literature that the presence of bigeye tuna in the purse-seine catch of the eastern equatorial Pacific Ocean (EEPO) was more likely with deeper floating objects. In addition, participants at ISSF "skipper's workshops" in Manta, Ecuador mostly agreed that deeper FADs will probably attract more bigeye but that shallow FADs would drift too fast and not attract tuna aggregations. A collaborative experiment was initiated in 2015 consisting of the simultaneous deployments by a purse seine vessel in the EEPO of 50 pairs of shallow (5m) and normal depth (36m) drifting FADs, to test the null hypothesis H_o: there is no difference in the proportion of bigeye caught in sets on shallow and normal depth FADs in the EEPO. Seven purse-seine vessels of the NIRSA fleet made a combined 21 sets on the normal depth FADs and 16 sets on the shallow depth FADs from this experiment. Results thus far are encouraging because the shallow FADs have caught similar quantities of tuna per set as the normal depth FADs. Simultaneous deployments of 100 more pairs of shallow and normal depth FADs in the EEPO have recently been completed for a second experiment. We expect to obtain sufficient data from sets on both FAD types, from the second experiment combined with those from the first experiment, to conduct appropriate statistical analyses of the null hypothesis using a general additive model.

Discussion:

In answer to questions about differences between the two FAD types in terms of non-target species caught, the number of fish aggregated, and FAD colonization rates, Kurt Schaefer said that the data were still being analyzed, and explained that oceanographic data such as water temperature, along with drift speeds, area, date, and other variables would be considered in the analysis.

A participant asked about feedback from fishers about the performance of each FAD type. Kurt Schaefer said that fishing captains are asked for their opinions at ISSF workshops, and gathering of that feedback and distribution through reports will continue.

Another participant asked why the catches were similar for both FAD types. Kurt Schaefer explained that the shallow FADs may have been subject to enough hydrodynamic drag that it resulted in similar speeds for the FADs and equivalent catches. Another participant noted that the catch of bigeye was slightly higher around the normal-depth FADs, and asked about any differences in sizes of tunas caught by FAD type. Kurt Schaefer indicated that length frequency sampling was not conducted, and confirmed that the shallow FADs had slightly lower proportions of bigeye but were not statistically different from those normal depth FADs. Since a more comprehensive and robust statistical analysis is required to fully address the hypothesis of whether depth of FADs influences the catch composition of bigeye tuna, a second experiment was initiated in March 2017 in which 100 pairs of normal and shallow depth FADs were deployed.

6.3. Biodegradable FADs

Martín Hall presented a progress report on the project on biodegradable FADs financed by the EU, and developed in close coordination with the ISSF staff who are carrying out similar projects in other ocean

areas, to complement each other's activities, and avoid duplication of efforts. In a first stage, different materials and designs were tested for durability at sea on the Panama coast, where monitoring was relatively simple. The observations made were communicated to fishing captains and fleet managers during the ISSF workshops in Ecuador, as were the suggestion by various captains of adding balsa wood to the flotation component of the FADs. Several FADs built by the SALICA company, following closely the suggested designs, were still at sea after more than 6 months. The next stage of the process is the deployment at sea of a significant number of FADs with the characteristics and materials selected in the first tests, to allow for statistical comparisons. The interest and support from industry and governments have been excellent, and the exploration of alternatives and close interaction with the fishers will continue.

Discussion:

During the discussion it was noted that the main challenge for the development of biodegradable FADs is the durability of materials at sea. The required duration varies by area; in areas with a shorter fishing seasons, like the Humboldt Current area, 5 or 6 months may be sufficient, but in the Equatorial area, for example, a year may be the goal. Other natural materials from the region are being considered.

6.4. Preliminary study of FAD deployments versus sets

Cleridy Lennert-Cody presented [SAC-08-06d](#), a preliminary analysis of the relationship between the number of FAD deployments and the number of FAD sets for the EPO purse-seine fishery. Limits on the numbers of FADs and/or on the number of FAD sets, by vessel, are management options that have been proposed for, and in some cases implemented in, purse-seine fisheries that target tropical tunas associated with FADs. However, quantitative analyses supporting such management options are lacking. Therefore, two analyses of AIDCP observer data during 2012-2015 were conducted, using agglomerative hierarchical cluster analysis to identify fishing strategies of vessels making floating-object sets, and mixed-effects models to analyze the relationship between FAD deployments and floating-object sets. The cluster analysis results indicate vessel groups with the following fishing strategies: a tendency to make dolphin sets versus floating-object and unassociated sets; and, among vessels making floating-object sets, a tendency to make floating-objects sets on the vessel's own FADs versus on objects found drifting and/or on FADs of unknown origin. Vessels fishing primarily on their own FADs tended to fish further offshore within the EPO than other vessels making floating-object sets, and made a greater number of FAD deployments. The overall relationship between number of FAD deployments and number of floating-object sets is characterized by an increasing, nonlinear relationship that begins to asymptote at several hundred deployments. However, this nonlinear relationship differs between those vessels fishing primarily on their own FADs and those vessels making a greater proportion of their sets on other types of floating objects. These preliminary results highlight the complexity of FAD fishing in the EPO, which has implications regarding development of any management strategies that limit FAD usage, both in terms of the conservation of tunas and in terms of the economic performance of the different purse-seine fleet components operating in the EPO.

Discussion:

Guillermo Compeán noted that the number of FAD sets appears to be asymptotic at several hundred deployments, and asked if the increase in FAD sets in the EPO is a result of vessels changing strategy to set on FADs or of new vessels setting on FADs. Cleridy Lennert-Cody explained that the analysis does not address the decision process by fishers, and noted that FAD deployment dynamics can differ between offshore and inshore regions; offshore floating objects may get lost, while floating objects in inshore regions can be stolen or set upon by other vessels. These dynamics contribute to patterns of FAD utilization across the EPO.

A participant expressed support for this analysis on FAD management, and noted that the heterogeneity in FAD fishing in the EPO was not present in other oceans, due to limits on sets and deployments of FADs . Another participant supported this opinion, and pointed out that this type of analysis can allow the Commission to make science-based decisions on FAD management. A participant asked whether the

analysis included vessels with DMLs and whether there were differences by vessel size in FAD utilization. Cleridy Lennert-Cody indicated that the vessels with dolphin sets had DMLs, and pointed out that the analysis was conducted on Class-6 vessels only, but did not separate out the size of vessel.

A participant requested information on the number of FAD deployments and number of FAD sets *versus* tuna catch prior to the Commission's meeting in July, to analyze the impact of limits to deployments or sets for Class-6 vessels. Cleridy Lennert-Cody indicated that Document SAC-08-06d included information on sets and deployments but not on catch, and that a table with set, deployment and catch information could be prepared. She noted, however, that an analysis of catch *versus* number of deployments is more complicated than comparing deployments and sets, because catch rates are influenced by multiple factors and therefore must first be standardized. She added that a rigorous analysis of catch-per-set *versus* number of deployments is in progress.

A discussion developed on the basis for decisions on limits on FADs, and whether those decisions are based on politics or science-. In other oceans these decisions, including political considerations and negotiations among fishing companies. Martín Hall explained that differences in fleet size can impact the extent to which FADs are shared among vessels. Cleridy Lennert-Cody noted that there is complexity in FAD utilization that is difficult to capture in the analysis, such as sharing and redeployments of FADs, because there is no system for identifying individual FADs

6.5. Report of the *Ad Hoc* Working Group on FADs

Josu Santiago presented the Report of the Ad Hoc Working Group on FADs. The report is divided into sections summarizing the following topics: Review of the data-collection requirements established in Resolution C-16-01; Definition of terms related to FAD fishing to implement obligations under Resolution C-16-01; FAD research plan (Annex 1); and Identification of potential management measures for FADs.

Discussion:

A participant noted that there is a recommendation to revise the form provided by the Commission by July, and suggested that feedback from the captains' seminars may not be available to include in the revisions. Another participant stated that the proposed changes are minor and should not impact usage by the vessel crews. It was suggested that the SAC endorse this document of recommendations on FADs.

Guillermo Compeán suggested adding a definition of a set on a FAD, so that the statistical analysis is based on a scientific definition, but Josu Santiago pointed out that such a definition is adequately covered in the text of the report. Guillermo Compeán also suggested further efforts to identify the owners of FADs, since the definition of fishing under the Antigua Convention includes putting FADs in the water, and if a FAD is not retrieved, it is still considered to be fishing.

A participant suggested that this analysis should be advanced to examine the effect of the FAD fishery on the number of individual fish caught and to recommend conservation and management goals.

7. ECOSYSTEM

7.1. Ecosystem considerations report

Shane Griffiths presented the ecosystems consideration report (SAC-08-07a), and explained that three additional presentations would be given on the IATTC's goals regarding the ecological sustainability of species impacted by pelagic fisheries in the EPO, with emphasis on the large-scale tuna longline fishery, which had received relatively little ecological research attention in the past. He proposed an ecological risk assessment (ERA) framework for the IATTC to demonstrate its progress towards meeting its obligations, and stressed the need for strong support from CPCs, particularly with respect to providing reliable catch and effort data.

Discussion:

The discussion of this presentation was deferred until after the presentation for Section 7.2.

7.2. Preliminary metadata review for the high-seas longline fishery

Shane Griffiths presented Document SAC-08-07b. The Antigua Convention defines the IATTC's responsibilities for ensuring the sustainability of tunas, tuna-like species and associated species, and the staff has been working to evaluate these responsibilities, primarily using Productivity-Susceptibility Analysis (PSA) for the purse-seine fishery. To evaluate the ecological sustainability of EPO fisheries, each fishery would need to be assessed separately, with ideally also a cumulative assessment. An analysis of the data available for a fishery is a prerequisite for a PSA, which may identify potentially vulnerable species and help prioritize future research. The large-scale tuna longline fishery was identified as a priority for assessment due to its interaction with a variety of bycatch species, including sharks, seabirds and sea turtles. Although there were many shortcomings in the data for the longline fishery held by IATTC, they were sufficient for a preliminary PSA. The metadata review used data submitted to the IATTC by CPCs (at 5° x 5° resolution) to identify species composition and location of catches, temporal and spatial effort dynamics, temporal trends in catches and nominal CPUE for the main target and bycatch species, and data gaps and deficiencies. It highlighted a clear need for improved reporting of bycatches at the species level, as well as operational level data to improve total catch and effort estimates and CPUE standardization, and better understand targeting practices (*e.g.*, shallow vs. deep sets). The staff again recommended that CPCs increase observer coverage on longliners to at least 20%.

Discussion:

Many participants spoke about longline data quantity and quality, for improving ERAs for non-target species.

One participant indicated that requests for operational-level data other than data collected by observers under C-11-08 seemed sudden. Shane Griffiths explained that improved data reporting is necessary to produce a reliable ERA. However, many CPCs with longline fleets noted that data coverage has increased, and improved data can be submitted to IATTC. Many participants highlighted that the SAC should (1) adopt a standardized reporting template for submitting longline observer data and (2) consider increasing observer coverage on longline vessels. One participant suggested that IATTC and WCPFC use a similar format for collecting observer data.

A participant questioned the lack of reporting of interactions with turtles and seabirds and noted that because these animals are not reported and these animals are specifically mentioned in resolutions, there is an apparent lack of compliance with these resolutions.

One participant asked how ecosystem-based fisheries management (EBFM) can be progressed and how bycatch species should be dealt with. Shane Griffiths said that EBFM was discussed, at a meeting at FAO headquarters in December 2016 with scientists from other tuna RFMOs.

Another participant asked which species should be considered for future assessment. Shane Griffiths stated that staff are not recommending species for further assessment or monitoring at this time. The work is considered preliminary, and the staff does not consider current information sufficient to recommend species for assessment.

Alexandre Aires-da-Silva noted that it is important that longline research continue and data collection improve now that Michael Hinton, the staff member most involved in research related to the high seas longline fishery, has retired.

Finally, participants discussed the need for the SAC to support the continuation and expansion of the ERAEF (Ecological Risk Assessment for the Effects of Fishing) framework, and that formal SAC recommendations were warranted. Guillermo Compeán noted that the Commission's endorsement of research plans and the funding necessary to conduct them was a critical component, and that the 5-year strategic plan that was submitted to the Commission includes ecosystem research.

7.3. Resolving redundancy in ecological risk assessment attributes

Leanne Duffy presented document SAC-08-07c "Resolving potential redundancy of productivity attributes to improve ecological risk assessments." Prior to producing PSAs for fisheries other than large purse seine, sensitivity analyses were conducted to determine (1) the efficacy of the attribute weighting system used in the previous PSAs and (2) which PSA productivity attributes may be correlated. The largest change was observed for giant manta rays, *Manta birostris*, with vulnerability scores that increased from moderate risk to high risk for all scenarios of removal of correlated attributes. For a few species of sharks, risk status shifted from high to moderate, or vice versa depending on the scenario, although most of these vulnerability scores were on the borderline of the high-risk threshold. Recommendations of productivity attributes were provided.

Discussion:

One participant questioned whether climate change could be incorporated in PSAs. Shane Griffiths stated that larger changes in productivity attributes (e.g. natural mortality) may be expected in a changing climate.

Another participant asked how the results of these PSAs compare with those in other oceans, what the results reveal about the conservation status of assessed species, and which species should be subjected to further monitoring. Leanne Duffy explained that this PSA and the previous purse-seine PSA followed the approach of Patrick *et al*. used for US fisheries. Some PSAs for other oceans combine productivity attributes into a single productivity index. Shane Griffiths noted that the results are not currently comparable, given the differences in PSA methodology used. He also clarified that a PSA provides only a relative indication of vulnerability; it does not provide a quantitative status indicator (*sensu* stock assessment biological reference points). PSA should be regarded as a triage approach for impacted species, whereby the most vulnerable species are subjected to improved monitoring and quantitative stock assessment (*i.e*. "Level 3" of ERAEF). Leanne Duffy stated that the relative risk was high for some shark species and the giant manta ray, which had the highest relative vulnerability scores in the PSA.

7.4. Preliminary ecological risk assessment for the high-seas longline fishery

Shane Griffiths presented Document SAC-08-07d, on the background to the need for a PSA for the large-scale tuna longline fishery in the EPO. PSA was used owing to its flexibility to utilize qualitative to quantitative data. In the ERAEF risk assessment framework of Hobday *et al*.[2], PSA is a "Level 2" assessment method, whereby vulnerable species are either subjected to "Level 3" quantitative population analysis or risk mitigation via management intervention. Only elasmobranchs and teleosts were assessed due to data availability. The assessment was based on 5 productivity attributes and 6 susceptibility attributes for 68 species, 18 of which (mostly sharks, including threshers, mako, blue) were classed as high risk, 38 species (mainly data-deficient mesopelagic species such as escolar) as moderate risk, and 12 species (including highly productive species such as bonito and yellowtail) as low risk. This research allowed prioritization of future work, in particular filling gaps in biological and reported catch data. However, it was suggested that, with improved operational level observer data, the staff may pursue other risk assessment approaches, such as Sustainability Assessment for Fishing Effects (SAFE), that can provide a quantitative indicator of risk for data-limited species.

Discussion:

A participant asked why both albacore tuna and yellowfin tuna were displayed in the red (high risk) zone, even though neither is a conservation concern. Shane Griffiths explained that ERA results do not reflect conservation status, but rather highlight which species are high-risk in the context of the longline fishery

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[2] Hobday, A.J., Smith, A.D.M., Stobutzki, I.C., Bulman, C., Daley, R., Dambacher, J.M., Deng, R.A., Dowdney, J., Fuller, M., Furlani, D., Griffiths, S.P., Johnson, D., Kenyon, R., Knuckey, I.A., Ling, S.D., Pitcher, R., Sainsbury, K.J., Sporcic, M., Smith, T., Turnbull, C., Walker, T.I., Wayte, S.E., Webb, H., Williams, A., Wise, B.S., and Zhou, S. 2011. Ecological risk assessment for the effects of fishing. Fisheries Research 108: 372-384

(because they are target species) and thus warrant Level-3 analysis (*i.e.* full assessments). That is, just because a species is considered high risk does not mean that it is at risk.

Another participant expressed surprise at seeing Pacific bluefin tuna classed as high risk because the species is rarely caught in longline fisheries in the EPO, and suggested that a PSA across all gear types would allow a simultaneous comparison of the impacts of each gear type. Shane Griffiths agreed generally, but noted that in the near-term it is most important to arrive at reliable risk assessments, and that with the limitations of the data currently available, even single-species PSA are difficult. If data gaps are resolved, cumulative assessments might be possible in five years' time.

A third participant asked for a list of species that should be subject to the Level 2 analysis based on these results. Shane Griffiths responded that the assessment is too data-poor and the results too preliminary for any such specific recommendations. Set-level operational data, including gear configurations, if available, would greatly improve the power and quality of the analysis.

7.5. Establishing minimum data standards and reporting requirements for longline observer programs under resolution C-11-08

Brad Wiley presented document SAC-08-07e. The adoption of Resolution C-11-08 on scientific observers for longline vessels was based on the Commission's recognition of the "need to collect scientific information on target species as well as comprehensive data on interactions with non-target species, inter alia, sea turtles, sharks and seabirds." The scientific need for high-resolution operational, effort, and species-specific catch data for the longline fishery is well understood, and has been discussed extensively at meetings of the Commission and its scientific bodies. Due to this paucity of important data for longline fisheries, in Resolution C-11-08 (paragraph 7) the Commission agreed that "every year, CPCs shall submit to the Scientific Advisory Committee … the scientific observers' information on the previous year's fishery in a format established by the Scientific Advisory Committee." However, despite attempts to resolve this issue over the last few years, the SAC has yet to establish a format for operational-level data1, and CPCs continue to submit only highly-summarized data from their respective national scientific observer programs, which limits their usefulness for conducting stock assessments, ERAs, and other research.

In order to facilitate discussion of the minimum data standards to be established by the SAC, the IATTC staff compiled a draft list of minimum standard data fields for longline observer programs (Appendix 1 of SAC-08-07e). Almost all the proposed are included in Minimum Standard Data Fields used by the Regional Observer Program of the Western and Central Pacific Fisheries Commission (WCPFC), as well as in the IATTC Longline Observer Forms, which are currently used by some IATTC CPCs. In addition, so that the level of observer coverage relative to total fleet activity can be easily determined, and to allow IATTC staff to calculate total catches and effort from the reported observer data, the staff has also drafted a data summary template for use by CPCs when submitting their annual reports (Appendix 3 of SAC-08-07e).

Discussion:

One participant stated that in general the proposed minimum data fields would be a significant step forward, but expressed concerns about preserving the confidentiality of such data. Brad Wiley noted that the IATTC data confidentiality standards and protections would apply, and have worked well with respect to observer data collected on purse-seine vessels.

Multiple participants representing CPCs with longline vessels that fish in both the WCPFC and IATTC convention areas also expressed general support, but also concerns regarding adopting any data fields not already included in the WCPFC Minimum Data Fields. Other participants stated that absolute consistency was neither necessary nor a reason for not considering additional fields that could be relevant or warranted in the EPO. Alexandre Aires-da-Silva pointed out that the lack of the operational-level observer data required by the resolution hindered the staff's work, and stressed that there are many more commonalities than differences between the IATTC observer forms and the WCPFC Minimum Data Fields. Another participant emphasized that the overriding concern was obtaining the key data, which are the same for the

IATTC and WCPFC, and proposed adopting both options; CPCs could then choose whether to use the WCPFC Minimum Data Fields or the IATTC observer forms.

Speaking on behalf of his government, a participant stated that it would not be able to join consensus on adopting the summary reporting format proposed in Appendix 3 of the document because observers in its program do not produce summary reports, making compilation of some of the fields too difficult for its national authority. Martín Hall noted that it would be helpful if CPCs could use Appendix 3 on a voluntary basis in order to improve summary data reporting.

The participants agreed to consider these matters further and return to the discussion on the last day of the meeting.

7.6. Progress on dorado research

Alexandre Aires-da-Silva summarized the work on dorado conducted by the staff over recent years. The first meeting, held in 2014, helped to establish the collaborative research forum that is necessary to work on dorado at the large regional scale of the EPO. Also, a large and diverse amount of fishery and biological data for dorado available from IATTC member countries was identified. The second meeting, held in 2015, led to significant progress on two important questions that need to be addressed for regional management of dorado in the EPO: stock structure assumptions, and which assessment methodologies and indicators of stock status to use. A third meeting in 2016 focused on evaluating data needs and assessment methods for data-limited dorado fisheries in the EPO. The biggest accomplishment of this collaborative work was an exploratory Stock Synthesis assessment model (SAC-07-06a(i)) for dorado in the southeastern Pacific Ocean, mainly exploited off the coasts of Peru and Ecuador. In addition, some exploratory MSE (SAC-07-06a(ii)) work has also been developed. The stock assessment and MSE work were made possible through a contract with WWF which allowed the hiring of an external consultant (Juan Valero) to assist the staff in this project. The staff has also developed and put forward some assessment approaches for fisheries in data-limited situations (mainly Central American countries).

There is great expectation by some countries for IATTC staff to propose alternative reference points and harvest control rules (HCRs) for dorado, which are required by some eco-labeling programs. Although the stock assessment results contributed to the knowledge about the population dynamics of dorado and its history of exploitation in the EPO, the IATTC staff was unable to draw conclusions about stock status, because no reference points, target or limit, have been defined for dorado in the EPO. The exploratory MSE work provided a good starting point for investigating potential reference points and HCRs. The MSE process may benefit from feedback and consultation with managers to develop candidate HCRs and reference points that are consistent with management objectives. A suite of alternative reference points and HCRs could be evaluated, but their implementation will be up to the interested Members. However, more research needs to be done, and the IATTC staff lacks the resources, human and financial. The staff was asked to present a funding proposal for this project at the Commission meeting in July.

Discussion:

A participant noted that Ecuador had asked that an item on the development and presentation of an HCR for dorado be added to the agenda, and expressed disappointment that no HCR was being proposed. Alexandre Aires-da-Silva responded that, although the staff is willing to prepare a proposal for continuing this work in order to develop alternative reference points and HCRs for dorado, it cannot commit to it; the work over the last three years had been done at the request of some CPCs, with external funding from WWF, but dorado is not a high priority for the Commission, and thus subsidiary to other demands on the scientific staff. The preliminary assessment and EEO represent significant progress, and the cooperative relationships that have been established provide a good foundation for further work. Multiple participants indicated that dorado is an economically important resource in the region, and that they would continue to ask for and support additional work on this species. Guillermo Compeán suggested that this be addressed during the consideration of the SAC's recommendations to the Commission.

8. BYCATCH:

8.1. Sharks

8.1.1. Update on purse-seine indicators for silky sharks in the EPO

Cleridy Lennert-Cody presented SAC-08-08a(i), "Updated stock status indicators for silky sharks in the eastern Pacific Ocean (1994-2016), with oceanographic considerations." Indices of relative abundance for the silky shark in the EPO, developed from purse-seine catch-per-set, were updated with data from 2016. The index for all silky sharks north of the equator (North EPO) shows a large decrease in 2016 relative to 2015. In contrast, the index for all silky sharks south of the equator (South EPO) remains at about the 2014-2015 level. Some recent strong increasing trends in the indictors for silky sharks have been identified in previous reports, but they are not biologically plausible. To help further the understanding of potential processes driving the recent trends in the North EPO indices, silky shark indices by sub-region within the North EPO, and by shark size category, were compared to an index of variability in oceanographic conditions, and to a preliminary silky shark index for the Western and Central Pacific Ocean (WCPO) associated-set purse-seine fishery. Based on the preliminary results of these comparisons, it is hypothesized that the recent changes in the silky shark indices for the North EPO, particularly for small silky sharks, may be influenced by changing oceanographic conditions (*e.g*., El Niño and La Niña events), and thus the North EPO indices are potentially biased. Further analysis will be necessary to evaluate the magnitude of this bias quantitatively and, if the indices for large silky sharks are found to be less susceptible to bias caused by changing oceanographic conditions, they may be used exclusively as stock status indicators in the future. The IATTC staff reiterates its previous recommendation (SAC-07-06b(i), SAC-07-06b(iii)) that improving shark fishery data collection in the EPO is critical. This will facilitate the development of other stock status indicators and/or conventional stock assessments to better inform the management of the silky shark and other co-occurring shark species. Spatiotemporal models that combine data from multiple gear types to improve spatial coverage should also be explored in the future, to facilitate modeling efforts once data from other sources become available.

Discussion:

A participant commended the analysis conducted on this topic, characterized it as a good example of cooperation between regional fishery management organizations, and asked about the planned schedule for the silky shark assessment. Shelley Clarke from WCPFC explained that there is a Pacific Wide silky assessment planned under the FAO-ABNJ project and the original goal was to bring this preliminary assessment to the WCPFC in August 2017, but with more work to be done on the analysis, the revised goal for a completed assessment will be August 2018.

8.1.2. Updated results of the FAO-GEF shark project

There is great concern about the exploitation of sharks throughout the world's oceans, as is shown by many initiatives (FAO International Plan of Action, resolutions by RMFOs, regional (OSPESCA) and national regulations for shark fisheries), and the EPO is no exception. There is a critical need for stock assessments of sharks to better inform their management and conservation; unfortunately, stock assessments of sharks in the EPO have to date not been possible due to the lack of reliable fishery statistics from all important fisheries.

The presentation summarized the work done to improve accessibility of existing data collected from Central American fisheries. The main sources of shark fishery data available in Central America are the landings inspection programs, which are operated mainly for compliance monitoring purposes. Such programs have been operating in all Central American countries involved in the fishery since the early- or mid-2000s. The quality of the data varies among programs. Some programs collect data on shark landings by species and fleet, while others pool all sharks into a single species category, which may or may not be broken down by fleet. Also, information on longline vessel characteristics (specifically their length overall, LOA) obtained from Central American data sources was presented.

Alexandre Aires-da-Silva noted that, at the request of CPCs, the names of the countries identified in the presentation will be omitted in the final report.

Discussion:

A participant asked about three aspects of the analysis: 1) how to convert total weight of sharks from trunk weight or weight of fins or body parts removed; 2) the percentage of thresher sharks in the samples; and 3) given the differences among countries, the likelihood of standardizing data collection in Central America. Regarding weight conversions, Alexandre Aires-da-Silva responded that conversion factors had been developed by regional shark experts, but not all of them had been verified, and more data need to be collected. Regarding thresher sharks, Salvador Siu explained that they constituted only about 10% of the samples; regarding standardization of data collection, he said that workshops have been held on this subject, and Central American countries have made significant efforts, through OSPESCA and the IATTC, to harmonize the collection and analysis of landings data.

A participant noted that Costa Rica now has 100% inspection of landings and is improving the quality of species composition data, including for sharks. He noted that efforts to standardize catch may be problematic, due to the great variability in the fisheries. Some vessels target sharks, and the species composition of their catches varies over time, depending on market prices; some vessels keep their product fresh, while others freeze their catches, and may or may not remove heads or guts.

Several participants asked about progress in the development of a work plan for silky sharks and hammerheads, called for in Resolution C-16-05. Alexandre Aires-da-Silva indicated that the staff do not have enough reliable data to prepare proper assessments, but continues to produce stock status indicators from purse-seine data, and would present recommendations for improving data collection for sharks, including from distant-water longline fisheries. Also, FAO is providing some continuing funding to develop a sampling design and a pilot sampling program for sharks.

8.1.3. Update on post-release mortality of silky sharks in the longline fishery

Kurt Schaefer presented, "Update on post-release mortality of silky sharks in the longline fishery."

The experimental design included deploying 34 Wildlife Computers (WC) mini-PATs on silky sharks. Mini-PATs were programmed to pop-up at 90 or 180 days following release for evaluating potential delayed mortalities, and obtaining additional useful information on movements. 17 mini-PATs were deployed from domestic longline vessels operating out of Puntarenas, Costa Rica, and 17 from those operating out of Manta, Ecuador by trained observers/scientists from those countries. Only sharks between 125 to 175 cm fork length, classified as alive in good condition at the time they were caught were tagged. All sharks were brought aboard the vessels for tagging to ensure: 1) proper tag attachments, 2) removal of hooks and/or the ganglion, 3) accurate length measurement, sex determination, and evaluations of condition when caught and released. The sharks were tagged and released as quickly as possible, in less than 3 minutes from the time they were brought on deck.

A shark tag/release data form was designed to be completed with all relevant information surrounding the capture, tagging, and release of each specimen. Survival or mortality events are determined by using the depth and temperature records transmitted from mini-PATs and received through Argos.

Preliminary results from the silky shark tagging project were presented.

Discussion:

A participant thanked Kurt Schaefer for presenting the preliminary results of this investigation, and for participating at the WCPFC expert workshop held in Wellington, New Zealand in January 2017 to formulate the experimental design for conducting post-release mortality experiments on sharks in the longline fisheries in the Western Pacific.

8.2. Sea turtles

Martín Hall presented the subject, noting that sea turtles, because of their extensive migrations, interact with many fisheries in the region, and are hooked or entangled in longlines, entangled in the webbing under FADs or in gillnets, captured in purse seines or trawls, etc. The IATTC has an extensive database of interactions with purse seines, but much less data for other fisheries that are believed to be much more significant in terms of impacts on the populations

Even though over a thousand turtles may be captured in purse seines in some years, the procedures to release them are very effective, and annual mortalities have declined from a peak of over 170 in 1999 to less than 10 in 2015 and 2016. Observers have recorded mortalities of 0 or 1 for the turtles in the most critical situation (leatherback, hawksbill and loggerhead) in recent years. Some additional mortality may result from entanglements in the webbing under FADs, but this cannot be quantified; however, the IATTC staff, ISSF, and industry are working on the development of non-entangling FADs that may eliminate that source of mortality.

For the longline fleets, the use of circle hooks instead of J hooks has reduced sea turtle mortality, in some cases by over 80%, because with circle hooks: a) fewer turtles are hooked, b) fewer turtles are dead when brought on deck, and c) releasing hooked turtles is easier. However, there may be a trade-off, since other species of conservation concern may have higher hooking rates with circle hooks. This evaluation needs to be done at the national or regional level, and the IATTC staff encourages this approach.

Discussion:

The implementation of some recommendations (training crews, providing equipment for freeing turtles to all longliners, etc.) approved several years ago is still very incomplete, and greater efforts are needed to convert resolutions into effective actions in the field. Of all the species affected by the tuna fishery, the three sea turtles mentioned above are closest to extinction.

The lack of observer data for the longline fleets, industrial and artisanal, hampers the staff's ability to address this situation.

8.3. Seabirds

ACAP made a presentation titled "Seabird Bycatch in the Eastern Pacific Ocean" to the 7th Meeting of the Bycatch Working Group. The Bycatch Working Group subsequently made several recommendations. The SAC did not discuss seabirds.

8.4. Report of the Working Group on Bycatch

Luis Fleischer presented his report on the 7th Meeting of the Working Group on Bycatch. The 40 participants at the meeting reviewed the status of research on assessing bycatches of sharks, sea turtles and seabirds in the tuna fisheries of the EPO, and developed a series of recommendations to submit to the SAC.

9. LIFE HISTORY

9.1. Progress report on the yellowfin tuna life history project

9.2. Alternative growth model for bigeye tuna

9.3. Review of research at Achotines Laboratory

Due to time constraints, these agenda items were not addressed. Guillermo Compeán referred participants to the presentations and background documents (SAC-08-09c and SAC-08-10a).

10. RESEARCH PLANNING

10.1. Staff activities and research plans

Alexandre Aires-da-Silva presented SAC-08-10a, "Staff activities and research plans." The work of the

IATTC scientific staff is divided into four programs: Stock Assessment, Biology and Ecosystem, Data Collection and Database, and Bycatch and International Dolphin Conservation Program (IDCP). The presentation summarized the current situation regarding the staff's activities in these programs, plus its capacity-building activities, and outlined future activities and planned improvements.

Discussion:

There was no discussion.

11. STAFF CONSERVATION RECOMMENDATIONS

The SAC reviewed the conservation recommendations made by IATTC staff and provided the following comments.

11.1.   Yellowfin, skipjack and bigeye tunas

The SAC had an initial discussion of the staff recommendations for conservation measures for tropical tunas on Wednesday, 10 May. The recommendations reflect the assumption that the reduction in F needed to offset increased purse-seine fleet capacity is approximately proportional to the reduction in the number of days that the fishery is open; in other words, to offset a 10% capacity increase, the number of days that the fishery is open needs to be reduced by about 10%. The average active capacity in the EPO during 2014-2016 was 247,000 cubic meters (m^3), and as of 30 April 2017, it was 263,000 m^3, an increase of about 6.7%. The corresponding number of closure days is 75, but the impact of the *corralito* closure reduces that to 72 days.

One participant noted that some of the vessels considered active in the EPO fish primarily or exclusively in the WCPO in any given year, and asked whether this could be considered when calculating the number of closure days needed. Guillermo Compeán noted that it is not appropriate to extrapolate future levels of activity from historical data because vessels that have paid their assessment and been approved by their government are eligible to fish the entire year in the EPO.

Another participant suggested that the uncertainty in the models and forecasting should be reflected in the conservation recommendation, perhaps as a range of closure days, and the Kobe plots should be included to illustrate the uncertainty. It was also noted that in recent years there had been no consensus on increasing the number of days of closure, so it might be useful for the staff to present options for alternative measures, such as those being applied in 2017.

One participant also noted that the recommendation did not include any additional measures for the longline fisheries, which should be considered so that all fisheries bear part of the increased burden. The staff pointed out that the longline fisheries already have catch limits for bigeye, and that the need for additional conservation measures is due to the increase in purse-seine capacity, not longline capacity.

Revised conservation recommendations were circulated on Friday, 12 May. The staff clarified that the proposed measure for the purse-seine fishery was a 72-day closure, retention of the existing *corralito* closure, and maintaining the full-retention requirement; it did not include any of the additional measures adopted for 2017, such as catch limits by species and set type.

In answer to a question about whether the recommendations accounted for the additional capacity recently approved for two CPCs, the staff indicated that they did not, because that capacity was not active and it was not known when it would be activated. The participant recommended that its activation should be anticipated in the recommendations. Other participants noted that in recent years, the "capacity at sea" of vessels fishing in the EPO had never exceeded 80% of the total active capacity on the Regional Vessel Register, and expressed a preference that recommendations should account for this reality.

The topic of purse-seine catch limits was discussed again, with some participants expressing a strong preference for their inclusion in a suite of possible options, for which the staff would also provide estimates of their impact. Some stressed their necessity because of the difficulty in accepting 72 days of closure,

while others highlighted the need for alternatives to days of closure that allow the Commission to address the catches of juvenile yellowfin and bigeye directly. They expressed concern that, if the increases in catches of juveniles were not addressed, conservation problems would persist and estimates of MSY would drop due to the configuration of the fishery. In response, Mark Maunder noted that the general rule applied by the staff when formulating conservation recommendations was to base them on the current configuration of the fishery, because doing otherwise involves making judgements that are outside the staff's competence. The staff has analyzed scenarios containing such adjustments, but only at the specific request of the SAC or the CPCs. Guillermo Compeán said that these comments would be taken into consideration in the preparations for the annual meeting in July.

Several participants noted that the best way for SAC participants to express their opinions on conservation measures was through the SAC's recommendations to the Commission. It was noted for the record that there was no consensus support among SAC participants for the staff conservation and management recommendations for tropical tunas.

11.2.   Pacific bluefin tuna

Mark Maunder explained that the staff recommendation for Pacific bluefin tuna in the EPO was to continue the existing measures, noting that the staff recommends that the WCPFC consider taking additional measures to protect adults. A number of participants expressed general support for these recommendations.

One participant expressed a preference urging the WCPFC to take "comparable" measures, reflecting the opinion that EPO fisheries were currently being disproportionately affected. Mark Maunder responded that the staff recommendations are based on the findings of the ISC relative to the rebuilding target.

Another participant expressed disappointment that staff recommended additional reductions in adult catches in the WCPFC area without also recommending additional reductions in catches of juveniles in the EPO, since that would also contribute to the rebuilding of the stock. Mark Maunder, noting that the recommendation was specific to the WCPFC only because adults are not caught in the EPO, explained that the recommendation regarding further reductions in adult catch was considered appropriate only as an emergency measure to protect spawning stocks in the short term, until they can start to rebuild, and did not reflect the staff's advice for the longer term.

Finally, one participant noted that the ISC recovery projections assume that all measures adopted by both commissions were being fully implemented, but the information available suggested that was not the case.

11.3.   Northern albacore tuna

One participant expressed support for the staff conservation recommendations on northern albacore tuna; no additional comments were made.

11.4.   Mitigation of bycatches of sharks

A participant asked if best practices for safe release have already been developed, and suggested that, if not, they be addressed under this recommendation. Martín Hall explained that the staff recommendation addresses those species not targeted, and indicated that best practices have been developed for sea turtles and are still being developed for mobulid rays, and that vessels are testing various different methods for safe release, such as stretchers for sharks. Developing best practices for releasing the largest animals, sharks and rays, is difficult because of their size and because lifting them can cause damage to body parts. One possibility is a door or ramp for releasing larger animals off the side of the vessel. A participant expressed support for the development of mitigation methods to release live sharks, especially in the longline fishery. Martín Hall indicated that shorter longline sets are being tested, as are tools to cut or release hooks from turtles and sharks. One limitation on the development of mitigation methods for longline fisheries is that there is little research or experimental data available on testing bycatch reduction methods for longline fisheries.

11.5.   Improving data collection and stock assessments for sharks

A participant noted that there is currently a format available for improving data collection for shark catches in longline fisheries, but expressed concern about the lack of a common reporting format for the data. Martín Hall indicated that Appendix 3 with the longline reporting forms poses a challenge for extracting totals, but the totals are still needed to begin to address impacts of the longline bycatches.

Costa Rica reiterated its offer to provide a field office in support of the specific recommendation by the IATTC staff to establish an IATTC field office in Central America to facilitate the study of shark landings. Guillermo Compeán thanked Costa Rica for the offer and noted that the field office request is included in the staff recommendations, but it is important for the SAC to support the recommendation. Costa Rica suggested that the SAC recommend that a field office be established in Costa Rica to facilitate studies of shark catches. Another participant supported this concept, but noted that funding for shark bycatch studies is only available for 2-3 years, so additional funding would be required for long-term studies. Alexandre Aires-da-Silva explained that the IATTC staff activities report includes a detailed outline for shark studies. An assessment of hammerheads is not currently possible due to lack of data, but milestones and a research plan are provided in Appendix 1 of the staff recommendations. For silky sharks, the staff is proposing an exploratory Pacific-wide assessment. A participant suggested a less-preliminary approach to the development of a shark plan. Alexandre Aires-da-Silva indicated that a pilot program on shark bycatch is already funded, and the plan is to execute the project and analyze the results, and then develop a recommendation on a more permanent approach to these studies.

11.6.   Silky shark

A discussion developed about the staff recommendation to continue Resolution C-16-05, as well as the staff's request for CPCs to provide implementation data that can be compiled and analyzed prior to staff feedback. A participant indicated that a more substantive analysis on this topic was expected, including proposals for data collection and estimates of timelines for developing analyses on silky and hammerhead sharks. Alexandre Aires-da-Silva explained that the IATTC staff has always been very proactive in the study of silky sharks, providing multiple workshops and attempting to develop an assessment model for silky sharks. Absent a reliable assessment, stock status indicators were developed which are the basis for Resolution C-16-05. The staff recommends continuing to use stock status indicators for silky sharks while working with the WCPFC on Pacific-wide analyses of silky sharks and working towards improved data collection.

11.7.   Hammerhead sharks

A participant reiterated that the staff should take a more proactive approach to addressing assessments of sharks, noting that other organizations have made non-quantitative assessments of shark species and these studies could be reviewed and assessed as to their reliability and usefulness for the EPO. Alexandre Aires-da-Silva noted that the IATTC Ecosystem Research Program has defined priority species, including sharks, for research and conservation, and the staff plans to prioritize sharks. The main requirement for advancing the analysis of sharks is a good data collection program. Martín Hall indicated that another problem in Central America is assessing the impact of the nearshore artisanal fishery that targets hammerhead sharks for human consumption, which is not reflected in the fishery catch data. Guillermo Compeán also explained that the IATTC already has a resolution that places high priority on hammerhead and silky sharks, and there are requirements for the CPCs to collect and provide data on sharks. The staff will continue to prioritize sharks, but it is important to obtain the data to advance the analysis. It was noted that Peru has established closure periods and some catch limits, so there are currently some national efforts on this issue.

11.8.   Mobulid rays

Several participants had questions about the implementation of the recommended biological and genetic sampling of mobulid rays, specifically the training of observers to conduct the sampling, and how samples would be obtained from individual animals. Martín Hall explained that observers would be trained during

closure periods, using methods developed in consultation with experts in the field, and that sampling would involve the non-invasive removal of a small tissue sample from the tail of the animal. Some funding would be needed for observer training.

Several NGO representatives thanked the staff for their efforts to assess the bycatch of sharks and rays. They urged the IATTC to take immediate precautionary measures to mitigate these bycatches, and suggested that the need for more data should not delay action, since some of these stocks are being seriously depleted. They also encouraged collaboration with the WCPFC.

A participant asked whether there has been any review or revision of the 5% fin-to-carcass ratio used in analyses of catches of sharks. Brad Wiley explained that a review was undertaken about 10 years ago, but no conclusion was reached regarding the accuracy of the ratio, or whether it should be based on whole or dressed weights.

11.9.   Seabirds

Regarding the recommendation to revise Resolution C-11-02, a participant stated that more data and information on seabird distributions and interactions with fisheries would be required before any revisions to the resolution could be considered. Guillermo Compeán indicated that, for this very reason, the staff has developed a recommendation for improved data on seabirds to better analyze mitigation measures. Martín Hall noted that, in the annual data summaries submitted by CPCs, it is important to distinguish between "zero interactions" and "not reported/not collected"; he also described several technologies for mitigating seabird bycatch that could be tested by fishing vessels. Guillermo Compeán explained that Resolution C-11-02 recommends that observer programs collect data on seabirds, and requires that those data be provided to the staff for use when considering of seabird mitigation recommendations.

11.10.   Sea turtles

A participant noted that there is already a resolution (C-07-03) on sea turtle bycatch mitigation. Martín Hall indicated that there are many rules and guidelines, such as those noted in the recommendations of the Working Group on Bycatch, but that there is little evidence that best practices on mitigation are being followed. Several participants reported on national measures, such as the mitigation practices required for longliners in Panama and the use of de-hookers by vessels in El Salvador. Several NGO representatives noted that Resolution C-07-03 is 10 years old, and suggested that the SAC recommend reviewing and revising it.

11.11.   FADs

Regarding the recommendation on the provision of data on FADs, a participant noted the importance of a universal reporting format and of developing management recommendations for FADs, and another participant requested guidance from the staff on managing FADs. Guillermo Compeán stated that there is no consensus on management measures at this point, and they are still under study by the staff. A participant commented on the recommendation that CPCs provide data from each trip as soon as they are available, and noted that Ecuador requires such reports in both a timely manner and a standard format. Guillermo Compeán urged countries to report data on a trip-by-trip basis and at least 60 days prior to the 2018 annual meeting.

11.12.   Fishing gear configurations

There was no discussion on this recommendation.

11.13.   Purse-seine fishery

Regarding the recommendation for observer coverage sufficient for estimating the catches and bycatches of vessels <363 t carrying capacity, a participant requested that the staff recommend a statistically adequate level of coverage. Several participants suggested possible levels of coverage, but Guillermo Compeán, while agreeing that a specific number would be helpful, noted that it could not be decided at this meeting.

11.14. Longline fishery

A participant noted that the staff's recommendation for minimum observer coverage on longliners >20 m in 2016 was 20%, but is now "at least" 20%, and asked if there was any scientific basis for the difference. Guillermo Compeán indicated that the staff would address the matter in its revised recommendations. Several participants stated that establishing minimum data standards for longliners is more important than setting observer coverage levels. A participant noted that there is no consensus regarding minimum data standards, and did not support the staff recommendations on data standards and reporting. Several participants thought that 20% observer coverage is not realistic, noting that many countries are having difficulties in meeting the current 5% coverage requirement, and that more funding from the industry is needed to properly address these recommendations. A participant expressed support for the staff recommendations, observing that they would be beneficial to many countries fishing in the EPO. Brad Wiley suggested that the SAC consider using the minimum data standards developed by the WCPFC.

12. OTHER BUSINESS

Guillermo Compeán presented the draft action plan, derived from the IATTC Performance Review completed in 2016, which presents a summary and background on actions recommended by the review.

Discussion:

Alexandre Aires-da-Silva noted that one of the recommendations summarized in the draft action plan is better communication between the staff and the SAC, and requested feedback on this issue. A participant suggested that, if documents for the SAC meeting are not completed in time, executive summaries could be prepared and distributed to SAC participants prior to the meeting. Alexandre Aires-da-Silva noted that some SAC participants questioned the need for annual stock assessments (many organizations conduct them every 2-3 years), adding that less frequent assessments might allow the staff more time to conduct important research that is currently not addressed. A participant suggested that stock assessments be conducted every few years, unless the Commission specifically requests an assessment due to some anomaly in the status of a stock. Another participant suggested rescheduling the annual submission of data by countries so that the assessments can be started earlier, and suggested adjusting the dates of the SAC and annual meetings as well.

Martín Hall suggested that the Working Group on Bycatch meet every year, but focus on just one species group at each meeting, and invite experts to facilitate the analyses. Guillermo Compeán agreed, noting that this would facilitate the work of the Working Group on Bycatch.

Noting the suggestion in the performance review that the Director and staff visit member countries to meet with their staffs, Guillermo Compeán indicated that he does so as often as possible to facilitate communication regarding the work of the scientific staff.

13. RECOMMENDATIONS TO THE COMMISSION

The eighth meeting of the SAC made the following recommendations to the Commission:

1. **Spatial-temporal modelling of CPUE data:** The SAC recognizes the important work and collaborative efforts on spatial-temporal modelling of CPUE data, and highlights that IATTC efforts in this area are at the cutting edge of complex approaches to stock assessments. The SAC recommends continued Commission support for future research efforts in this area.

2. **Strategic Science Plan:** The SAC recommends that the scientific staff prepare a strategic science plan for the 2018-2022 period, which includes clear objectives, specific priorities, strategies, actions, responsibilities, and resources, including a tentative budget. The SAC also recommends that this strategic science plan include, *inter alia*, a stock assessment schedule, an action plan for implementation of Management Strategy Evaluation (MSE) with priority to tropical tunas, and a shark research plan.

3. **Management Strategy Evaluation (MSE):** The SAC recommends continued and expanded

Commission support for the staff's work and collaborative efforts in the area of MSE. Specifically, the SAC recommends further efforts to identify priorities for further research and progress, along with a calendar for a plan of work and an accounting of the necessary resources.

4. **Dorado (*Coryphaena hippurus*):** The SAC recognizes the importance of the dorado resource for coastal CPCs, and recommends that the Commission continue to support the participation of IATTC staff in data collection and research efforts, and consider financial support for such efforts, as appropriate.

5. **Tagging:** The SAC reiterates its recommendation to establish and continue tagging programs, for which the staff should develop a sampling design, indicating the target species, budget, and potential sources of financing

6. **Sorting grids**: The SAC recommends continuing the research efforts into sorting grids for juvenile tuna, developing an experimental plan in accordance with Resolution C-17-01

7. **Observers on purse-seine vessels of less than 364 t capacity:** The SAC reiterates recommendation 5 of its seventh meeting in 2016: "*Establish observer coverage for purse-seine vessels of less than 364 metric tons carrying capacity, and evaluate the use of electronic monitoring systems.*"

8. **Limits on FADs:** The SAC recommends establishing a limit on the number of FADs. To that end, the SAC also recommends that the scientific staff perform some dedicated work to enable future discussions by the Commission.

9. **Data on well volume of longline vessels:** The SAC recommends that the well volume of longline vessels, in cubic meters, be included in the data fields to be collected by longline observers.

10. **Support for developing countries:** The SAC recognizes the contribution of the projects presented with regard to support for developing countries and recommends that they be strengthened and continued, seeking financial resources.

11. **IATTC office in Costa Rica:** The SAC acknowledges the offer of Costa Rica to host and support the establishment of an IATTC field office in their country.

12. **Pacific bluefin tuna:** To further its work on the recovery of Pacific bluefin tuna, the SAC supports the continued coordination between the IATTC and WCPFC to develop a rebuilding plan including how the second rebuilding target will be calculated, any assumptions about recruitment that need to be made, and the required probability of reaching that target.

13. **Conservation of tropical tunas:** The SAC recommends that the scientific staff prioritize work on the analysis of various options for the management and conservation of tropical tunas such as maintaining the 62-day closure, maintaining the "*corralito*", establishing a limit on the number of FADs deployed and the manufacture of these devices using biodegradable and non-entangling materials. The SAC requests the scientific staff to evaluate fishing effort for calculating the days of closure on a different basis from capacity in cubic meters. This request is based on the imperfect correlation between fleet capacity and fishing mortality.

14. **Minimum data standards for longline observer programs:** The SAC adopts the following minimum standards for collecting and reporting data to the Commission by the CPCs' longline observer programs, pursuant to paragraph 7 of Resolution C-11-08. CPCs that choose to use the longline observer forms and manuals available on the IATTC web site should collect and report all the relevant data found on those forms. Observer programs not using the IATTC forms should collect and report to the Commission the data specified in Annex 1 of Document SAC-08-07e, excluding those fields highlighted in yellow that are not currently included in the WCPFC list of minimum standard data fields.

15. **Fin-to-carcass ratio for sharks:** The SAC recommends that the scientific staff review the provisions

of Resolution C-05-03 related to the fin-to-carcass ratio for sharks.

16. **Shark research:** The SAC recommends that shark-related scientific work is aligned with the requirements of Resolutions C-05-03, C-16-05, and C-16-06.

17. **SAC documents:** To allow SAC members sufficient time to prepare for the meetings of the SAC, the SAC recommends that all meeting documents are posted on the IATTC website at least three weeks ahead of every meeting.

18. **Analysis of catch limits:** The SAC requests that the scientific staff assess catch limits based on the update of the 3-year period 2014-2016, pursuant to resolution C-17-01.

19. **Analysis of impacts of juvenile mortality:** The SAC recommends that the scientific staff assess the impact of the fishing mortality of juveniles on future spawning biomass of yellowfin and bigeye tunas[3].

The following recommendations are based on advice received from the 2nd Meeting of the Ad Hoc Working Group on FADs:

1. **Data on FADs:** The SAC agrees with the *Ad Hoc* Working Group regarding the need to set minimum data requirements and standards for the collection of the data specified in Resolution C-16-01. The SAC recommends that efforts to revise data collection on FADs continue intersessionally, using the *Basecamp* virtual forum and with the help of IATTC staff, with a goal of submitting a revised form for consideration by the next meeting of the *Ad Hoc* Working Group scheduled for July 2017, which will in turn pass the document to the Commission for consideration at its 92nd Meeting

2. **FAD database:** The SAC also recommends that the Commission request that the IATTC staff develop a common database for the management of FAD data collected pursuant to Resolution C-16-01. This work should be informed through an informal workshop to be held in 2017 with broad participation of relevant CPCs and IATTC scientific staff. The SAC recommends that, following the development of a common database, CPCs designate a representative responsible for transmitting the relevant data to IATTC.

3. **Workshops on FAD data:** The SAC acknowledges that some fleets may have difficulty in complying with FAD data collection requirements, and therefore recommends that CPCs, IATTC staff and staff from national observer programs should organize training workshops that will help vessel captains and crew learn how to properly fill out FAD data forms.

4. **Collection of data on FADs:** The SAC recommends that the Commission consider the appropriate levels of observer coverage (using both observers and electronic monitoring systems) in various fleet categories with the goal of improving FAD-related data collection.

5. **Definitions of FAD-related terms:** The SAC recommends that the Commission, through the *Ad Hoc* Working Group on FADs, develop definitions for a suite of terms related to FAD fishing operations, within the context of Resolution C-16-01, taking into consideration the definitions used by other tuna RFMOs, as appropriate. The terms recommended for definition include: floating object, log, FAD, interaction with floating object, set on floating object, set on unassociated school, set on whale shark, biodegradable FAD and non-entangling FAD. The development of a definition for "interaction with floating object," should take into account the definition of "interaction" provided in the Antigua Convention. Regarding the definition of "floating object set", the Working Group should explore the possibility of developing a checklist that would allow the validation of the definition based on the fulfillment of some specific criteria. The Working Group should also work with the staff of the IATTC to review the biological information of population structure associated with floating objects to support the development of this definition. Legal aspects of this definition should also be evaluated, including, among others, ownership of the floating object. The current definition of floating object sets used for

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[3] This recommendation was adopted without the participation of the European Union.

data reporting should also be taken into consideration.

6. **FAD research:** The SAC recommends that the Commission support the research plan prepared by the *Ad Hoc* Working Group (Appendix 1) and work to identify priority areas for research. The research should proceed with the support of those that can contribute to the elaboration and implementation of the Commission's management measures for FADs.

7. **Biodegradable FADs:** The SAC recommends that future work on the development of biodegradable FADs take into account the social, economic and environmental sustainability of the materials evaluated.

8. **Funding for FAD research:** The SAC recommends the development of work plans and budgets for priority FADs research, and identify possible sources of alternative funding for initiatives that cannot be covered by the regular budget of the IATTC. Project leads should be identified to oversee the development of these priority research projects.

9. **Future actions on FADs:** The SAC agrees with the key areas for future action identified by the Joint Tuna-RFMO FADs Working Group Meeting. Accordingly, the SAC recommends that the IATTC FAD Working Group, in collaboration with the SAC and the Commission staff, develop a planning roadmap for future actions to be taken in support of progress on these key areas. The roadmap should identify the necessary participants and actors, timelines for progress, and budgets, including identification of potential funding sources.

10. **FAD questionnaire:** The SAC recommends that the Commission circulate an additional request to the FAD Working Group members, asking them to complete the questionnaire designed to inform its work.

The following recommendations are based on advice received from the Working Group on Bycatch:

The SAC recommends:

1. **Observers on longline vessels:** Consistent with the advice of IATTC scientific staff, that the observer coverage on longline vessels be increased to 20% in order to collect more data on bycatch by longline vessels, and that the resulting operational-level data be submitted to the Commission.

2. **Mortality of sea turtles:** The development and adoption of a format for CPC reports on the implementation of FAO Guidelines to reduce sea turtle mortality in fishing operations, as mandated by Resolution C-07-03, and compliance with this reporting requirement should be improved.

3. **Online access to national reports:** That the national reports submitted pursuant to Resolution C-07-03 be made available online to all CPCs through a controlled-access portal on the IATTC web site.

4. **Bycatches of sea turtles:** That the Commission analyze the extent of implementation by CPCs of the measures to reduce sea turtle bycatch in Resolution C-07-03, with a view to updating the measure, if necessary.

5. **Cooperation with the IAC:** Continued and enhanced cooperation and collaboration with the Inter-American Convention for the Protection of Sea Turtles (IAC), and in particular:

   i. strengthened cooperation between the two organizations in sea turtle protection activities, including IAC participation in the meetings of the SAC and IATTC participation in relevant meetings of the IAC.

   ii. that the IATTC and IAC Secretariats work together to continue supporting training regarding best practices for safe handling and release of sea turtles.

   iii. joint collaboration on sea turtle bycatch mitigation research (*e.g.* the use of illuminated nets and reductions in set duration).

   iv. joint collaboration between the IATTC and the IAC scientific committee to identify bycatch

hotspots associated with leatherback inter-nesting areas.

6. **Seabirds:** That the existing guidelines and other tools relating to the removal of fishing hooks from incidentally caught seabirds be made available to CPCs through the IATTC web site.

7. **Seabird data:** Improvement in seabird data and interaction information provided in annual reports by CPCs pursuant to paragraph 7 of Resolution C-11-02 (*e.g.* identification to species of seabirds interacted with, confirmation of "zero interactions" as opposed to leaving fields blank, stratified data, and any other relevant information available from an observer or other monitoring program).

8. **Seabird mitigation measures:** That the Commission analyze the extent of implementation by CPCs of the measures contained in Resolution C-11-02 (*e.g.* regarding mitigation measures used, materials used, etc.) with a view to updating the measure, if necessary.

9. **Seabird mitigation measures:** That the Commission consider revising the suite of mitigation measures in Resolution C-11-02 to include additional options, such as hook shielding devices.

10. **EMS:** That pilot projects be developed to examine the use of electronic monitoring systems, particularly on longline vessels, and that CPCs include in their national reports any relevant information on their use of electronic monitoring systems at the national level.

11. **Meetings of the Bycatch Working group:** Regular meetings of the Working Group on Bycatch, preferably on an annual basis.

14. ADJOURNMENT

The 8th Meeting of the SAC was adjourned on the evening of May 12, 2017.