INTER-AMERICAN TROPICAL TUNA COMMISSION

SCIENTIFIC ADVISORY COMMITTEE

14TH MEETING

La Jolla, California (USA)
15-19 May 2023

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1. OPENING OF THE MEETING

The Director, Dr. Arnulfo Franco, opened the meeting. He was accompanied by the Chair of the Commission, Alfonso Miranda, the Coordinator of Scientific Research, Dr. Alexandre Aires-da-Silva, and the Senior Policy Advisor, Amb. Jean-François Pulvenis. Dr. Franco welcomed delegates and asked all the attendees to give their best during this week of work considering the busy agenda for the meeting.

Delegates from the following Members were present at the meeting: Belize, China, Canada, Colombia, Korea, Costa Rica, Ecuador, El Salvador, United States, Guatemala, Japan, Mexico, Nicaragua, Panama, Peru, Chinese Taipei, y Venezuela. From Cooperating non-Members Chile was present.

2. ADOPTION OF AGENDA

The **United States** requested the incorporation in the agenda of an item regarding climate change. The Director proposed to add it as item 3c in the agenda.

The **European Union** requested that the topic of "Functioning of the SAC" be considered under in Agenda item 15 "Other Business." This was accepted and the provisional agenda was adopted.

As a result of many comments regarding the lengthy agenda for SAC14 as well as other SAC meetings over recent years, the SAC agreed to review options for reducing it in future meetings, so as to allow for deeper discussion of the relevant issues more directly linked to the recommendations for management and conservation.

3. RESEARCH PLANNING

a. Strategic Science Plan (2024-2028)

- The Coordinator of Scientific Research, Alexandre Aires-da-Silva, presented an overview of the activities conducted under the current 2019-2023 Strategic Science Plan (SSP). He also presented some considerations for the future since this plan finishes in 2023 and a new plan is needed.
- The 2019-2023 SSP provided a very useful roadmap for planning and prioritizing the staff's activities (IATTC-93-06a). Along with its two companion documents which are the Staff Activities and Research Plan (SAC-14-01) and the Unfunded Projects document (e.g. IATTC-100-02b), the SSP framework also helped to better communicate the staff's research to the Commission and stakeholders, as well as in the budget planning of future activities. The goals and targets of the SSP have accommodated 88 research projects within the 5-year timeframe of the plan. These projects can now be easily navigated on the SSP project query system implemented in the new IATTC website.
- The Coordinator of Scientific Research highlighted some projects under each of the seven themes, the main areas of research and pillars of the SSP. The projects highlighted under the theme "Data collection for scientific support of management" were: Pilot study to develop the Enhanced Monitoring Program (EMP) for bigeye catches, two projects and a workplan on electronic monitoring (purse seine and longline), and the FAO-GEF ABNJ funded project to improve data collection for shark fisheries in Central America. On the theme "Life-history studies for scientific support of management", the multi-year tropical tuna tagging study and the feasibility study to develop a program for updating morphometric relationships and collection biological samples for priority species in the EPO tuna fisheries were mentioned.
- Under the theme "Sustainable fisheries", the projects highlighted were: several projects to improve the stock assessments for yellowfin tuna, bigeye tuna, the development of a new risk analysis methodology for the tropical tuna, new stock assessments for skipjack and south EPO swordfish, participation of the south Pacific albacore assessment (developed in collaboration with SPC),

developing alternative buoy-derived biomass indices for the tropical tunas, and workplan to develop a Management Strategy Evaluation (MSE) for the tropical tuna. On the latter, funds are sought to extend the MSE workplan into 2024.

- Various projects were highlighted under the theme "Ecological impacts of fisheries". One project was the development of a flexible ERA methodology (i.e. the EASI-fish approach) for quantifying the cumulative impact of tuna fisheries and prioritize data-limited species (including the development of other projects assessing the vulnerability for sharks, mobulids and the east Pacific leatherback turtle). Several projects related to mitigating bycatch and ecological impacts were mentioned, specifically on developing and testing bycatch release devices in tuna purse seiners, evaluate the best handing practices and post release survival for silky sharks in longline fisheries, manta and devil ray post-release survival, and develop and test non-entangling biodegradable FADs.
- Some projects were also highlighted under the theme "Interactions among environment, the ecosystem and fisheries". Related to climate change, a project developing models on the effects of climate change on pre-recruit life stages of tropical tunas was mentioned (conducted by the Early Life-history Group). Also, a project supporting climate-ready fisheries was highlighted (in collaboration with San Diego State University). Finally, the project focusing on developing an updated ecosystem model for the EPO was also mentioned.
- On the "Knowledge transfer and capacity building" theme, the three MSE workshops with stakeholders were highlighted. Finally, the external reviews of the tropical tuna assessments as well as the CAPAM meetings were highlighted under "Scientific excellence", the seventh and last theme of the SSP.
- Strengths of the IATTC are permanent, high-level highly dedicated staff, including new members among the scientific staff, but challenges are the lack of dedicated funding for some emerging topics of interest to the Commission (e.g., MSE, stock assessments of new species tied to MSC certifications). The main challenges for scientific research are related to data. The tagging program is producing data that can be used to estimate absolute abundance for tropical tunas, but funding for cruises is not guaranteed in the long-term. The future of the research program at the Achotines laboratory should also be discussed as there are some retirements pending.
- It is desirable to extend the SSP for one additional year not only because the management cycle ends in 2024 but also considering that the benchmark assessments for the three tropical tunas were postponed from 2023 to 2024. Extending the current 2019-2023 SSP into 2024 would allow a year to discuss priorities to become incorporated in the next SSP.

Discussion:

- The **European Union** complimented the staff for the high-quality of its research and for their hard work in structuring such a thorough research program. The SSP is very well structured, so users can follow the objectives, tasks, and progress on each research project. This format is encouraged to continue in the next SSP. Some challenges were also noted which are mainly related to the limited human and financial resources available to address the growing demands on the scientific staff (e.g., stock assessments for new species).
- The **United States** asked for clarification on whether a SAC recommendation was needed in order to extend the current SSP for one additional year. The Director noted that there may be budgetary

considerations involved in this extension. For this reason, receiving support from the SAC is desirable so that the possible one-year extension of the SSP is considered by the Commission. This would extend the current plan on additional year (2024), and the new SSP plan would initiate one year later in 2025, when the new management cycle is also expected to start.

- **El Salvador** thanked the staff for their hard work and inquired about the best opportunity for members to participate in discussions about priorities and funding needs related to the next SSP. The Coordinator of Scientific Research noted that the main priorities of the staff's research activities are already well established under the Antigua Convention. These consist mainly on the extensive stock assessment work for the tuna-billfish stocks as well as assessing and mitigating the ecosystem impacts of the tuna fisheries. There is ample opportunity for discussions with members about other research priorities to be included in the next SSP. These include the meetings of the SAC, the Commission and its subsidiary bodies.
- The stronger needs for additional human and financial resources to meet the growing number of requests to the staff was reiterated by **Ecuador**. For example, many CPCs have requested an updated stock assessment for dorado (mahi mahi) and management measures. This resource is exploited by most coastal nations in the EPO and the last stock assessment was conducted in 2016. An updated assessment for dorado along with its required additional resources should be planned under the new SSP.
- Also, on the needs for additional resources, the Commission has committed to the process of management strategy evaluation (MSE) and developing harvest strategies for key stocks. **PEW** expressed its support to IATTC for this commitment and pointed out to the immediate priority of securing funds for the continuation of the MSE process for bigeye in 2024, and beyond for other tropical tunas. On other ways of strengthening this commitment, PEW encouraged the Commission to establish a new dialogue Working Group on MSE. It is important that such WG would address MSE & harvest strategies and allow for inclusion of southern hemisphere stocks such as dorado, South EPO swordfish, as well as other emerging issues that need input from science and managers.

b. Staff Research Activities and Workplans (SSP 2024-2028)

Key Points:

Presentation summary for this section is combined with item 3a above.

Discussion:

Discussion summary for this section is combined with item 3a above.

c. Climate Change

The **United States** requested the inclusion of an item on climate change in the agenda of future SAC meetings. The Director acknowledged the request from the US. He also noted that climate change will soon be reflected in the research priorities of the staff after the planned hiring of a climate change research scientist (position of Senior Vulnerable Species Ecologist).

4. PROGRESS AND OUTCOMES IN THE IMPLEMENTATION OF PREVIOUS SAC AND WORKING GROUPS (WG) RECOMMENDATIONS

Alexandre Aires-da-Silva presented the document SAC-14-02 Implementation of SAC recommendations.

Key Points:

- Overall, there is good progress in the follow-up of the recommendation of the last SAC meeting.
- Some of the staff's activities to follow-up on the SAC recommendations are still ongoing and

should continue receiving the support of the Commission. This is the case of the activities related to the development of an electronic monitoring system (EMS) for tuna fisheries in the EPO and those related to the process of the management strategy evaluation (MSE).

Discussion:

There was no discussion under this agenda item.

5. THE FISHERY IN THE EPO

a. The tuna fishery in 2022

Alexandre Aires-da-Silva presented a review of the tuna fishery in the EPO in 2022 (SAC-14-03), based on the most recent data available. Not all data are available in time for the SAC meeting; for example, CPCs are not required to submit longline data until 30 June, so longline catches for yellowfin and skipjack have been estimated based on 2021 figures.

Key Points:

- **Total EPO Catches by Species**: The retained catches for all tuna species in the EPO were ~703,000 ton for the 10-year average and ~670,000 tons for 2022. The 10-year average catch proportions for each species were: 34% of yellowfin, 44% for skipjack, 14% for bigeye, 6% for albacore, 1% for Pacific bluefin and 1 % for all the other tuna species.
- **Total EPO Catches by Gear**: The 10-year average catch proportions for each gear type were: 87% purse seine catches, 10% longline catches and 3% by all other gears.
- **The total longline fishing effort in the EPO has been stable or slightly declining** over recent years**.**
- The preliminary 2022 data for total well volumes of purse-seine vessels show that **the capacity of the purse-seine fleet operating in the EPO was 253,071 m^3**, 4% below the average capacity levels operating during the *status quo* period (2017-2019).
- **The general increasing trend in the number of floating-object sets observed since 2005 has resumed.** Although this increasing trend had been interrupted with the onset of the COVID-19 pandemic in 2020, this trend has resumed in 2021 and 2022, when the effects of the pandemic on fishery operations gradually diminished. In 2022, the number of sets on floating objects reached its highest historic value since 2000 (17,699 sets), a number that exceeded the *status quo* level (~16,000 sets) by 11%.
- **Yellowfin**: The 10-year average (2012-2021) for yellowfin tuna retained catches by all gears was ~242,000 tons with 62% on dolphin sets, 21% on floating object sets, 12% on unassociated sets and the remaining 5% by other gears including longline. The catch made in 2022 was ~292,000 tons which was ~22% higher than the 10-year average. The preliminary 2022 estimate of yellowfin catch on floating-object sets is ~90,000 tons, ~45% above the *status quo* level. This recent increase in the catch of yellowfin on floating-object sets in 2022 is particularly strong, which was at the highest level since 2000 (increase of ~39% and ~68% from 2021 to 2022, in bias adjusted weight and numbers, respectively).
- **Skipjack**: The 10-year average (2012-2021) for skipjack tuna retained catches by all gears was ~310,000 tons with 69% on floating object sets, 30% on unassociated sets and the remaining 1% under other sets which included all other gears and dolphin sets. In 2022 the total catch was 298,000 tons which was 4% lower than the 10-year average.
- **Bigeye**: The 10-year average (2012-2021) for bigeye tuna retained catches by all gears was ~96,000 tons and the catch for 2022 was ~64,000 tons (~34% was lower than the 10-year average). The preliminary estimate for the bigeye catches on floating objects in 2022 is ~46,000 tons, ~30% be-

low the *status quo* level of 66,000 tons. Therefore, there is no concern that the *status quo* catch level has been exceeded for bigeye in 2022.

Discussion:

- **Venezuela and Mexico** expressed concern about: 1) the resumption of the increasing trend in the number of floating-object sets which have exceeded the *status quo* level by 11% in 2022; 2) the very strong increase in the yellowfin catches on floating-object sets in 2022 (~90,000 tons, ~45% above the *status quo* level), which could potentially represent increase fishing mortality and affect future yellowfin recruitment to other fisheries (e.g. dolphin associated sets); 3) the strong decline in bigeye catches on floating-object sets, about a 30% reduction with respect to the *status quo* level.

- **Ecuador** expressed general agreement with the comments previously made but noted the need for additional scientific research before any changes in the current conservation measures, if needed, can be considered by the Commission. Some important questions to clarify are the reason for the increased number of floating-object sets, the decreased average length for yellowfin caught in dolphin sets, and an apparent shift of floating-object sets into northern waters in 2022. On the latter, could it be related to environmental conditions? The staff agreed that these issues warranted further investigation.

- In response to the concerns above expressed by various participants, the staff reiterated its particular concern about the resumption of the increasing trend in the floating-object sets, but did not find an immediate need to recommend any modifications to the resolution. Regarding the unusual trends in the 2022 catches noted for yellowfin and bigeye, these could be due to several reasons:

    - For bigeye: At this stage, the staff cannot determine if the strong decline in the catches of bigeye in 2022 is due to the expected reduction on the catches from the establishment of the thresholds on individual purse-seine vessel annual catches that will trigger additional closure days under resolution C-21-04, or another factor such as weak bigeye recruitments recently entering the fishery.

    - For yellowfin: At this stage, the staff cannot determine if the strong increase in the yellowfin catches in 2022 is due to a change in fleet behavior/fishing strategies motivated by the bigeye catch reduction measures under resolution C-21-04, a very strong recruitment, or increased availability of yellowfin resulting from favorable environmental conditions.

    - These strong trends will be better understood from the staff's research planned for SAC-15 in 2024. This includes benchmark assessments for all 3 tropical tuna species and also an investigation of potential changes in fleet behavior/fishing strategies resulting from the bigeye measures under C-21-04.

- **Mexico** inquired if the staff has any estimate about the levels of yellowfin catches taken by artisanal fleet of EPO coastal nations. Alexandre Aires-da-Silva commented that the volumes of yellowfin tuna catch from artisanal fisheries reported by members is very minor compared to those of industrial fisheries. However, he also recognized that improvements are needed on data collection programs for artisanal fisheries in EPO coastal nations. Recent progress has been made through the FAO-GEF ABNJ funded projects (phases 1 and 2).

- In addition, **Mexico** inquired the staff about an update on the use of sorting grids by the purse seine fleet. Specifically, what percentage of purse-seine sets are using sorting grids, and if whether there is knowledge about the post-release mortality rates for small tuna resulting from the use of the sorting grids? The staff clarified that an evaluation of the use of the sorting grids has not been

conducted as this will require observer time, currently very limited, to gather this detailed information. In addition, an evaluation of the impact of the sorting grids on the survival of released fish will require a dedicated scientific research project for which there are currently no human and financial resources available.

- **Colombia** asked whether the staff has any concerns about the possibility of misidentification juvenile yellowfin versus bigeye and whether the results of port sampling are reliable in this respect? The staff replied that there are no concerns about possible species misidentification under either the regular port sampling program conducted by IATTC staff or under the new Enhanced Monitoring Program (EMP) established under resolution C-21-04. All samplers receive significant amounts of training in this respect. On the latter program, it was further clarified that the work of the EMP samplers is recorded by video and reviewed by multiple individuals with tuna ID expertise and no significant problems have been found.

b. National reports

This agenda item is included in the agenda for presentations by CPCs regarding any national research activities pertaining to the resources managed by the Commission. No national reports were presented.

c. Longline observer program reports

Brad Wiley gave a presentation based on document SAC14-INF-B. This document summarizes reporting received so far from CPCs regarding longline observer coverage achieved in 2022 and also the status of the reporting of operational longline observer data to IATTC for previous years under Resolution C-19-08 (and under the previous Resolution C-11-08).

Key Points:

- Of the 17 CPCs with qualifying longline vessels on the RVR (i.e vessels over 20m LOA or those without a length registered), 5 of them reported that the measure did not apply to them in 2022 (e.g., because their vessel(s) did not operate or did not fish for IATTC species).
- Of the remaining 12, 9 CPCs submitted summary reporting prior to SAC14 (due date for annual summary reporting for the previous year pursuant to Annex A of the Resolution is March 31), and 7 of these reporting meeting or exceeding the 5% observer coverage.
- The summary reports received from CPCs are in the SAC14 meeting page under, "Annual summary reporting – scientific observers for longline vessels (Resolution C-19-08)".
- Operational-level longline observer data is required to be submitted to one of the two sets minimum standards provided in Annex B of C-19-08.
- Of the CPCs that typically submit summary reporting for the longline observer programs, 7 have submitted their observer data for all years which observer data was collected.

Discussion:

- A participant asked whether C-19-08 was applicable to cooperating non-Members (CNMs) and the staff replied that it does if they have longline vessels on the RVR greater than 20m LOA.
- **Peru** indicated that they did not have longline vessels operating in 2020 and asked that the tables be updated to reflect this.
- **Venezuela** asked if, in general, members are complying with the requirement to submit summary reporting using the format provided in Annex A of the Resolution. The Secretariat staff responded that as of this year, 100% of CPCs submitting summary reporting had done so using the correct format.

- **Chile** indicated that their qualifying vessels did not operate in 2022, so the requirement was not applicable to them.
- **Costa Rica** explained that they continue to have difficulties in establishing and maintaining a longline observer program, noting that they had initially established a pilot program in 2015, but that it did not continue to operate beyond that year, so they have no longline observer data to report for 2022.
- **Belize** noted that they did not have an observe program in 2020 because of COVID-19, and expressed confusion over the "red" cells attributed to Belize for % observer coverage achieved in 2013 and 2014 because they had already reported to IATTC that they did not have an observer program in those years. Brad Wiley explained that the red cells in the table showing % observer coverage by year did not indicate that no information had been received, but rather than the % observer coverage achieved was 0%.
- The **United States** noted that, consistent with staff recommendations, C-19-08 should be amended to eliminate "effective days fishing" as a metric for fishing effort, leaving only "number of hooks" as the measure of fishing effort and observer coverage under the Resolution. The US will propose a SAC recommendation to this end.
- **China** indicated that they have operational longline observer data to submit for 2013-2018, and that they would do so once it was properly formatted.

d. Transshipment observer program

Ricardo Belmontes presented the document SAC-14-INF-C_Regional-program-of-observers-for-transshipments-at-sea.

Key Points:

- The program has been in operation for more than 15 years and has been developed mainly for compliance purposes to verify the amounts of tuna that are transshipped at sea by large tuna longliners.
- FAO approved in July 2022 guidelines for transshipments at sea and in general terms the IATTC program conforms to these guidelines.
- A feasibility study to evaluate the use of electronic scales installed in the cranes to determine the precision of the tuna transshipment estimates reported in the transshipment declarations, as well as those made by the observer on board, is being considered.

  As specified in resolution C-22-03, cooperation with WCPFC officials in charge of the transshipment observer program has been increased.
- For scientific purposes, an attempt will be made to record shark transshipments, by species, by requesting their identification and notification from the transshipping fishing vessels.
- Resolution C-22-03 will be reviewed at the Commission annual meeting in 2023, and if necessary, measures will be adopted for the effective authorization, monitoring and control of transshipments with vessels not included in the IATTC Regional Vessel Register.

Discussion:

- **Nature Conservancy** offered their experience regarding a project prepared for WCPFC in which, working with FFA, SPC, and a fishing company, the catch held by the crane is weighed electronically, and this information is integrated into the ME system on board the vessel. The project has the output to verify if the calculation made by observers are accurate and is currently in its third phase. The IATTC Secretariat thanked NC for the offer and will take it into consideration.

- Consideration that most of the tuna transshipped is albacore (>50%), **PEW** asked if the transshipment estimates for this species are recorded by region (south and north). The Secretariat responded that observers on transshipments vessels have not been recording the albacore tuna by stock (south or north). Likewise, fishing vessels have not been asked to report it by region. The Secretariat will review and consider this possibility.

6. STOCK ASSESSMENTS

a. Potential bias on the 2020 and 2021 tropical tuna-catch estimates resulting from COVID-19

Ananda Majumdar presented an update on the ongoing investigation of potential bias on the 2020 and 2021 tropical tuna catch estimates resulting from the impact of the COVID-19 pandemic on port sampling operations (SAC-14 INF-D).

Key Points:

- Port-sampling data are used to estimate the tropical tuna catch composition of the purse-seine fleet. The COVID-19 pandemic hindered collection of port-sampling data in 2020-2021. Some of the ports most affected were where bigeye tuna (BET) catch is unloaded. Thus, there is concern that the Best Scientific Estimates (BSE) of catch may be biased, particularly for bigeye tuna.
- One possible solution to deal with this issue is to develop a new statistical methodology that is less vulnerable to bias caused by pandemic-related data loss. In addition to using the available port-sampling data, this new methodology could use other data sources for catch composition to produce estimates as similar as possible to the pre-pandemic best scientific estimates, BSEs (2010 – 2019). The modeling is focused on developing the new methodology for floating-object (OBJ) sets.
- A modeling challenge is that there are four primary data sources available for estimating catch composition: observer, logbook, cannery and port-sampling data. These data sources differ in terms of fleet coverage, spatial and temporal resolution, potential biases (catch amounts, species identifications), and extent of data pandemic-related loss in 2020 – 2021.
- To help mitigate pandemic-related data loss spatio-temporal Conditionally Auto Regressive (CAR) models were used by incorporating data from multiple time periods into one model, thus taking advantage of spatial pattern evolving in a correlated manner through time. The total BET catch was estimated to be 69 901 t and 48 087 t (12% 18.2% bias), in 2020 and 2021, respectively. The total SKJ catch was estimated to be 190 243 t and 239 692 t (0.6% and -6% bias), in 2020 and 2021, respectively. The total YFT catch was estimated to be 53 924 t and 60 701 t (-17.5% and 9.5% bias), in 2020 and 2021, respectively.
- For future work, development of fine-scale spatio-temporal models (e.g., 5°- month or 5°- quarter) will be undertaken because the stock assessment models have a quarterly time step, and the fisheries definitions differ from the 13 areas used in this analysis. Development of fine-scale models that are not constrained to be highly correlated with the BSE will also be undertaken.

Discussion:

- The **United States** asked which bias-corrected catches will be used in the 2024 benchmark stock assessments and what are the criteria for making those decisions? Mark Maunder responded that at this stage the staff is considering using the CAR estimates for the upcoming assessments. However, he also noted that the CAR analysis could be further improved by, for example, adding 2022's data into the CAR model. IATTC staff have not made the final decision yet and are open for any input from the SAC on this decision.

b. Tropical tunas stock status indicators (SSIs)

Haikun Xu presented on stock status indicators for tropical tunas in the EPO (SAC-14-04) .

Key points:

- Stock status indicators, based on both purse-seine and longline data, were presented for the three tropical tuna species.
- The general increasing trend in the number of sets in the floating-object fishery since 2005, except in the first COVID-19 pandemic year of 2020, is reflected in increased catches, reduced catch-per-set, and reduced average length for all three species in the floating object fishery, although there has been a flattening of the trends in some indicators over the most recent decade.
- As the impact of the pandemic on the fishery operation began to diminish in 2021, the number of sets on floating objects resumed its general increasing trend. In 2022, the number of sets on floating objects reached its maximum historic level and exceeded the *status quo* by 10.6%.
- In 2022, both the catch in weight and catch-per-set for bigeye in floating-object sets reached their lowest levels since 2000, which may partly be a result of the introduction of a catch threshold scheme per vessel for bigeye tuna under Resolution C-21-04.
- The recent increase in the catch of yellowfin on floating-object sets in 2022 is particularly strong, which was at the highest level since 2000. This catch increase is of 38.9% and 67.5% from 2021 to 2022, in bias-adjusted weight and numbers, respectively.

Discussion:

- **Venezuela** inquired about how to interpret recent stable fishing effort for longline, despite bigeye tuna catch decreasing since the year 2000. The presenter pointed out caution in this interpretation since the time series of total longline effort combines all fleets which can have different fishing strategies (e.g., target species). Although overall effort has been nearly stable over recent years, perhaps targeting of BET by some fleets may have decreased as fleets have shifted to other species as target (e.g., South Pacific albacore, swordfish). Following up on this comment, **Mexico** noted that it may be useful to separate indicators by fleet/CPC to better account for targeting and other differences in fishing strategies.
- On the recent increased effort and/or shift to other target species such as South Pacific albacore and swordfish towards the southern region of the EPO, **Ecuador** commented on the decreased coverage of the longline fleet in the tropical area compared to 20 years ago. Longline effort should be reported by area fished and species targeted. The presenter noted that these changes are difficult to understand as it is often not clear what the target species is and these changes may also occur by season, over time, fleet, CPC. Assistance by longline fishing nations is needed to better investigate and understand these complex changes.
- **Japan** stated that although there has been a gradual increasing trend in the proportion of albacore tuna in the catch of the Japanese longline fishery, Japan targets BET and this has not changed in 20 years. Japan will continue to collaborate with the IATTC staff to better understand these changes.
- **Colombia, Mexico,** the **United States** and **Venezuela** expressed concerns about the increase in OBJ effort over time. This resuming trend along with several indicators for BET which are declining are reasons for concern. However, it was also commented that the recent conservation measures under resolution C-21-04 focused on dis-incentivizing and reducing BET catches (catch thresholds by vessel), so it is unclear if that could explain the decrease in some of the indicators. Is the recent

declining trend in BET catch a sign of overexploitation, or due to changes in fishing strategies to avoid large BET catches, or any other reason? It is important to understand these changes in 2024 when the Commission discusses the new conservation measures for the tropical tuna. The Director noted that only two vessels went above the BET catch thresholds in 2022.

- The Coordinator of Scientific Research commented on two main pieces of information that will be available to SAC-15 in 2024 to help better ascertain these trends. The first are the 2024 benchmark stock assessments for the three tropical tuna species. In addition, the staff is also planning to conduct an investigation on recent changes in fishing strategies potentially resulting from the recent measures in C-21-04.
- The **European Union** commented on the critical importance of the longline CPUE in current and future stock assessments. It is important to foster the ongoing collaborative work between the staff and scientists of longline nations in order to obtain the best indices of abundance (and other relevant data) for the 2024 benchmark stock assessments and beyond.

c. Bigeye (BET) and yellowfin (YFT) tunas stock assessment:

i. BET: exploratory analysis

Haikun Xu presented a stock assessment exploratory analysis for bigeye tuna in the EPO (SAC-14-05).

Key points:

- IATTC staff proposes six major modifications to improve the stock assessment models for bigeye tuna in the EPO. These changes fall into three categories: fishery definitions, survey fleet characteristics, and fishery fleet characteristics.
- Although the staff considers that the proposed new "base" reference assessment model for bigeye tuna is superior to that from the last benchmark assessment based on a variety of model diagnostics, this exploratory analysis is considered preliminary and should not be used as the basis for providing any management advice.
- The proposed model modifications show potential in significantly reducing or even resolving the previous bimodal pattern in model-combined joint distributions of management quantities. Specifically, these modifications result in more optimistic estimates of terminal year depletion for the pessimistic group of assessment models, and more pessimistic estimates of terminal year depletion for the optimistic group of assessment models.
- In order to continue improving the stock assessment of bigeye tuna, the staff has identified several desirable research projects to be conducted in preparation of the 2024 benchmark assessment.

Discussion:

- **Japan** asked for additional clarification on the new rationale to define fisheries. The presenter reminded that in the previous benchmark assessment (SAC-11), fisheries were defined as a compromise among gears and set types. The main purpose of the new fisheries definition methodology is to group areas with similar length frequencies and thus similar selectivity curves. A question was also asked about the impact of the time block in selectivity in 2010. The presenter mentioned that this additional time block for longline selectivity improves the overall fit to longline length compositions, specifically those for the longline fishery with an asymptotic selectivity.

  The **European Union** recognized that one of the main differences between the 2020 benchmark assessment for bigeye tuna (SAC-11) and the models used in the new exploratory analysis is that

new sources of longline length frequency data are used in the latter. Specifically, the new exploratory analysis includes not only Japanese length frequencies but also Korean. The presenter noted that the lengths compositions are weighted by the catch for the fisheries defined in the model. As catch has been decreasing for the Japanese fleet, it is desirable to include length frequency data for other fleets in the model. Since the Korean fleet is now the main longline fleet that catches bigeye tuna in the EPO, it is important to include its length frequencies to adequately represent the catches removed from the population.

- The **European Union** asked if new CPUE data from other fleets was available and included in the analysis.
    - The presenter replied that it is complicated to combine CPUE data from different fleets because their selectivity may be different. If the selectivity is different, those differences need to be accounted for by using a length-specific spatiotemporal model to standardize the CPUE collected by various flags. More research is needed before switching from the Japanese index to a joint longline index of abundance. This research could be added to the next 5-year strategic plan.
- The **United States** noted that the results of the new models look reasonable as a production function was estimated using the age-structure production model diagnostic (ASPM) like the models in the 2020 benchmark (SAC-11). However, concern was expressed about removing the time-block in the longline index in 1995, as there were substantial changes in fisheries operations in the mid-1990's (e.g., high seas drift net ban, changes in gear material, among others). How confident is the staff that the CPUE standardization is able to capture these changes and is there is a risk of making the model "too rigid" by eliminating the block?
    - Haikun Xu responded that the spatial temporal model for CPUE standardization uses hooks between floats (HBF) and vessel effects. The models in the 2020 benchmark used two indices, an early and a late period, however results are contradictory, as the catchability was estimated to be smaller in later periods, when it is expected to increase over time due to the improvements in fishing technology. In the new model, the estimates of catchability of the two indices were very similar, therefore the block was removed. The selectivities of the two periods were also estimated to be similar. The staff believes that the approach of removing the time-block is preferable given this contradictory change in catchability. Also, the staff looks forward to further investigate the possibility of effort creep and its effects.
    - Mark Maunder added that the floatation of hooks changed with the change in mainline material. Perhaps the HBF were changed to adjust for the change in mainline to maintain the same depth for targeting bigeye tuna.

ii. YFT: exploratory analysis

Carolina Minte-Vera presented document SAC-14-06.

Key Points:

- A conceptual model for yellowfin tuna in the eastern Pacific Ocean (EPO) was developed based on a review of all available information, including information on stock structure. The main component of the updated conceptual model is the idea that there are at least two stocks of yellowfin tuna in the EPO associated with different biogeochemical provinces, epipelagic and mesopelagic, which is supported by a suite of information.
- The distribution of these two putative stocks varies seasonally and interannually following the expansion and contraction of the biogeochemical provinces.

- The main challenges that this pattern poses to stock assessment is to determine where to define the boundary among stocks and how to estimate mixing rates among them.
- The dynamic shape of the biogeochemical provinces can be summarized using oceanographic variables, which allows a path forward to delimit the preferred habitat of each stock. In this study, the staff summarized the biogeochemical characteristics of the locations of each purse-seine set from 2000-2017 using principal component analysis. The first component (PC1) summarized the vertical structuring of the water column, while the second component (PC2) mainly represented the sea surface temperature (SST).
- Tree analyses were used to split the length composition of purse-seine fleet on floating objects, where the two principal components (a proxy for the location within the environmental gradients) and seasons (quarters and cyclical quarters) were used as explanatory variables. The tree analysis showed the first split on the PC2, separating the areas colder from warmer areas. When the colder areas were removed, the tree analyses on the tropical areas split the length composition along PC1 axis, into two distinct areas, a northeastern (NE) area with lower seas surface height, shallow thermocline and shallow upper layer of the mesopelagic zone, and a southwestern (SW) area with higher sea surface height, deeper thermocline, and deeper upper layer of the mesopelagic zones. The locations of those areas vary seasonally and interannually.
- The catches were split between the two putative stocks according to the membership defined by the tree analysis. A pragmatic decision of allocating the colder areas according to their position in the PC1 axis was made. The NE putative stock encompasses almost all the purse-seine catches in weight on dolphins sets, 96% on unassociated sets and 83% of floating objects, while only 17% of the longline catch in numbers (average for 1995-2017).
- The SW putative stock, in contrast, encompasses 79% of the longline catches and 17% of the floating object catches, with an increase in that proportion in recent years.
- These analyses will be used as bases to structure models that will be included in the risk analysis for the 2024 Benchmark Assessment.

Discussion:

- **Mexico** noted that the analysis is based on environmental data only and other data such as fishery and biological data are not considered. For example, the staff should carefully examine why is the NE putative stock comprised mostly of 1–3-year-old yellowfin and there are no large (older) fish in the catches. This is unexpected given that the natural mortality rates for these larger fish should be low. Limited tag-recapture records from the longline fishery have shown that these older fish are part of what has been suggested as a putative SW stock. Biological considerations about reproduction for old yellowfin do not necessarily match the proposed NE-SW differentiation. For the SW putative stock, small fish are found in floating-object sets and large fish are found in longline sets, there are no fish of intermediate sizes. Although Mexico supports the continuation of the work on the yellowfin conceptual model, it expressed caution in a NE-SW stock separation hypothesis.
    - Carolina Minte-Vera clarified that the staff made sure the conceptual model is consistent with the biology of the species. It is known from published work that larvae and spawning occur in both the NE and SW areas. Based on current biological assumptions, the mean generation time for yellowfin is estimated at about 2.5 years; the population is dominated by young age-classes and high proportions of large (and old) fish are not critical to sustain population levels. The proportions of large fish are expected to be low based on current mortality rates. In addition, the level of longline effort in the NE is small so even if there

are large (and old) fish, which predominantly inhabit below the thermocline, their vulnerability to the fishing gear may be low which explains their rare occurrence. The tagging data also supports the staff's proposal. The staff is aware that genomic and archival tagging data are limited for the SW stock, but all available data are consistent with the proposed hypotheses.

- Mark Maunder added that during the 2019 yellowfin tuna external review, the staff found support for different cohorts (north and south) based on length composition data from floating-object and unassociated purse-seine sets. It is common to see small yellowfin in floating-object sets and large yellowfin in unassociated sets, it is difficult to find middle-size yellowfin worldwide.
- Dan Fuller noted that most yellowfin tagged in the north are found close to where they were tagged. Yellowfin tagged in the NE show no or limited movements to the SW.

- **Colombia** noted that changes in environmental conditions can result in changes of the spatial distribution, availability and stock partition of yellowfin. Could this explain the very strong catches of yellowfin of floating-object sets observed in 2022? Or could these strong changes be explained by a change in fishing strategies in 2022? The presenter responded that the hypothesis of associating the stocks to particular water masses could result in different partitions of the habitat depending on environmental conditions. Yellowfin tends to have fidelity to environmental conditions rather than directional movement such as temperate tunas. Regarding the explanation for the strong 2022 catches of yellowfin, the staff will be investigating different hypotheses including change in environmental conditions and/or fishing strategies.
- The **United States** noted that they understand that there are potentially two yellowfin stocks, but the episodic mixing and its management implications is confusing. Does having two stocks mean two separate stock assessments? The presenter indicated that the staff will continue to capture the uncertainty in the yellowfin stock structure assumptions using the risk analysis approach.

d. Skipjack tuna (SKJ) stock assessment

i. IATTC Regional Tuna Tagging Program

Dan Fuller presented an update on results of the IATTC tagging program for tropical tunas (SAC-14-07).

Key Points:

- Project objectives: Capture, tag, and release:
  - 15,000 skipjack (SKJ), 2,500 yellowfin (YFT), and 2,500 bigeye tunas (BET) with plastic dart tags (PDT);
  - 600 skipjack, 150 yellowfin, and 150 bigeye tunas with archival tags (AT);
  - Implement a functional tag recovery program to facilitate the recovery of high-quality recapture data;
  - Con-currently execute a tag seeding experiment to evaluate reporting rates and accuracy.
- 6,181 SKJ were tagged and released with plastic dart tags and 250 with archival tags;
- 1,679 YFT were tagged and released with plastic dart tags and 472 with archival tags;
- 265 BET were tagged and released with plastic dart tags and 57 with archival tags;
- Return rates of plastic dart tags were, 27.4% (1,695) for SKJ, 16.5% (277) for YFT, and 39.6% (105) for BET;

- Return rates of archival tags were, 24.0% (60) for SKJ, 18.7% (88) for YFT, and 38.6% (22) for BET;
- There were four key factors inhibiting IATTC from completely meeting the project objectives:
    - High purse seine (PS) fishing effort throughout the equatorial EPO;
    - PS vessels setting Tropical Atmosphere Ocean (TAO) buoys where tagging was historically successful;
    - Insufficient industry cooperation in providing dFAD locations for fishing/tagging;
    - Majority of cruise time is spent searching for fish, rather than fishing and tagging.
- Tag recovery specialists located in three of the busiest unloading ports are critical to project success, although there were access issues for about 18 months during the COVID pandemic.
    - Tag seeding is a useful tool to evaluate real-time reporting rates and reporting accuracy during tagging campaigns. It also trains unloaders to search for tags.
- Using PDT and AT tag data collected from these cruises, and the six cruises from the early 2000's, a length-structured spatiotemporal tagging model has been developed.
- Evaluate the efficacy of using a portable sea cage to hold fish for tagging and other in-situ experiments:
    - Tag PS captured tunas from different set types;
    - Provide the opportunity to tag tunas when they don't bite;
    - Provide the opportunity to estimate tagging induced mortality.
- Identify opportunities to tag aboard pole-and-line vessels operating from coastal states.
- Develop relationships with company/vessel owners/captains to provide access to dFADs so more time can be spent fishing rather than searching.
- Develop agreements with fishing companies to deploy dFADs specifically for tagging cruises.
- Results may have value for conducting dFAD design and echo-sounder buoy experiments as well.

Discussion:

- **Japan** asked if any length-based movement analyses have been performed, as Japan has previously seen this trend in similar Japanese tagging projects. Dan Fuller insisted that although length-based analyses haven't yet been performed by the IATTC, perceptively, this does not seem to be the case for tropical tunas in the EPO.
- The **United States** asked if the IATTC can undergo future tagging events similar to what SPC does in the WPO/CPO, where there is greater collaboration with the fishing industry. Dan Fuller mentioned that much of SPC's success in the WPO is largely attributed to FAD closure periods, where the fishing industry is much more willing to cooperate and share the locations of company FADs. He added that similar ideas are in the works for the IATTC to foster and strengthen relationships with the EPO fishing industry to increase the efficiency of future IATTC tagging programs.
- Alexandre Aires-da-Silva urged delegates to reflect on the results from the IATTC Regional Tuna Tagging Program. Throughout the IATTC's history, many tagging trips have been completed and much has been learned. Moving forward, a strong relationship between the IATTC and the EPO

fishing industry will be imperative to future tagging programs (including sea cages and collaborations with existing and new pole-and-line boats). He also added that direct application of tagging data into stock assessments have historical been limited at the IATTC; however, a recent methodology developed by Anders Nielsen and Tobias Mildenberger (Technical University of Denmark) in collaboration with the staff will make tagging data more useful in stock assessments.

- The **European Union** inquired if the difficulties presented in the recent IATTC regional tuna tagging program was attributed to a lack of communication, in particular between IATTC and the fishing industry. Dan fuller recognized that improvements could be made in communicating the scope of the program to industry stakeholders in the future. It is critical to foster and strengthen cooperation with the fishing industry in future tagging campaigns. Alexandre Aires-da-Silva reiterated those comments.

- **Mexico** supported the idea by staff that a research budget for FAD deployments to support tropical tuna tagging operations should be considered by the IATTC. Mexico also mentioned that the fishing industry would likely be willing to cooperate, where access to FADs no longer being used could be given to the IATTC staff for tagging efforts. ISSF shared previous experiences from the Indian Ocean and suggested using FADs that are already deployed by the fishing industry instead to the IATTC deploying new FADs for tagging research. The concerns with IATTC developing its own FAD deploying program for tuna tagging is the price, the lack of IATTC experience deploying FADs, additional ocean pollution, and is probably not the best use of resources.

ii. **1st External Review of the SKJ stock assessment for SKJ**

Key Points:

Mark Maunder presented documents "1st External Review of IATTC staff's stock assessment of skipjack tuna in the EPO" (WSSKJ-01 Report), "Spatiotemporal modelling for skipjack" (SAC-14 INF-E; item iii), and "Skipjack exploratory analysis" (SAC-14-08; item iv), as they are directly related.

- The stock assessment for skipjack tuna in the EPO conducted in 2022 was the first assessment undertaken by the IATTC scientific staff for this species since 2005, and it is also the first conventional stock assessment considered reliable by the staff for use in management advice. The stock assessment was conducted using an integrated statistical age-structured catch-at-length approach using Stock Synthesis.
- In 2022 the skipjack assessment was subject to an external review with the objective of improving the assessment. The panel agreed that the basic stock assessment modeling approach was sound but had particular concerns about both indices of abundance (longline and echosounder buoy), the level of natural mortality and its dependence on age, and the strongly dome-shaped selectivity for the purse-seine fisheries. The possible improvements under consideration by the staff for the upcoming 2024 skipjack tuna benchmark assessment are basically those recommended by the External Review Panel.
- Although the management results were found to be robust to the sources of uncertainty in the assessment, the management advice could be improved by further improvements to the model. In addition to the recommendations of the external review, there are also several other sources of information that can be used to improve the skipjack assessment. These include lessons learnt in the development of the EPO yellowfin and bigeye tuna assessments, lessons from assessments of tuna and other species conducted by other organizations, and information from the CAPAM workshop series and other workshops.

- A new approach using spatiotemporal models has been developed for analyzing the skipjack tagging data. The results of this analysis will be included in the skipjack assessment (see item iii below).

Discussion:

There was no discussion following this presentation.

iii. Spatiotemporal tagging modeling for SKJ

A length structured spatiotemporal population model was developed that allows estimation of movement as an advection-taxis diffusion process and length-based mortality rates utilizing available tagging and effort data and might ultimately allow estimation of population size, distribution and sustainable harvest levels (SAC-14 INF-E). While advection might be informed by ocean currents, taxis can be based on smooth habitat preference functions of environmental covariates such as sea surface temperature or the mixed layer depth. Results indicate that the movement of SKJ in the EPO is inversely related to the velocity of ocean currents and depends on sea surface temperature. SKJ prefers intermediate sea surface temperatures around 25-26°C and exhibits stronger undirected movement at low and high temperatures. Further, the model estimates length-based fishing mortality rates in space and time for each fleet and a length-based natural mortality rate in line with previously reported rates.

Discussion:

- The **United States** noted that the model outputs could be sensitive to what input variables are used. For example, since FADs influence fish behavior (e.g., to aggregate around them), should the distribution of FADs be used as input data in the model? Mark Maunder responded that there have been some discussions about how FADs influence fish behavior, for example, whether FADs density affects the size of a tuna school or the number of schools. There is some information on FADs density which could potentially be included in this analysis.
- **Peru** noted that the average fishing mortality is high for small size skipjack, and asked if there is any evidence supporting the distribution of fish by size (North vs South) and whether the size distribution can be driven by environmental conditions? Mark Maunder responded that since the model is size-based, the environmental impact on the size distribution of fish can be modelled as a size-based process.

iv. SKJ stock assessment: exploratory analysis

This item was presented and discussed under item 6(d)(ii) above.

v. Proposed interim target and limit reference points for SKJ

Mark Maunder presented documents "Proposed interim target and limit reference points" (SAC14-INF-O) and "Proposed interim target and limit reference points for SKJ" (SAC-14-09) together as they are directly related.

Key Points:

- Although MSY-based reference points are established for the tropical tuna stocks in the eastern Pacific Ocean (EPO) under Resolution C-16-02, they are currently only defined for yellowfin and bigeye tuna. In addition, according to the FAO Code of Conduct for Responsible Fishing, Regional Fisheries Management Organizations (RFMOs) should adopt, on the basis of the best scientific information available, stock-specific target and limit reference points, and corresponding management actions. Therefore, reference points are needed for all species associated with the EPO tuna fisheries. Unfortunately, the relevant information may not be available to reliably estimate reference points for all species and the formal adoption of reference points can be time consuming. Therefore, the IATTC staff proposes interim limit and target reference points that can be used

for tuna, billfish, and other highly productive fishes in the EPO. These reference points are based on the interim reference points currently used for bigeye and yellowfin and the assumption of a conservative value for the steepness (h = 0.75) of the Beverton-Holt stock-recruitment relationship.

- Target Reference Point: defined as 0.3 of the dynamic unfished spawning biomass (S0 or B0) or the spawning biomass that maximizes yield under current relative age specific fishing mortality when the spawner-recruitment relationship follows the Beverton-Holt function with an assumed steepness (h) of 0.75, whichever is largest. The fishing mortality (F) target reference point is the value of F that, under equilibrium conditions, maintains the spawning biomass at the biomass target reference point.
- Limit Reference Point: defined as the spawning biomass that produces 50% of the virgin recruitment (R0) when the spawner-recruitment relationship follows the Beverton-Holt function with an assumed steepness (h) of 0.75. The spawning biomass at the limit reference point is equal to 0.077 of the equilibrium unfished spawning biomass (S0 or B0). The fishing mortality (F) limit reference point is the value of F that, under equilibrium conditions, maintains the spawning biomass at the biomass limit reference point.
- These interim limit and target reference points would be adopted for species for which there are no reference points, interim or otherwise, until sufficient information is available (i.e., there is sufficient knowledge about the stock-recruitment relationship, or the tradeoffs related to the age-specific selectivities to the fisheries) for a stock to produce species-specific reference points.
- Analyses based on assumptions about the steepness of the Beverton-Holt stock-recruitment relationship (h = 0.75) for skipjack tuna in the EPO support the conservative SMSY/S0 = 0.3 proxy target biomass reference point previously proposed based on values estimated for bigeye and yellowfin tuna in the EPO.

Discussion:

- The **United States** asked on whether management reference points are already established in C-16-02. Alexandre Aires-da-Silva clarified that C-16-02 defines MSY-based reference points for the tropical tunas. However, the interim stock assessment for skipjack shows that MSY related quantities are not well defined for skipjack, therefore some proxies are needed for reference points. This proposal outlines proxies that could be used in situations where MSY-based reference points are not available or are not definable.

e. 2nd workshop on improving the risk analysis for tropical tunas in the EPO

Mark Maunder described recent workshops organized by the Center for the Advancement of Population Assessment Methodology (CAPAM) to which IATTC staff actively contributes to. These included workshops on Stock Assessment Good Practices (FAO Headquarters, Rome, Italy, 24 - 28 October 2022), Tuna Stock Assessment Good Practices (Wellington, New Zealand, 7 - 10 March 2023), and Model Weighting (virtual, 28 Nov – 2 Dec 2022). The CAPAM workshop series started as the IATTC October Workshop series in 2002 and ran for about 10 years before transforming into the CAPAM series in 2012, when CAPAM was founded. Over this period all of the main components and issues of fisheries stock assessments were covered.

Key Points:

- The CAPAM model weighting workshop occurred concurrently with the 2nd IATTC Workshop on Improving the Risk Analysis for Tropical Tunas in the EPO: Model Weighting in Integrated Stock Assessments. This workshop focused on designing an approach to create an ensemble and to

weight models in that ensemble that is more objective, transparent, and automated. The workshop report is structured around the following key questions that formed the basis for discussion: (a) Which models to consider and what measures (diagnostics) should be used to exclude models? (b) What measures to use in weighting and how to determine the weight for each metric? (c) How to combine weights? (d) How to present and use results? Developing an ensemble is comprised of three steps a) what models should be considered? b) how to fix and/or eliminate models, and c) how to weight models.

- The models to consider should be based on the development of a conceptual model of the system and Good Practices to represent the alternatives identified by the conceptual model in the form of assessments models. Duplication of models should be avoided to prevent double weighting of certain hypotheses. Diagnostics are then used in an iterative process to fix and then accept or reject the models in the ensemble.
- Finally, the models in the ensemble should be weighted by either their ability to fit the data or to predict out of sample observations. However, the statistical properties of stock assessment models (e.g., inappropriate data weighting, unmodelled process variation, etc.) usually make fit to data an inappropriate measure for model weighting.

Discussion:

- Mark Maunder noted that a synthesized good practice report has been drafted based on recent CAPAM workshops and stock assessment reviews. The staff will incorporate results from the draft into the next benchmark assessments. Stock assessment results may change significantly but the impacts of new modifications are still unknown.
- The **United States** stated that the hindcast approach is a good approach for model weighting. For IATTC's assessments, how is it possible to have a transparent and fully objective process for model selection. Mark Maunder acknowledged that the current model weighting approach is based on the staff's expert judgement and is not totally objective. There is need to develop model weighing practices that do not inadvertently result in "cherry picking" of desired models as it may be the case when broad groups of stakeholders are involved in a consultation process. He noted that the staff has not arrived at the final data weighting procedure yet.
- Alexandre Aires-da-Silva asked about the future of CAPAM. Mark Maunder responded that one of the main goals is to produce a good practice guide. NMFS provided funding initially but recently it has been difficult to obtain funding. The CAPAM workshop series has covered most topics already so it is unsure what the future will be and where the funding will be from. The workshop will likely continue but it may be distributed to other institutions and collaborators. The next topic will likely be data-limited assessment or other potential topics such as MSE and environmental indicators.

f. Updates from ISC WGs:

i. Pacific bluefin tuna (PBFT)

Hiromu Fukuda presented a summary of the latest updates from the ISC Pacific Bluefin tuna Working Group (PBFWG).

Key points:

- The latest assessment was conducted in March 2022, and in 2023, PBFWG confirmed a continuation of the stock recovery through the several observation data such as the abundance index of spawner and recruitment index.

- The PBFWG developed a general framework of the PBF MSE during 2022-2023. This includes the short-term population dynamics model for PBF conditioned by the observation data from 1983 onwards, the operating models (OMs) which considered several uncertainties for the productivity assumptions, and management procedures (MPs) with requested harvest control rules and reference points.
- The WG performed several test-runs to illustrate the potential overlap of the performance of the candidate MPs through several performance metrics based on the candidate management objectives.
- Although there is good progress on the technical component of the MSE development, the WG still requires several inputs from the stakeholders such as agreed management objectives, and a realistic number of candidate MPs to be tested.
- The PBFWG summarized a progress report on the PBF MSE development, and this will be presented at the IATTC-WCPFC-NC Joint Working Group meeting in July 2023.

Discussion:

There was no discussion following this agenda item.

ii. North Pacific albacore tuna (NP-ALB)

Steve Teo presented on the 2023 stock assessment for NP Albacore tuna conducted by the ISC NP-ALB WG. The results presented are subject to change upon ISC Plenary Review in July 2023.

Key Points:

- Major changes from the 2020 assessment: There were four main changes to the base case model compared to the previous assessment in 2020.
    - 1) Increased uncertainty was imposed on the size composition and abundance index data for 2020 and 2021 because fishery operations and data collection protocols were likely affected by COVID-19 safety protocols.
    - 2) Two JPLL fleets were further subdivided nominally into juvenile and adult fleets to improve model fits and diagnostics.
    - 3) A new adult abundance index was developed from the JPLL fleet in Area 2, Quarter 2 and used as the abundance index.
    - 4) Selectivity patterns for the two main JPLL fleets were modified to have only a single time block (2016 – 2021) due to model convergence issues. Sensitivity of results to the model structure changes listed above are illustrated with a model using a similar structure to the base case model in the 2020 assessment, albeit with the same data as this assessment.
- The following information on the status of the north Pacific albacore stock was provided:
    - 1. The stock is likely not overfished relative to the threshold ($30\%SSB_{current,\ F=0}$) and limit ($14\%SSB_{current,\ F=0}$) reference points adopted by the WCPFC and IATTC, and
    - 2. The stock is likely not experiencing overfishing relative to the target reference point ($F45_{\%SPR}$).

Discussion:

- **Canada** asked what are the possible factors contributing to the recent increase in biomass? The presenter responded that the observed increase is in total biomass, not spawning biomass, and it is caused by a recent high recruitment. This increase should also be seen in spawning biomass in

the future. The recent high recruitment may be due to ENSO conditions. High recruitment in 1999 was also an ENSO year. The size composition data also indicates that recruitment was high. However, this estimate is uncertain due to sampling issues and caution is recommended in its interpretation.

- The **European Union** asked for additional information on the spatial segregation of the stock by sex. The presenter responded that fishermen report that there are more males around Hawaii. This is supported by the Japanese training vessel data for large albacore. However, there is some concern over the training vessel sampling and the areas where they sample. A Taiwanese study showed that growth differs by sex and also computed sex ratios in the Eastern Pacific. Although it has been challenging to obtain sex information, it is now possible to use genetics to sex albacore.
- Mark Maunder added that growth differs by sex and spatially, so selectivity should also differ, and there is a poor fit to the sex specific length composition data for JPN training vessels. The presenter noted that the US is collecting sex and age data in Hawaii to partially address this concern.
- Alexandre Aires-da-Silva noted that the IATTC staff investigated and corrected the EPO tropical tuna catch estimates for biases resulting from the impact of the COVID-19 pandemic on port sampling operations. Was any similar analysis conducted for albacore? The presented responded that the effect of the COVID pandemic on the data is unknown. CPCs have been asked to investigate for possible changes in fleet operation and whether there has been any impact in the data.
- Alexandre Aires-da-Silva inquired whether there is any plan for independent reviews of ISC assessments? The presenter confirmed ISC's interest is receiving external input on its stock assessments, including that from independent external reviews. Although the stock assessment of North albacore has received substantial external input, including that from the IATTC staff through its participation in the WG, an informal review from IPHC staff, and a desktop review through the US system, an in person review from an independent panel is still lacking. ISC plenary has been discussing potential independent reviews and their formats for ISC assessments. Logistics and funding, as well as terms of reference for such reviews have been under debate. If this is an important matter for the IATTC, the presenter suggested that the IATTC Director formally contacts the ISC Chair expressing interest for these reviews.
- **Chile** inquired on why some sensitivities are associated with overfishing and how is this result is related to uncertainty in the recent recruitment. The presenter clarified that this result should not be strongly influenced by recent recruitment because spawning biomass is used for stock status, and the uncertain recruitment has not strongly prorogated into spawning biomass yet. He also noted that while the stock status plot uses the 3-year average, a period of 10 years is used in the HCR. The choice of the period to use in the stock status plot should be discussed.

g. Other species

i. South EPO swordfish (SWO) benchmark assessment

Carolina Minte-Vera presented the 2022 south EPO swordfish stock assessment, which included data up to 2019. The previous stock assessment for swordfish in the south EPO was done in 2011.

Key Points:

- Models were developed to represent three stock structure hypotheses: south of 5°S and east of 150°W (as in the 2011 assessment), south of 10°N and east of 150°W, and south of 10°N, east 170°W. In the last 10 years, catches in the equatorial region have sharply increased and there is evidence of connectivity between the equatorial areas and the areas south of 5°S. The average catch per year from 2000 to 2009 was about 15,000 tons (south of 10N and east of 150W), while the average catch per year for 2010 to 2019 almost doubled to about 29,000 tons. In the last

three years of the compilation (2017 - 2019) the average catch was about 34,000 tons a year. The fleets that are currently the most important are the Spanish longline fleet, which catches about 30% of the total catches in weight, followed by the Chilean gillnet fleet with 22%, and the Ecuadorian longline fleet with 20%. The indices of abundance also show an increase over time.

- Five models developed to represent the hypotheses that may explain the simultaneous increases in catch and indices of abundance: Model 1: Real increase in productivity, Model 2: Increase in availability, Model 3: Increases both in productivity and availability, Model 4: Stock structure and connectivity. Indices derived from fleets in the western Pacific Ocean show increase in density at similar times. Model 4 includes catches in the WCPO up to 170°W (thus implements the 3rd stock structure hypothesis). In addition, a model that assumes that the stock is distributed south of 5°S and east of 150°W, and that updates the 2011 assessment, was added.

- The IATTC is yet to adopt reference points for South EPO swordfish. Dynamic reference points were used as an illustration to report the stock status, due to the potential changes in productivity. According to arbitrary spawning biomass reference points simply used for comparative purposes (a limit reference point (LRP) of 20% unfished biomass and target reference point (TRP) of 40% un-fished biomass), the stock is approaching the biomass TRP in Model 3 productivity and availability, (SSBcurrent/SSBF=0 =0.42). The spawning stock would be larger than the value corresponding to that TRP for the other models (SSBcurrent/SSBF=0> 0.5). The fishing mortality was measured as the effect in spawning potential ratio (SPR), which is the spawning stock biomass per recruit with relation to the spawning stock biomass per recruit in the unfished condition. Large SPR are indicative of low fishing mortality, thus a proxy for fishing mortality is 1-SPR. All models estimate a strong increase in fishing mortality since the start of the fishery. The fishing intensity is slightly above the fishing intensity TRP for one model, and below for the other models.

- It was recommended the Commission adopts provisional reference points and the stock continue to be monitored.

Discussion:

- **Chile** noted that there were many assumptions made about the catch and length compositions which may cause bias, and that the costal nations could improve their data. The presenter responded that for some fisheries with large catches it was unclear whether the length composition data well represents the catches. Therefore, it would be important to obtain the details of how data is collected for these fisheries. Chile's data could provide an example of how data should be reported. The Ecuadorian size composition data could not be used in the assessment because there was large variation between samples, no information on the type of gear used, and the size of fish caught may differ among gears. The IATTC has a work plan with Ecuador to investigate this issue. The IATTC is also in discussions with Spanish scientists to continue working with the Spanish fleet catch data. The Spanish fleet is widely distributed and targets swordfish, so it is important to use that data.

- **PEW** suggested there should be a working group to foster dialog between scientists and managers to consider the management of southern Pacific stocks, including swordfish and albacore, for example. It was also noted that swordfish connection with squid is a clear example of the importance of ecosystem-based management (EBM). If the focus is only on single species then this interaction might be missed. Also, the gillnet fleet takes a large fraction of the swordfish catches and this may have an ecosystem impact which should be carefully monitored.

- **Ecuador** expressed interest in continuing to collect and contribute with data for the swordfish assessment, including from observer deployments on vessels. It is desirable that observers on longline vessels are trained by IATTC staff to ensure that the data collected is useful for stock assessments.

- **Korea** noted that the swordfish catches in the equatorial region have increased. This area corresponds to the Korean fishing ground. Since Korea provides high quality data, this could be used for the construction of an index of abundance. The presenter welcomed this suggestion and acknowledged that the Korean data might become even more important for different stock structure assumptions.
- The **United States** noted limitations in the catch and effort data from longline fleet and asked clarification. The presenter explained that the Spanish data collection system, when introduced, did not include a field for the number of hooks, but it is now included. Therefore, the assumption that the number of hooks per set remained constant over time was made. Despite these data limitations, the trends in the Spanish CPUE data were considered to check if the increase in the Japanese fleet CPUE was also seen in other fleets. The issues with the Spanish data were not considered important since the CPUE showed a similar trend. The assumption of constant number of hooks per set over time could be tested via sensitivity analysis if there is any anecdotal information about trends over time which is currently not available.
- The **European Union** noted that Spain and the EU have conducted extensive work to provide the data for the swordfish stock assessment. There efforts will be continued. The presenter acknowledged the difficulty of these efforts considering that it was the first time that these data were used in a swordfish assessment.
- **Peru** noted that often CPUE can be biased due to, for example, the inclusion of data corresponding to areas of high densities of fish associated with optimal environmental conditions. In their case, the Peruvian artisanal fleet data is dominated by juveniles caught in waters off central northern Peru. The standardized CPUE could be overestimated in this feeding area and whether this has been considered. The presenter responded that spatiotemporal models were used and if there is an increase in availability, for some reason, it is interpreted as density. A covariate for catchability is needed to account for increased availability and this could be investigated in future. Since size composition data in used in the standardization, the high representativeness of juveniles in the catches is reflected in the index.
- The **Unites States** noted that MSY may not be applicable as no reference points have been adopted for this stock. The time is appropriate to recommend a discussion on reference points for swordfish, so that future assessments can evaluate them. The staff is proposing interim proxy reference points for stocks in the absence of adopted reference points (SAC-14 INF-O).
- The presenter noted that data improving species and catch data reporting is needed and recalled the workshop series recently initiated by the staff for this purpose (SAC-12-09). Operational (set-by-set) data should be reported. This should include catch composition for other species to investigate changes in targeting practices (e.g., blue shark vs swordfish targeting).

7. MODELLING

a. Workplan for tropical tuna Management Strategy Evaluation (MSE)

Juan Valero presented an update on the Management Strategy Evaluation (MSE) for tropical tunas in the EPO (Document SAC-14 INF-F). This project is funded by the European Union between 2021 and 2023, the SAC supported extension of the current workplan to 2024 to take into accounts impacts of the COVID pandemic on other IATTC meetings. However, funds have not been secured yet to continue this work in

2024.

Key points:

- The purpose of Management Strategy Evaluation (MSE) is to compare the performance of alternative management strategies in meeting management objectives, using computer simulations and relevant fisheries performance metrics.
- MSE is recognized as best practice to evaluate alternative management strategies, and has been widely used both nationally and internationally, including all tuna RFMOs which are at different stages in their implementation. There is an ongoing MSE process for EPO tropical tunas at IATTC, with an initial focus on bigeye tuna.
- The work includes a technical component and a dialogue component via a series of MSE workshops. Three IATTC MSE for tropical tuna workshops have been conducted (2019, 2021 and 2022).
- The technical component has included developing operating models, estimating models, customizing online tools to communicate the MSE process and results, developing computer code to conduct the simulations.
- MSE work for tropical tunas at IATTC has been conducted by an external contractor funded by the European Union (2021-2023).
- The MSE workplan for tropical tunas was extended to 2024 with support from the SAC and the Commission to accommodate some of the challenges derived from the recent COVID pandemic.
- Funding has not been secured yet for continuation of the MSE work during 2024 nor beyond, in order to allow completion of the bigeye work and the inclusion of skipjack and yellowfin in the MSE work in the future.

Discussion:

- **Peru** asked about the advantages and disadvantages of managing the three species of tropical tuna together as opposed to managing each species separately, given their different biology. The presenter responded that the management of the three species of tropical tunas at IATTC is currently based on the species needing the strictest management. It promotes conservation of the weakest stock and therefore of the three species as a whole. Theoretically, there may be alternative options for single species management. But from theory to practice, fisheries in the EPO are multispecies, multigear (e.g., longline, purse seine) and multi modes of fishing (e.g. FADs, dolphin, unassociated, longline) which would make individual species management challenging. That does not mean it cannot be done, but these challenges, how it may be evaluated and implemented needs to be discussed.
- **European Union** stated that this is an important process that requires sustained funding. A clear, robust recommendation from the SAC is necessary to guarantee funding and avoid the interruption of the MSE process at IATTC. In addition, the EU asked for an explanation for some changes in the workplan. Under item 2a. in the previously adopted MSE workplan (SAC-13 INF-C), it was expected that the staff would run and present a preliminary MSE based on initial input from managers and stakeholders in 2022. However, the current chronogram of activities shows it occurring in 2023 (SAC-14 INF-F). The presenter highlighted those activities under point 2.a were previously expected to take place during 2022-2023, however they were entirely moved to 2023 in part due to challenges described during the presentation (i.e., COVID-19, IATTC extraordinary

meetings, not all elements necessary to conduct the simulations available in 2022, etc.). Tools on how to illustrate de MSE process and present the results were advanced. The staff has also continued to advance the technical work, but there are no fully completed simulations to present at this stage.

- **El Salvador** noted that harvest strategies are increasingly used in all other RFMOs and should be a priority area for the Commission. El Salvador supports continuing the MSE work for tropical tuna and its expansion to other species under the purview of the Commission, including securing its long-term funding.
- The **United States** concurred that the MSE process is very important to the Commission and that a strong recommendation should come from the SAC in support of its continuation. Assuming that continuing funds will be available in 2024, after the first round of the MSE workshops having been completed, does the staff plan to present the preliminary MSE results and then fine tune it based on feedback from stakeholders?
    - The presenter responded that funding is secured for the continuation of the MSE process for tropical tunas, including workshops with stakeholders during 2024 (dates to be determined) to show results and iterate based on feedback.
- **Ecuador** added support to the MSE work and its importance to the Commission. Skipjack tuna should also be included in the workplan, along with other species such as dorado, billfishes and other species. The presenter noted that although the staff and collaborators have lead (e.g. dorado MSE) or collaborated in other MSE work (e.g. North Pacific albacore tuna), the current work is developed on tropical tunas with an initial focus on bigeye tuna. The intention is to eventually expand the workplan to other tropical tuna, pending securing funding. MSE work should be seen as a sustained process. It is not a process that becomes completed with one species, or one evaluation, in other tuna RFMOs there are long term plans for MSE work.
- **Peru** expressed congratulations on the work done so far. MSE is not a type of work that is concluded, but it is a permanent and continuous process, in part because management objectives and other elements of the management strategies change over time. Just as there are changes in the environment and the fisheries, management strategies and their evaluation must be adaptative.
- **World Wildlife Foundation** congratulated the Commission for the important work done so far. This work should be understood as a permanent process, instead of a term-limited project, which eventually will imply a paradigm change in how management is conducted, beginning with the tropical tunas. It is critical to secure the proper resources to institutionalize this process so that the work becomes continuous and permanent.
    - The presenter noted that in all the other tuna RFMOs (and in many other RFMOs) there are established processes for MSE including their long term funding.
    - The IATTC Coordinator of Scientific Research highlighted that this is a very important moment for the Commission regarding the MSE process. So far, the work has been conducted on a reactive rather than proactive manner. Currently, the MSE work is supported by external funds and these expire at the end of 2023. The staff has recommended funding of the MSE work for 2024 and beyond, however the Commission should consider planning this work in the long-term. If ensuring the sustainability of the MSE process at IATTC is desired, ideally the Commission should hire a permanent

member of the staff dedicated to this process (i.e., a Harvest Strategy senior scientist). For comparison, in other RFMOs (e.g. WCPFC) there are several staff dedicated to management strategies. The Commission has also expressed interest to include other species in the MSE process. Although the technical capacity is available, financial support is needed to get the needed additional human resources.

- The **European Union** inquired about establishing an ad-hoc working group to foster dialogue and engage the Commission and relevant stakeholders on the MSE process in the future, in parallel with additional human resources for the consideration of the Commission.
    - The Coordinator of Scientific Research acknowledged value in the establishment of such working group to work in coordination with the staff's additional human resources in case they become available.
    - Mark Maunder mentioned that MSE is not the only component of the work that needs to be strengthened. There are other needed analyses related to management strategies, so the new staff member would help with these tasks.
- The **Ocean Foundation** acknowledged the substantial progress and the funding support from European Union on the MSE work. This NGO also added support to the established of a science -management dialog group to help to move the process forward. The MSE work should be included in the core duties of the staff and accounted for in the annual budget of the Commission.
- The IATTC Director recognized the invaluable contribution of Dr. Valero's capacity building activities under the dialogue component of the MSE process.

b. CAPAM workshops

This item was presented and discussed under item 6(e) above.

c. Poseidon model

Dr. Katyana Vert-Pre presented the application of an agent based bio-economic model (POSEIDON - Document SAC-14 INF-G) for the tropical tuna fishery in the EPO developed in collaboration with IATTC staff, Oxford University, Arizona State University, University of Wisconsin, Ocean Conservancy and ISSF. The goal is to supplement the existing tools of IATTC staff to analyze the impacts of alternative management scenarios in the EPO tropical tuna fishery.

Key points:

- The Eastern Pacific Ocean (EPO) tropical tuna fishery includes bigeye tuna (BET), skipjack tuna (SKJ), and yellowfin tuna (YFT). It is a highly dynamic fishery with ever changing technology and the growing use of fish aggregating devices (FADs) since the early 90s. Species and fishers' spatial dynamics are strong drivers of this fishery, further complicating analysis. Thus, scientists and fisheries managers have expressed an interest for a time- and cost-effective approach for the evaluation of alternative management scenarios across multiple species.
- SAC-14 INF-G presents a coupled agent-based bio-economic model, POSEIDON, which was adapted to represent the EPO tropical tuna FAD fishery. It uses an adaptive behavior algorithm to represent vessels that are spatially explicit and inclusive of intra-species interactions.
- The adaptive nature of the agents allows for the evaluation of complex management scenarios while assessing social, biological, and economic tradeoffs and identifying unintended management consequences.
- The POSEIDON – EPO tuna model integrates six modules to represent different aspects of the

fishery including the environment, biology, FADs, fishing fleets, markets and management. This complexity of each module can be adapted to represent existing data.

- Class 6 purse seine vessel dynamics are modeled explicitly while fishing mortality from class 1 through 5 and longline/pole-and-line fishery are externalized. The Poseidon team and staff collaboratively developed appropriate diagnostics for the POSEIDON model.
- The calibrated model was able to capture key behavioral components of large purse seine vessels in the EPO including total landings, catch per action type, number of action types, timing of action types (FAD sets, unassociated sets, dolphin sets, and FAD deployments) within a trip, and other characteristics of the fishery).
- The spatial distribution of the model showed higher errors especially in the area south of the equator experiencing higher than expected effort in the model. The team is working to address and investigate these and any other concerns from the IATTC staff.
- The model can run 448 simulations in 1h10min allowing staff to reduce staff time to explore alternative management options.
- The POSEIDON application to the EPO tropical tuna fishery is hoped to strengthen the set of tools available to the staff for the evaluation of the impact of alternative management scenarios.
- In the next year, POSEIDON team will be testing a list of management scenarios to potentially explore for 2024, make the model R accessible and train the staff in running the model.

Discussion:

- **Mexico** expressed interest in how the system works, especially with respect to behavior of fishermen and how the model learns. In the past, similar models used economic rewarding/punishment systems to force fishers to learn or shape behavior. The presenter explained that currently, behavior is based in part on past behavior of vessels (mostly Class-6). In addition, there are other elements that influence their behavior, such as distance to FADs, biomass under the FAD, etc. If the strategy fishermen employ was successful, they would tend to repeat it. The model doesn't force fishermen to do anything, but helps them learn about decision making.

8. DATA COLLECTION

a. Electronic monitoring (EM) program

i. EM review rates (purse-seine fleet): exploratory analysis

Dan Ovando presented a series of considerations to develop efficient EM coverage and review rates (EMS-05-02). This information will help the SAC better understand the different elements and objectives that need to be taken into account to establish EM coverage and review rates to meet the Commission's scientific and management goals.

Key points:

a. Electronic monitoring has great potential to improve data collection and monitoring in the EPO, but there are logistical and scientific questions that need to be addressed to facilitate its implementation.

b. Logistical constraints mean that not all EM footage will be able to be reviewed given current technologies, so the IATTC conducted a pilot study comparing observer and EM data from some sample purse seine vessels.

c. Results indicate that review rates that produce acceptable levels of error in total catch estimates for some species may be insufficient for others, highlighting a need to plan EM review rates around the weakest link in the management objectives.

d. Results also indicate that differences between EM and observer data can vary by species, indicating the need for further research on how to effectively integrate EM and observer data into assessment and management programs.

e. Clear guidance on both objectives and constraints is needed to design an effective course of study on the use of EM in monitoring, assessment, and management in the EPO.

Discussion:

- **Mexico** pointed out the effect of the observer in the data collection as an important consideration, and thus wonder whether cameras may influence fishing-fisher's behavior. Also, interest was expressed in better understanding the potential results of a similar exercise for longliners. The presenter noted that there are some studies on how new control and surveillance tools affect actors' behaviors. However, the staff is unsure on whether such studies are available for EPO tuna fisheries and acknowledged this would be an interesting research to be conducted by a social scientist. Regarding longline vessels, the presenter responded that there could be significant differences as the fisheries are quite different in its operation, although is too early to provide any details. However, the staff concurs with the great potential of EM for LL fisheries.
- **Ecuador** asked if the staff has considered the enormous data storage resources and analysis of imagery data which will be required to implement an EM program for tuna fisheries in the EPO. The staff acknowledged that there are important technical challenges related to data collection and analysis. It was also noted that while great demands are expected for data analysis, there are also rapid advancements taking place in technology, including AI tools. Developing algorithms to detect frames/images showing events/species of interest will be very important.
- **Nicaragua** inquired if whether 20% EM coverage and review rates are enough to predict with certainty catches by species. The staff replied that the answer to these questions depends upon the specific goals, scope and data collection priorities of the EM system. Once these have been clearly defined and adopted by the IATTC, the staff can conduct additional research to evaluate coverage and review rates.
- The **United States** inquired whether the differences shown in the analysis are attributable to differences in species alone or if there may be other factors at play. Scientific analyses often use observer data with no error but an observer effect may need to be considered. The US also asked whether it is similarly difficult to estimating catch in weight and numbers.
    - The staff replied that although species seems to be an important factor contributing to the differences identified between EM and observer estimates, other factors may exist (e.g., observer and gear effects). Some exploratory analyses were done comparing catch estimates in numbers versus weight and they were not significantly different. Additional research is needed to better understand error rates by source type (EM versus observer).

ii. Updated staff considerations and recommendations

Marlon Roman presented a summary of the document "Implementation of an Electronic Monitoring System (EMS) updated staff considerations and draft recommendations – Progress report" (SAC-14-INF-H).

Key points:

- Two EM workshops were organized during this reporting period. The first workshop addressed the technical standards (document EMS-04-01) and the priorities in data collection (document EMS-04-02), while the second workshop addressed the financial considerations of an EMS (document EMS-05-01).
- A total of 24 recommendations were proposed by the staff during the reporting period.

- Unlike previous workshops, the two workshops during this reporting period included a significant number of external presenters, providing regional and global expertise, advances, and examples to the participants.
- For each of the recommendations presented, the background, scientific rationale and workshop participants' feedback were obtained.
- Overall, there were diverse trends of opinions pronounced during these workshops. Some of them polarized but many others were in agreement. The staff's preliminary recommendations were revised as needed in SAC-14 INF-H.
- Unlike the presentations of exploratory analyses of EM review rates and EM cost-benefit analysis in the last two workshops, the recommendations presented have been mostly oriented towards management issues. Discussions on standards are expected to begin in fall 2023.

Discussion:

There was no discussion following the presentation of these recommendations.

b. Enhanced Monitoring Program (EMP) for BET catches

i. Results of the pilot study and workplan for 2023

Cleridy Lennert-Cody presented preliminary results from analysis of data collected by the EMP pilot study, the protocol currently being used in the EMP, a comparison of the EMP BET trip-level catch estimates to estimates for the same trips from observer data, and an explanation of how the IATTC staff's will determine the Best Scientific Estimate (BSE) of BET catch, by trip, for trips sampled under the EMP, as well as those not sampled under the EMP (Document SAC-14-10).

Key points:

a. Intensive sampling of catch composition during the unloading of wells with catches from floating-object sets found large-scale systematic variation in the proportion of BET over the course of unloading of individual wells. This large-scale variation, which needs to be addressed by the EMP within-well sampling protocol, was related, in part, to the number of sets from which catch was loaded into the well.

b. A simulation study using the sample data determined that a systematic sampling protocol with 3.33% coverage of units of fish unloaded from a well should be a reasonable compromise between low error and practicality. In actual implementation, collection of *one* systematic sample using this protocol would be as follows: sample one out of every 30 units of fish unloaded from a well, from the beginning to the end of the unloading of the well, starting at a randomly selected unit in the first 30 units unloaded.

c. Among-well variance was estimated to be roughly an order of magnitude greater than within-well variance, providing support for a decision to not allocate additional resources to estimate within-well variance at this time.

d. Taking into consideration results from a second simulation study, which was used to determine the number of wells to sample per trip, the following two-stage sampling protocol will be used by the EMP: 1) at least 6 wells will be sampled per trip, selected at random for the primary catch stratum (or strata) of interest; and, 2) one systematic sample will be collected per well, using the protocol described above in b., where for each unit of fish sampled, the species identification and length or weight will be obtained for every tropical tuna in the unit.

e. This preliminary EMP protocol, which was tested during the latter part of the pilot study, produced reasonably reliable estimates of trip-level BET catch for the primary catch strata of interest, with coefficients of variation largely between 0.22 and 0.39.

f. Following further simulation studies, it may be possible to considerably improve the precision of the BET catch estimates from the EMP, which will lead to a reduction in the coefficient of variation on the estimates.

g. A comparison of BET estimates from observer data to estimates based on the EMP protocol, for the same trips, suggested that the EMP estimates should be more reliable than observer estimates, and that there may be a tendency of some observers to systematically underestimate BET catch.

h. For trips sampled by the EMP, the trip-level BSE will be the sum of the EMP estimates for different catch strata, plus estimates from other catch sources for any catch strata of the trip not sampled. If the trip carried an observer, observer data will be used to estimate the catch of unsampled catch strata for the trip. Otherwise, cannery and logbook data will be used.

i. For trips not sampled by the EMP, the current procedure will be to use observer data to estimate the BSE, if an observer was onboard, or cannery/logbook data, if an observer was not onboard. This hierarchy of data sources was established based on a comparison of observer BET estimates to cannery BET estimates, using historical data, which showed that the cannery estimates were typically smaller than the observer estimates for the same trips, and the result mentioned in f. above.

Discussion:

- The **European Union** asked to what extent the EMP estimates are useful for compliance? The presenter responded that by providing these catch estimates, the EMP is making available to CPCs and vessel companies additional information that they can use in making their decision about their vessels' catch relative to the thresholds in Resolution C-21-04, should they choose to do so. That the staff is aware of, the estimates from the EMP program are the most independent from among those available to CPCs and vessel owners. In addition, all estimates of BET trip-level catch have associated error. The EMP strives to be transparent about the uncertainty on the EMP estimates by providing an estimate of error associated with the catch estimates, which is not done, and in general is not possible, for the estimates from other sources. If and how CPCs might use these estimates for compliance is their decision, per the Resolution.
- The **United States** indicated that one potential recommendation from the SAC would be to fund the EMP through 2024, in order that the program is in place at least as long as the CMM itself in Resolution C-21-04, which is to the end in 2024. The US noted that the point of this program is not for enforcement, but to provide information on the catch amount per vessel relative to the thresholds in the Resolution.
    - The presenter replied that by the end of 2023 the staff will have a final methodology for estimation of the variance on the catch estimates, and it is possible there will be a reduction in the estimated variance. This will ultimately result in a reduction in the coefficient of variation of the BET catch estimates and improved confidence intervals.
    - The Coordinator of Scientific Research noted that the staff is recommending the continuation of the Enhanced Monitoring Program in 2024 considering that the resolution on tuna conservation extends to 2024.
- **El Salvador** noted that although the work resulting from the EMP program is thorough, the produced catch estimates are still associated with large margins of error (CVs). The question was asked if the methodology and estimates presented are final? The presenter responded that although the results presented are preliminary, the staff does not anticipate that the methodology

for estimating the catch will change. The staff will make a final decision on the scaling of the variance estimates following further simulations to be conducted in 2023, and thus be able to present final error estimates for the estimates of the BET catch per trip by the end of the year, at the latest.

- **Guatemala** asked why staff did not include the cannery data in the comparisons between EMP estimates and estimates from other sources? The presenter explained that at the time that SAC-14-10 had to be finalized, the staff had not received cannery data for most of the trips sampled during Phase 2 of the EMP. Once these cannery data are received, the staff will be able to make comparisons between EMP and cannery estimates. These comparisons are part of the work planned for the remainder of 2023.
- **Venezuela** noted that the differences between the catch estimates obtained by the EMP and observers could be due to the difficulty for the observer to estimate specie composition on sets with large catches. The presenter indicated that additional analyses will be conducted to better explain these differences. These differences may also be due to other factors that should be investigated, including the skill of the observer.
- **ATUNEC** commented on the mention of sampling 6 wells per trip under the recommended protocol. Couldn't the sampling be proportional to the number of wells of the trip? How does the staff plans to sample vessels with 10 or more wells? The presenter responded that selection of the wells of a trip to be sampled is at random, from among those wells with catch from the same set type and large area. The expectation is that as much as a third to a half of the wells of each trip will be sampled. The staff does not plan to sample fewer wells of a trip if there are only a few wells with catch from a certain set type and area because, at this point, the variability among wells is not expected to be substantially less when there are fewer wells. However, this is something that the staff can look into as part of the additional analyses to undertake during the rest of 2023.

ii. Logistical aspects of data collection

Cristina De la Cadena presented on the logistical aspects involved in the data collection activities under the pilot phase of the Enhanced Monitoring Program (EMP). The presentation covered the preliminary measures taken to implement the pilot study related to hiring, training and distribution of personnel, coordination with key stakeholders on actions and exchange of information, and identification of unloading processes by the purse seine fleet in the Ecuadorian ports where the pilot study was carried out. The evolution of the logistical arrangements of the pilot study phase on the EMP towards full implementation of the final EMP in March 2023 was also presented.

Key points:

- Resolution C-21-04, adopted by the Commission in October 2021, establishes new measures that address bigeye tuna (BET) conservation concerns by defining thresholds for annual catches of BET per purse seiner vessel. In support of this measure, the Enhanced Monitoring Program (EMP) was created.
- The EMP was preceded by a pilot study which was developed in Ecuador, in the ports of Manta and Posorja, and began in July 2022 with the hiring and training of personnel, coordination with government representatives, private sector and national observer programs for coordination and exchange of information necessary to identify the characteristics of trips and wells to be selected for sampling.
- In order to comply with the recommendation of the SAC, related to prevent interfering with the normal unloading process during sampling, the types of unloading were identified according to the time at which the sampler has access to the sampling, this to define the best sampling strategy in each case. Two types of unloading were defined: standard, when the sample can be taken in

the wet deck; and cargo net or *'chinguillo*', when the sample is accessible on the main deck of the vessel.

- During the implementation of the pilot study, different arrangements were tested in the conformation of the groups of samplers in order to comply with the desired protocol with the least number of people per group. In addition, tests were made for the use of voice recorders and digital scales as support resources for the sampler to allow greater efficiency in the sampling.
- Remote monitoring for quality control of the data collected by samplers was made using GoPro cameras. It was possible to identify possible biases in the length measurement of individuals due to body curvature caused by freezing or absence of the caudal fin, which motivated the change of the measurement from length to weight.
- During the 6-month pilot study, vessels from Ecuador, El Salvador, Spain, the United States, Nicaragua, Panama, Venezuela, and the United States were sampled, with 74 fishing trips and 165 wells total.
- For the implementation of the fully developed EMP, starting March 2023, thanks to the implementation strategy tests carried out during the pilot study, the following improvements were achieved: reduction of the sampling team from 4 people to 2 people. Use of voice recorder for data recording, use of electronic scale for measurement, use of GoPro camera for remote sampling monitoring.
- During 2023, work will continue on defining the sampling protocol for cargo net unloading; sampling will be carried out outside Ecuador looking for more cost-efficient ways to comply with logistical requirements, without affecting data quality.
- As of June 2023, there will be a dynamic table on the Commission's web page for sharing information on bigeye catch estimates by fishing trip from the different data sources available, including that of the EMP. Each CPC will have credentials for access to the information of its flag fleet.

Discussion:

- **Panama** asked if any sampling activities were conducted during mixed tuna unloading methods. The presenter replied that there were cases of unloading using a mix of methods and that the sampling protocol took into consideration this situation.
- **El Salvador** questioned if whether the work under the EMP has delayed the duration of the unloading process? The presenter indicated that a good balance was achieved between the sampling activities and the unloading work, and that it is the staff's understanding that the sampling has not significantly delayed the unloading process. So far the staff did not receive any negative comments from the fleet representatives regarding delays.
- **Venezuela** understands that the sampling activities planned under the approved EMP project were to be carried out exclusively in ports with high unloading of bigeye. The presenter pointed out that although 80% of the BET catches are unloaded in the ports of Manta and Posorja in Ecuador, the staff considers important to have a sampling experience in La Unión, El Salvador, which has historically received 6% of BET catch unloading. These data will be included in the budget information to be presented to the Commission for planning and decision-making purposes regarding future activities under the EMP.
- **ATUNEC** asked which unloading method was used for the wells shown in the plots presented of the proportion species by unit. The presenter clarified, after checking the data following the presentation, that the unloading method of those wells was 'dry'.
- **ATUNEC** asked if whether there has been good collaboration between the vessel owner and crews, unloading personnel and the sampling technicians working for the EPO? Also, what is the

degree of safety for the samplers? The presenter noted that the key to success of the project has been a great communication with the vessel's owners. It was also noted that one of the main guidelines to be followed by the sampling teams was to interfere the least, to the extent possibly, with the unloading process. With respect to safety, all samplers were well trained in safety measures and provided with gear necessary to conduct their job in a safe manner. In addition, their work is conducted in compliance with the safety protocols established by the port authorities, both private and public.

c. 1st Workshop on data improvement (industrial longline fishery)

Carolina Minte-Vera presented the results of the 1st Workshop on Improving Data: Longline Fisheries.

Key Points:

- This workshop was the first of a series of workshops planned after the SAC and Commission endorsed a recommendation by the staff (SAC-12-16, General Data Provisions) to hold a series of workshops to revise Resolution C-03-05 on data provisions in consultation with CPCs taking into account SAC-12-09. This Resolution predates the Antigua convention and needs update.
- Data improvements for the target-species are needed in order to:
    - analyze current and historical trends of tuna, billfishes and sharks in the EPO;
    - combine data from different fleets to produce better indices of abundance;
    - assess shifts in target species and effect of factors related to catchability in indices of abundance;
    - estimate sizes associated with indices of abundance;
    - estimate selectivity for different fisheries using size-frequency data.
- Data improvements for the non-target species are needed in order to:
    - identify vulnerable species, prioritize research, reporting and management;
    - estimate species-specific catch and discards (noting differences in species composition by gear);
    - report more precise catch locations and presences for bycatch species to improve knowledge on species distribution;
    - estimate gear selectivity using size-frequency data;
    - separate between deep (BET) and shallow (SWO) sets in EASI-Fish (prioritization analysis).
- The two industrial fisheries under the mandate of the Antigua convention, purse-seine and longline, have currently very different data provisions. The class 6 purse-seine vessels have 100% observer coverage, are under the IATTC port-sampling program for length-composition and species composition data, and report confidential data on FAD position. For the longline fisheries, most data comes from the submission by CPCs in the attendance of the data provision Resolution C-03-05 and the longline observer resolution C-19-08. The observer coverage is only 5%, not enough to estimate catches, and the catch, effort and size composition data is reported aggregated in broad spatial resolution, mostly without catchability data, not enough for estimating indices of abundance. However, there is the opportunity of incorporating logbook data required by national regulations to the data submitted to the commission for scientific research.
- Recommendations of the staff for industrial longline data provision were discussed during the workshop. Revised recommendations incorporating the discussions from the workshop are presented in SAC-14-INF-Q. The recommendations include mandatory submission of operational

level (set-by-set by vessel) catch and effort data, and report catch for a list of species, including shark species.

Discussion:

- **Ecuador** expressed support for the staff's recommendations and noted that they should be implemented either directly via routine data submissions under C-03-05 or by Memorandums of Understanding (MOU). Ecuador is currently signing an MOU with the IATTC for longline data submissions and encourages all CPCs to do the same to improve data availability for science, in particular for fisheries with low observer coverage. Ecuador is aiming for 100% observer coverage for their longliners but support that all CPCs increase their coverage to at least 20%, which has been recommended by the staff. The Ecuadorian observer program intends to collect data for bycatch species to support ecological analyses. Ecuador recommended to hold a second longline data improvement workshop and offered to host the meeting in hope to continue the data improvement process.
- **Venezuela** reiterated their concerns expressed in previous years regarding deficiencies in longline data provision. In particular, the required 5% observer coverage may not even be met for some fleets and there is no data provision for vessels under 24 meters. It is also not clear if all longline vessels listed on the IATTC vessel register are currently active, if weather they are providing data, and there is also lack of clarity regarding the metrics to be reported in order to evaluate the 5% observer coverage. In contrast, the data available for the large purse-seine class-6 vessels are of great quality. As far as the small (classes 1-5) purse-seine vessels, there is need for improved observer coverage. However, information on fishing effort and number of trips for these vessels is of good quality. Related to the longline data improvement workshop, a comment was made that staff could support with training activities on species identification and reporting for longline crew members. These efforts should be harmonized with other tRFMOs.
- **Colombia** urged all CPCs with longline fleets to at least meet the minimum 5% observer coverage, but to ideally increase coverage towards the 20% level as recommended by the staff.

d. Improvements: Morphometric relationships and biological sampling for priority species

Leanne Fuller presented a staff collaboration on improving data gaps and a proposed phased-based approach to plan and implement project F.3.a on improving morphometric measurements and opportunistically collecting biological samples for tunas, billfishes and prioritized bycatch species (SAC-14 INF-J) to improve stock assessments, ecological models and catch estimations.

Key points:

- SAC-14 INF-J summarizes the staff's discussions on Project F.3.a and provides background information, data gaps, ideas for potential sampling opportunities—through a collaborative approach—of tunas, billfishes, and prioritized bycatch species.
- This work is complementary to the staff's additional efforts on improving data to better align with the scientific mandates under the Antigua Convention (SAC-12-09, WSDAT-01-01, WSDAT-01-Report, SAC-14 INF-M, SAC-14 INF-L).
- Morphometric relationships are used in stock and ecological assessments, yet these relationships are outdated by several decades for tropical tunas and may be non-existent, borrowed from similar species within the EPO, or based on data from other oceans for bycatch.
- Catch estimations are influenced by morphometric relationships where length-weight data are used to convert catch data in numbers to weights and vice versa, and weight-weight data are required to convert processed weight to whole weight (e.g., to estimate artisanal shark landings (SAC-14 INF-L).

- Different forms of relationships may be available in the literature (e.g., processed weight vs. whole weight and total length vs. precaudal length) and the analyst must convert to the appropriate form required for the methodology.
- Biological data are used to parameterize stock and ecological assessments to characterize growth, reproduction, longevity, natural mortality, and foraging dynamics, but data collection has been limited to dedicated projects. These data are key to improving conservation and management of prioritized bycatch species to help define stock/population structure.
- Implementing routine sampling provides a means for monitoring fishing impacts over dynamic ocean conditions (e.g., extreme El Niño or La Niña events) and a comprehensive database will allow scientists to develop the necessary relationships and/or analyze biological data for dedicated projects.
- A proposed hierarchical, phase-based approach to collaborative sampling that aims to maximize the spatial range and size distributions of fish was presented as:
- *Phase 1*: a feasibility study consisting of planning and implementation components to determine logistics and evaluate at-sea sampling by IATTC staff onboard potential collaborating vessels.
- *Phase 2*: a pilot study where collaborations continue, and sampling is expanded to additional vessels and EPO regions after sampling protocols have been revised based on lessons learned during *Phase 1* and statisticians have designed an appropriate sampling design for industrial fisheries. Collaborate with statisticians to design sampling protocols for coastal, multi-gear/multi-species fisheries.
- *Phase 3*: an EPO-wide, statistically robust sampling where collaborations continue, and sampling is expanded to additional vessels as feasible (i.e., PS class 1-6 vessels, coastal States and distant-water LL vessels, coastal multi-gear/multi-species fisheries) and EPO regions after sampling protocols have been revised during *Phase 2*. Establishment of a comprehensive database.
- Success of the project is dependent on strong collaborations, logistics and funding. Therefore, the proposed strategy suggests a phase-based approach with opportunistic biological sampling.

Discussion:

- The Coordinator of Scientific Research reminded the SAC that the development of tropical tuna measures has dominated SAC discussions for the past several years so it's timely to focus on addressing major data gaps pertaining to basic longline data improvement needs and for outdated morphometric relationships that are needed for stock assessments, not only for tunas, but for bycatch species. For example, length-weight relationships in the tropical tuna assessments are decades old and need to be updated. For non-target species, there are issues with sharks where catch estimates are influenced heavily by weight conversion relationships (i.e., different 'cuts'). The SAC was encouraged to support the proposal as a staged approach.

9. FADs

a. Biodegradable FADs: prototypes performance

Marlon Roman of the IATTC staff summarized the presentation offered to the attendees of the 7th Meeting of the Ad Hoc Working Group on FADs on the report of results of the large-scale biodegradable FAD experiment conducted by the IATTC staff.

Key Points:

- A total of 1,544 experimental Fish Aggregating Devices (FADs), consisting of NEDs (Non-entanglement devices) and paired control FADs, were deployed during the experiment.

- Prototype 2 was the most frequently utilized and yielded an average of 29 metric tons per set.
- Prototype 1 seemed to be the most durable, lasting at least two months, according to observer records whereas prototype 3 displayed the less durability among the prototypes.
- Paired control FADs exhibited an average lifespan of 176 days, while the three NED prototypes had average lifespans ranging from 57 to 193 days.
- This study suggests: 1) considering the prototypes used in this study as potential models for effective construction of biodegradable FADs, 2) initiating a gradual and stepwise transition to biodegradable FADs to minimize negative impacts on associated species and ecosystems, 3) minimizing the amount of material used for NED design and construction to the greatest extent possible, without compromising fishing efficiency.

Discussion:

No questions or comments were registered following this presentation.

b. Report of the FADs WG

The Chair of the *Ad-Hoc* Working Group on FADs presented a summary of the recommendations approved by the participants to the 7th meeting of this working group, held in La Jolla, California on May 13, 2023.

The Chair reminded the participants that, although the permanent working group on FADs have the capability to provide these recommendations directly to the IATTC plenary meeting, it would be a good opportunity for the attendees of SAC-14 to endorse such recommendations.

Discussion:

- The chair of the working group on FADs indicated that, as a novel item, a brief report of the meeting was made available to the attendees which would address the request of the IATTC regarding the implementation of Annex II of resolution C-19-01.
- He also noted that during the presentation of future ideas for management of abandoned and/or deactivated FADs, some of the participants indicated that resolution C-99-07 prohibits certain activities that are performed by what are called *tender* vessels. In addition, some of the ideas, like collecting or replenishing FADs as noted in the presentation, could be construed to be *in support of vessels fishing on FADs in the EPO*, and therefore, the WG recommended that this resolution be reviewed.
- After a brief description of all FAD WG recommendations, the attendees agreed to endorse them.

10. ECOSYSTEM AND BYCATCH

a. Ecosystem considerations

Leanne Fuller presented a broad overview of the effects of the fishery on the ecosystem including reporting of taxa incidentally caught as bycatch, environmental indicators that can assist with explanations of changes to catches, vulnerability assessments, updates in ecosystem modeling and the need for improvements to data collection for bycatch (SAC-14-11).

Key points:

- A time series of estimated total catches using observer data from large purse-seine vessels and minimum estimates from annual CPC submissions of gross annual removals by longline vessels—for each broad taxonomic group—is included in SAC-14-11 to provide greater transparency, which may serve as an early warning system for potentially vulnerable species. A shark example was shown.

- Complementary to the time series of bycatch data, the large-purse seine observer data were used to provide scaled, relative catch of key shark species to better understand anomalies in the catches.
- The spatial distribution—with a focus on silky shark—caught incidentally by the large purse-seine fishery in 2022 compared to the 2017–2021 average was also presented.
- Minimum interactions and mortalities from the longline observer data were also provided (2021) using a seabird example, and minimum catch estimates from small purse-seine vessels (2022; by taxonomic group) were presented.
- A series of documents on data gaps for bycatch create awareness and seek opportunities for data improvements, including the 1st collaborative workshop on improving data collection for the industrial longline fishery in January 2023 (SAC-12-09, WSDAT-01-01, WSDAT-01-Report, SAC-14 INF-J).
- Interannual events shown by the Oceanic Niño Index (ONI) and interdecadal events shown by the Pacific Decadal Oscillation (PDO) were presented (1993–2022).
- Sea-surface temperature (SST) and chlorophyll-a (chl-a) concentration was shown to visualize these conditions across the eastern tropical Pacific (ETP) over a time series.
- Mean quarterly SST and chl-a concentration for 2022, with the distribution of tropical tuna catches overlaid, were also presented to provide a general indication of these environmental conditions over the last year, noting that the staff plan to produce species distribution models (SDMs) of key bycatch species to better describe potential relationships between environment and species.
- An EASI-Fish vulnerability plot, showing various hypothetical conservation and management measure scenarios for silky shark and hammerhead sharks was shown as an example of updates to EASI-Fish performed in 2022-2023 noting details are provided in SAC-14-12.
- The ETP ecosystem model was updated with data through 2021 and ecological indicators showed changes in the structure and dynamics of the ecosystem over the 42-year time period.
- Together, improvements to reporting of bycatch, environmental indicators, ecological risk assessments and ecosystem models provide transparency in how the staff delivers against science goals and mandates to consider ecological impacts of EPO fisheries.

Discussion:

- The **United States** proposed that the ecosystem item of the SAC meeting agenda be considered for inclusion of an item on climate change in future meetings. The staff agreed with the US proposal and noted that the staff is considering the inclusion of some climate change indicators in the Ecosystem Considerations report.
- The **European Union** asked if the staff has a clear understanding about the reason for the large inter-annual variability in minimum shark catches for the longline fishery. Could this be a reporting issue? The staff agreed that this may be due to reporting because these data are not mandated to be reported. Hence the staff's recent work and workshop on longline data improvements and a recommendation for the data provision Resolution (C-03-05) to be revised and updated (see item 8.c). The EU stated that it would be important for the SAC to recommend an update to the data provision Resolution with an emphasis on data improvements for longline vessels, and Colombia agreed with this statement.
- **Ecuador** expressed concern about the great uncertainties they perceive regarding data quality for the longline fishery, and that the Commission needs to better understand the effect of this fishery

on the ecosystem. Ecuador is improving their data collection and reporting for longline vessels, so it is possible for others to do the same. CPCs should be reporting full data starting, at a minimum, from the last 10 years. The SAC should make a recommendation on longline data improvements and the **United States** supported the call for a SAC recommendation on this topic. **Venezuela** also agreed and suggested that the SAC should review the Resolution(s) that mandate the provision of longline data, including observer coverage.

- **Ecuador** noted that SAC-14-11 shows that dorado bycatch in purse seine fisheries has increased. Therefore, improved data provisions on dorado are supported. Aiming at improving data sources available for research on dorado, Ecuador has developed and implemented new captain logbooks.
- **Panama** noted the great importance of the dorado fishery resource to EPO coastal states. A request was made for the IATTC scientific staff to resume its dorado research activities, in particular those related to stock assessment. The Coordinator of Scientific Research responded that the staff could resume research activities on dorado given the approval of the Commission and in case that additional human and financial resources are made available.
- **Peru** also noted increased catches of dorado by large tuna purse seiners (Class 6) and estimates for class 1-5 vessels are not even accounted for. Peru added support for a SAC recommendation for improvements in data collection and reporting, in particular for Class 1-5 purse-seiners and longline vessels.

b. Report of the Ecosystem and Bycatch WG

Manuel Correia presented the report of the Ecosystem and Bycatch Working Group and reviewed the nine recommendations to the SAC from the first meeting of the newly formed EBWG.

Discussion:

- **Japan** and the **United States** asked for clarification on procedure regarding recommendations by the EBWG. In its response, the staff took this opportunity to remind the participants that the process is clearly defined in Resolution C-22-06 paragraph 3 which stipulates that the conclusions and recommendations adopted by the Working Group "*shall be submitted first to the Scientific Advisory Committee (SAC) for its consideration and endorsement and later submission to the Commission as endorsed*." This provision establishes two exceptions to this process: the conclusions and recommendations "*may be submitted to the Commission directly, whenever there could not be considered and/or endorsed by the SAC or upon the request of the Commission itself*."

c. Dolphin research: update

An external consultancy has been offered for the project "design and implementation of a scientific experiment to evaluate dolphin cow-calf separation during purse seine operations in the ETP. The project will be conducted by a consortium team with scientists from University of Alaska Southeast (UAS) and Associação para Investigação do Meio Marinho (AIMM). The SAC received a presentation of document SAC-14 INF-K. by Dr. Heidi Pearson from UAS.

Key points:

- Despite a > 99% reduction in bycatch-related mortality in the Eastern Tropical Pacific (ETP) purse-seine tuna industry over the past three decades, eastern spinner dolphin and northeastern offshore pantropical spotted dolphin populations have not increased as projected and are still considered depleted under the Marine Mammal Protection Act. This suggests that cryptic and unobserved sources of mortality may be occurring, preventing population recovery.

- For the past two decades, it has been postulated that one such source may be mother-calf separation during fishery interactions, leading to calf mortality. The aim of this project is to use unmanned aerial vehicles (UAVs) to determine: (i) if mother-calf pairs become separated during chase, encirclement, backdown, and/or post-release "run" from the net; and (ii) if/how mother-calf separation may be affecting population growth.
- These results will help to inform population models and management and conservation actions for dolphins in the ETP.
- This project will use drones to study mother – calf spatial positioning. One of the drones is fixed wing but can be converted / vertical take-off and landing.
- 1st phase of the project will be a pilot study. The first phase of the pilot will occur in Portugal to learn UAVs and camera resolutions /angles to answer research questions. The objectives of the first phase of our pilot study are to: i) test and become proficient with two new UAVs, (ii) test UAV performance (e.g., with respect to battery life, wind), (iii) assess video quality under varying environmental conditions (e.g., wind, sun glare, sea state, water visibility), (iv) test the resolution of the visible light and infrared cameras at various heights to determine the maximum height at which the UAVs can be flown and still extract metrics for assessing mother-calf separation, and (v) refine image analysis techniques.
- The second phase of the pilot will take place on a Mexican purse-seiner in ETP waters. The objectives of the second phase of the pilot study are to: (i) apply the UAV methods used during pilot study phase 1 to a purse seiner in the ETP; (ii) become familiar with fishery operations, the behavior of the dolphin species of interest, and working under various fishery and environmental conditions (e.g., Beaufort sea state, swell) in the ETP; (iii) determine the optimal UAV(s) and camera(s) for use during the main study (e.g., according to image resolution, battery duration); (iv) define mother-calf separation; (v) determine if mother-calf separation can be observed in real time; and (vi) obtain a preliminary estimate of mother-calf separation.
- The third and final phase will consist of the main study to be conducted from October to mid-November on a Mexican purse seine vessel in the ETP.
- Study timeline: Pilot study from August – September 2023, main study from October – November 2023, presentation of results at SAC15, May 2024

Discussion:

- **Mexico** noted that drone technology is new, and it should present benefits for scientific research of the dolphin cow-calf separation hypothesis. How does the proposed work and past studies?
    - Dr. Heidi Pearson responded that there is limited research on the dolphin cow-calf separation despite the hypothesis has been around for nearly two decades. The early imagery records were obtained from a helicopter with a camera attached during normal purse-seine operations. However, this imagery was collected on film, during flight, and is not high resolution. In 2004, Weiss introduced the idea of calf slippage based upon still photo records. The calf was losing its place near its mom. Otherwise, we haven't had technology to obtain fine-scale data to adequately investigate mom-calf separation. The new technologies are promising.
- The **United States** mentioned that they have marine mammal scientists at SWFSC who are very interested in the project. The presenter welcomed any discussions with US scientists.
- **Colombia** asked how the team intends to deal with chasing when the herds are too large and if they split, and how could we verify if there is a reunification of mother and calf?

The presenter acknowledged that pod sizes can be very large and split in the ETP. The final methodology will be fine-tuned during the pilot study and the team will need to coordinate very closely with the helicopter operation. The team still does not know how high the drones can be flown while maintaining high resolution in the imagery. With the new drone technology available, the team will maintain the drone in the air as long as possible to image the entire pod.

d. Vulnerable species best handling practices: knowledge and research gaps

Melanie Hutchinson presented a review of the available knowledge and data gaps to the implementation of best handling and release practices for vulnerable species captured in IATTC fisheries. The IATTC is working towards creating a living document of BHRP guidelines for vulnerable species captured by various fishing gears across the convention area. However, several data gaps need to be addressed before this goal can be achieved. To help prioritize research efforts, the staff has prepared document EB-01-01, which reviews existing literature to identify knowledge and data gaps that impede BHRP development. EB-01-01 also reviews the current vulnerable species Resolutions to identify where BHRP guidelines can be implemented into the regulations and where additional research is required.

This presentation and the associated paper review the activities and research priorities identified as important next steps in the development of BHRPs.

Key points:

- EB-01-01 summarizes the IATTC Resolutions that call for CPCs to encourage their fishers to release vulnerable species in a manner that minimizes harm and identifies which provide actual guidance on handling practices and those that require updating with BHRP guidance.
- Unless or until official BHRPs are adopted, methods that prevent injuries should be implemented as a minimum, such as banning the rolling of sharks and other discarded species through the power block in purse seine fisheries and leaving as little trailing gear on discarded species as possible in longline fisheries.
- The adoption of a framework and minimum set of standards for BHRP would ensure that BHRP are harmonized with regional efforts, feasible, and enforceable across all CPCs, as appropriate. Thus, a framework and minimum set of standards for BHRPs be adopted and implemented, including the tools required to be carried on board for their implementation.
- It is desirable that CPCs, fishing companies and other relevant stakeholders work together to compile existing BHRP guidelines and training materials across vulnerable taxa and fisheries for the development of efficient, regional BHRP guidelines:
    - CPCs and other relevant stakeholders support the IATTC staff in a survey to gather details on national efforts or programs that can help elucidate post-release survival rates in fisheries and the identification of BHRPs for vulnerable species.
    - A small ad-hoc group of experts be established to begin drafting BHRPs for vulnerable species captured in IATTC fisheries.

Discussion:

- **El Salvador** offered congratulations for the work and support to this effort. They noted that Members need to make sure that resolutions and guidelines to fishermen are updated with the current and best information available.
- **Costa Rica** commented that best handling release practices (BHRP) should be designed for each vessel type and design, based on their experience with sea turtles. The Commission should not only promote BHRPs but also encourage the recording of releases.

- The **European Union** noted that for sharks caught in the purse-seine fishery, mortality is high and post-release survival of sharks is low. However, there are other efforts-experiments in other regions (Indian Ocean) that show that mortality could be reduced up to 50% when BHRPs are used. The EU encouraged efforts in this direction, as BHRPs could help vulnerable species.
- **Mexico** highlighted the tuna fishery in association with dolphins under the AIDCP as a good example of BHRP. They also noted that fishers need specific and clear protocols instead of open-ended requirements to use best practices and they support the IATTC's effort to create these guidelines. They noted that incentive programs are also important for rewarding good behavior.
- The **United States** expressed surprise that there are no handling guidelines for marine mammals. Prioritization of activities and taxa can be a starting point for development of guidelines.
    - In response to the United States comment on prioritization, the staff noted that they have developed the EASI-Fish framework to help assess vulnerable species and establish priorities. They also noted that one of the recommendations to the SAC in this paper is the establishment of an ad-hoc working group to conduct these activities (prioritization and BHRP development).
- **Panama** congratulated the staff and supports this work. They expressed interest in the incorporation of BHRPs into their fisheries and pointed to sea turtles as an area where they have already taken steps and made efforts of this nature.
- **Mexico** noted that in one of the tables (Table 4 of the paper), in reference to class 6 purse-seiners it was colored red with respect to seabirds and that this was confusing because interaction with seabirds on these vessels is minimal. They suggested that the table should be updated with text like "N/A" so that it could not be misinterpreted as non-compliance.
    - The presenter responded that the color reflected information in gaps, not non-compliance.
    - **Ecuador** insisted that interactions with seabirds and marine mammals are minimal in their fisheries, and that table 4 expressed in this way could generate confusion. They also noted that they have codes of good practices for longline and swordfish fisheries.
- **Japan** asked whether crew safety measures are also included among the best practices, taking into account the technological advances employed in some of the release methods. The presenter replied that crew safety is always paramount and language to that effect is included.

11. SHARKS

a. Silky and hammerhead sharks: impact of alternative management measures on vulnerability status (EASI-fish assessment)

Shane Griffiths presented the results of an EASI-Fish ecological risk assessment that explored the potential efficacy of 43 hypothetical conservation and management measures on the vulnerability of four vulnerable shark species (*Carcharhinus falciformis*, *Sphyrna lewini*, *Sphyrna mokarran*, *Sphyrna zygaena*) captured in EPO pelagic fisheries.

Key points:

- Silky and hammerhead sharks are frequently caught—either as a target or incidental catch (i.e., bycatch)—in the industrial and artisanal pelagic fisheries in the eastern Pacific Ocean (EPO). These species are slow growing, long-lived, and have low reproductive output, leading to concerns about their long-term sustainability in the EPO.
- In 2016, the IATTC implemented Resolution C-16-05, which called for a workplan to complete stock assessments for four species: silky shark (*Carcharhinus falciformis*), scalloped hammerhead

(*Sphyrna lewini*), great hammerhead (*Sphyrna mokarran*), and smooth hammerhead (*Sphyrna zygaena*). However, a lack of reliable long-term time series of abundance has hampered previous attempts of stock assessments for silky shark.

- The EASI-Fish ecologically risk assessment approach, designed for use with data-limited species and fisheries, was used as an alternative approach to assess the vulnerability of these species under 43 hypothetical scenarios involving practical conservation and management measures (CMMs)—used in isolation and concert—to guide future research and management efforts.
- Several of the 43 CMM scenarios resulted in a significant reduction in the vulnerability status of all four species, although none resulted in a species being reclassified as "least vulnerable". The CMMs having the greatest positive impact was similar for all four species, imposing EPO-wide closures of 120 or 180 days, especially for the industrial longline fishery.
- Other practical measures, such as banning wire traces, imposing a 100 cm total length minimum retention length for all sharks, and even prohibiting landing of all sharks, was predicted to greatly reduce at-vessel mortality, however, this positive effect on vulnerability was negated due to high post-release mortality of these species.
- The results indicate that the most effective mitigation measure for these sharks is to avoid interaction with EPO fisheries. However, there are significant socioeconomic factors to consider as fishery closures are likely to greatly reduce the catch of target species (e.g., tuna and billfish) or encourage movement of effort to the eastern region of the western and central Pacific Ocean where these fisheries may continue to impact the species that the measure was designed to protect.
- Recent catch estimates of silky and hammerhead sharks by artisanal fisheries (SAC-14 INF-L) rival those from the industrial longline fishery, although this was not reflected in the EASI-Fish results. Sensitivity analyses were conducted and showed that model results were sensitive to catchability estimates for each fishery and the coarse spatial resolution of data reported to the IATTC by the industrial longline fishery and therefore, require further investigation.
- The assessment identified several major data gaps that need to be addressed through a participatory collaborative research approach between the IATTC and its CPCs, including basic biology and improved species-specific catch and size composition data in artisanal fisheries and the industrial longline fishery.

Discussion:

There was no discussion following this presentation.

b. Improvements on shark data collection for EPO coastal States:

i. Central America: pilot study final report

Dan Ovando presented the results of the order of magnitude estimate for silky and hammerhead sharks in Central American Artisanal Fisheries (SAC-14 INF-L). This information will help the SAC better understand the importance of these shark fisheries and whether these catches should be further considered for stock assessment, conservation and management of these species.

Key points:

- There is a lack of consistent data on catches of silky (*Carcharhinus falciformis*) and hammerhead (Sphyrnidae spp.) sharks in Central American (CA) (Costa Rica, El Salvador, Guatemala, Nicaragua, Panama) artisanal ("*panga*") fisheries.

- There are concerns that these CA *panga* catches may be substantial enough to require consideration in monitoring, assessment, and management.
- In order to help address this gap IATTC staff identified shark landing sites throughout CA and conducted field surveys of catches of silky and hammerhead sharks at key locations.
- Based on these data IATTC staff developed a series of models to estimate the total catch of silky and hammerhead sharks by the CA *panga* fishery in part of 2020 and throughout 2021.
- Our models estimated a catch of roughly 12,500 metric tons (t) for hammerhead and 5,000 t for silky sharks in 2021, with catches concentrated at a relatively small proportion of landing sites throughout the region.
- Key uncertainties in these estimates relate to raising factors from processed to whole weight, the numbers of *pangas* operating at each landing site, and the consistency of the estimated catches across space and time given the natural variability of the fishery and the challenges of COVID-19.
- Next steps include exploring new technologies for monitoring fishing activity in the region, refining sampling designs for coastal shark fisheries throughout the EPO in line with objectives, and harmonizing other existing databases on shark catches throughout the region.
- These results indicate that catches of silky and hammerhead sharks are likely to be significant enough to require consideration in regional monitoring, assessment, and management plans.

Discussion:

- **Mexico** asked whether the interpolation and extrapolation models would be able to include movement of fishers between sites as they have seen this happening with local fishermen. The presenter clarified that the catch-per-week-trip model should be able to pick this up, but it is not possible to estimate the number of *pangas* for each site for each week. The staff reiterated the need to look into ways to improve these assumptions. However, the fishery is dynamic in Central America, but fishers are stationary, they do not tend to move from site to site due to the associated costs.
- **Panama** mentioned that their fishery is very dynamic and does not target sharks, they are caught as bycatch. Their fleet is composed of small *pangas*, longliners of 10-12m and gillnet vessels. They wondered if this information was considered when conducting the study. The presenter clarified that a census was done in 2019 to estimate/count "*pangas*" or artisanal vessels, as well as the gear used, size, make, motor, etc. in Panama and other Central American countries.
- **Costa Rica** commented on the importance of maintaining this project alive in the region. They also stressed that there are sources of variation and uncertainty that need to be taken into account. In addition, their fisheries are usually multi-specific and that can have an impact in data collection, as does the weather. For example, hammerhead shark fisheries' seasonality is clear and is related to the dry-wet season. Costa Rica also stressed the need for the SAC to consider bringing forward a recommendation to support continuing this project in Central America.
- **El Salvador** expressed support for the project and stressed the importance of maintaining a data collection program like this one. They also mentioned that data collection harmonization is important and should be guaranteed across the region, including for sampling designs. The staff noted that multiple options of sampling designs are being constructed for different objectives and budgets for the Commission's consideration.
- **Nicaragua** congratulated the effort and mentioned that this is the first time that a preliminary estimation of silky and hammerhead shark catches in the region is available.

- **Panama** stressed the need to keep this data collection program alive. In addition, they asked whether the species data collection was just focused on silkies and hammerheads or if it also included other species? The staff clarified that although the sampling designs are focused on silky and hammerhead sharks, more than 15 species of sharks and around 20 species of rays were recorded during the project.
- **OSPESCA** congratulated the effort and stressed the importance of collecting these data in meeting the objectives of the IATTC. In that sense, OSPESCA reminded that funds might be depleted but not the objectives, as monitoring and evaluating the status of these resources is key and will remain one of OSPESCA's priorities. Therefore, OSPESCA supports finding the funds necessary to continue this work in Central America.

ii. Others: ABNJ (phase 2)

Key Points:

Alexandre Aires-da-Silva informed the SAC about the initiation of the second phase of the IATTC ABNJ project to improve data collection for shark fisheries in the eastern Pacific Ocean (EPO). This second phase continues to receive funds from the FAO-GEF Common Oceans program, and specifically the *Sustainable Management of Tuna Fisheries and Biodiversity Conservation in the Areas Beyond National Jurisdiction* (ABNJ) project. The work builds on successful work completed under phase 1 in Central America (SAC-11-13), and will aim at improving shark data collection in Ecuador, Mexico and Peru. The work has been planned in close coordination with the fishing authorities of each member.

The tasks to be carried out are: 1) Identify available data sources (Metadata) and incorporate these into IATTC databases; 2) Determine and map landing sites for shark species, and collect data on site characteristics, fishing activity, and catch composition; 3) Develop feasibility studies and proposed sampling designs for shark data collection (including close kin mark recapture).

Discussion:

- **Guatemala** expressed support for the expansion of the project beyond Central America to other EPO coastal nations.
- The **United States** asked about the possibility of routine monitoring of the landings instead of intense sampling.
    - The staff responded that their priority is to collect data for stock assessment of sharks, including estimates of catches. There are thousands of vessels (e.g., *pangas*) landing across the coastline of the EPO. The monitoring of all these landing sites is not feasible and is cost prohibitive. The implementation of cost-effective sampling designs and use of the model-based approach developed by the staff could help obtain order of magnitude catch estimates that can be incorporated into stock assessments (item 11.b.i). However, the staff is conscious that building long-term data series for conventional stock assessments of sharks could take too long. The staff will provide options for the Commission's consideration in the short and medium term as well. Processes like EASI-Fish could help in the short term, while close-kin mark recapture and traditional stock assessments may come at play in the medium and the long term, respectively.

12. ACHOTINES LABORATORY

a. Research program and activities: future directions

Alexandre Aires-da-Silva presented an overview of IATTC research program at the Achotines Laboratory, Panama, including insights into future directions.

Key Points:

- The Early Life History (ELH) Group of the IATTC conducts most of its research on pre-recruit life stages of tunas at the Achotines Laboratory in the Republic of Panama. The Achotines Laboratory provides the IATTC a unique research facility for both field-based and experimental research designed to identify and quantify important factors that determine pre-recruit survival.
- As part of ongoing efforts to update the Strategic Science Plan (SSP), the ELH group initiated discussions on a plan to strengthen and provide future direction for the research program conducted by the ELH group at the Achotines Laboratory.
- At this stage, the plan which is still under construction addresses areas to strengthen the research, infrastructure, staffing, collaborative agreements and funding of the ELH group's research, consistent with the goals of the SSP. At a later stage, and taking into consideration the input from other IATTC scientific Programs, the Scientific Advisory Committee (SAC) and the Commission, the plan should consider further expanding beyond the early life history of tunas.

Discussion:

- The Director informed the SAC of the staff's plan to utilize the Achotines Laboratory as platform for IATTC capacity building activities. He also briefly described the sensitivity of the environment surrounding the laboratory. **Colombia** expressed great interest and supports any fishery science related capacity building activities that may take place at the lab.
- Upon the Director's request, Vernon Scholey described the ongoing terrestrial conservation and reforestation plan for the 70-hectare property. Much of the work aims to restore sensitive habitat and to improve water quality from extensive siltation/run-off which contributed to coral reef degradation.
- Gala Moreno from ISSF noted that the various research opportunities presented by the Achotines Laboratory offer great value to all tuna RFMOs. There is potential for different experiments, including gear modifications, acoustics, and behavioral responses to stimuli like light, sound, etc. She discussed how the applications of the sorting grids and other activities could be investigated at the Achotines Laboratory. ISSF supports the continuation of long-term research at Achotines.
- The European Union asked if budget is secured to expand the research being undertaken. They agreed that capacity building should be included in any long-term plans for the Achotines Laboratory. The Coordinator of Scientific Research responded that the staff may include a proposal in the preparation of the next IATTC Strategic Science Plan.

13. STAFF RECOMMENDATIONS TO THE COMMISSION

Alexandre Aires-da-Silva presented the staff recommendations to the Commission on other topics (SAC-14-14). Discussion on the different recommendations is described in the above sections of this report.

14. SAC RECOMMENDATIONS TO THE COMMISSION

1. GENERAL CONSIDERATIONS

(a) That the Commission and the SAC reconsider the way in which the Committee conducts its work, so that future SAC meetings are more oriented towards responding more effectively to the needs of the Commission, and to this end include this topic on the agenda of SAC15.

(b) That CPCs work in close collaboration with the Director and the Chair of the Commission for the discussion of proposals for practical improvement to the operation of the SAC meetings.

(c) Considering, among others, the importance of the coastal fisheries in Central America, in particular

for sharks, and the need for constant improvement of sampling and landings data, as well as the strengthening of capacities in the region, that the Commission review the updated proposal to be developed and presented by the Commission staff for establishing an additional IATTC field office in Central America, with the objective of strengthening scientific activities and ensuring coordination with this sub-region.

(d) The SAC endorses, in general terms, the recommendations on tunas presented by the commission staff (SAC-14-14).

2. RESEARCH PLANNING

That the current Strategic Science Plan (SSP) be extended for one year, to align with the assessment schedule for tropical tunas.

3. TROPICAL TUNAS (YELLOWFIN, BIGEYE, AND SKIPJACK):

3.1. Bigeye

That the IATTC staff be requested to evaluate the effectiveness of BET measures established in Resolution C-21-04, especially for the annual BET catch limits for individual purse seine vessels, and report results of the evaluation to the SAC in 2024.

3.2. Skipjack tuna

That the Commission consider and adopt interim reference points for Skipjack Tuna, based on the staff's proposed methodology (SAC-14-09).

3.3. Yellowfin tuna

That the Commission staff include in its research activities on yellowfin, the dynamics of the fleet and its impact on the post-pandemic data.

4. TEMPERATE TUNAS:

4.1. Northern Pacific Albacore Tuna:

(a) That the Commission adopt HCRs for North Pacific albacore tuna, based on the results of the MSE.

(b) That the Commission consider advice from the ISC on the criteria for identifying exceptional circumstances for inclusion in the harvest strategy.

4.2. South Pacific Albacore Tuna:

(a) That the Commission request the WCPFC to plan a joint effort between IATTC scientific staff and SPC to explore management strategies for South Pacific Albacore tuna.

(b) That the Commission endorse the continuation of joint work between IATTC scientific staff and SPCs on the stock assessment of South Pacific Albacore tuna, emphasizing the provision of data from all CPCs reporting catches in the IATTC area.

(c) Based on a joint MSE results, that the IATTC scientific staff propose reference points based on the methodology described in document SAC-14 INF-O.

(d) That the Commission considers providing support to IATTC staff participation in this MSE process by ensuring multiannual financial support and providing the necessary human resources.

4.3. Swordfish:

(a) Continue to monitor the south EPO SWO population (for example, using population status

indicators and conducting baseline assessment again in 3 – 5 years).

(b) That the Commission consider the interim reference points developed for South EPO Swordfish for the Commission, taking into consideration document SAC-14 INF-O.

(c) That the Commission coordinate with the WCPFC and adopt reference points for North Pacific Swordfish.

5. MAHI-MAHI:

That the Commission consider assessing and managing the mahi- mahi stock.

6. TROPICAL TUNA MANAGEMENT STRATEGY EVALUATION (MSE)

(a) that the Commission continue support and secure funding for MSE for tropical tunas in 2024 and beyond, following the guidance of C-16-02 and C-19-07;

(b) That the Commission considers providing permanent support to the MSE process by ensuring multiannual financial support and providing the necessary human resources, including to work also on other species, as determined by the Commission.

(c) That the Commission consider the Science-Management Dialogue (SMD) or informal workshops approach to continue the MSE process and provide the appropriate funding and human resources to complete the technical and communications components of the MSE.

7. DATA COLLECTION AND PROVISION

7.1. Resolution C-03-05

That the Commission review and update Resolution C-03-05 on "Data Provision", taking into consideration document SAC-14 INF-Q.

7.2. Bycatch data collection

That the Commission develop the necessary efforts to improve the collection of non-target species catch data in 1 to 5 class purse seine vessels and longline vessels without observers on board.

7.3. Regional Tuna Tagging Program

(a) Conduct tagging cruises at regular intervals for the next five years. These cruises should focus on developing stronger relationships with the tuna industry, fostering collaboration to improve project outcomes;

(b) Continue the tropical tuna tagging programs, especially skipjack, in the EPO, with stable financial support through the regular budget.

(c) Ensure a greater interaction with the fishing sector, including education and promotion activities, so that tagging campaigns and tag recovery are more effective

7.4. Enhanced Monitoring Program (PRM)

(a) Continue the Enhanced Monitoring Program (PRM) for bigeye catches through, among others, securing financing for the continuation of PRM operations in 2024 considering that the resolution on tuna conservation extends to 2024;

(b) That the IATTC staff be asked to provide in 2024, a cost-benefit analysis and options for reducing the uncertainty associated with the EMP estimates of bigeye catches by individual vessels;

(c) Ensure the improvement of port sampling protocols to estimate the proportion of bigeye

tuna catch, including, among others, including mechanisms for data transmission between IATTC staff and the CPC, so as to have greater accuracy in the bigeye catch estimates based on Resolution C-21-04.

7.5. Longline vessels observer program

(a) That the countries with longline fleets update, in the IATTC Regional Vessel Registry, the list of vessels over 20 meters that operate in the EPO, as well as report the number of trips made by the different vessels during the previous year in order to calculate the percentage of observer coverage on longliners and assess compliance with Resolution C-19-08;

(b) That CPCs submit all operational longline observer data collected from 1 January 2013 to present, consistent with the minimum data standards contained in Annex B of C-19-08 or provide a clear and complete explanation as to why the missing datasets have not been submitted;

(c) That the Commission examine once again the percentage for observer coverage on LL vessels;

7.6. Transshipment observer program

That the IATTC staff be asked to study, in close contact with flag CPC and other stakeholders, the possibility of guaranteeing greater accuracy regarding the fish that is transshipped and reported in the declaration of transshipments.

8. FADS

Taking into account the importance of FAD recovery, the SAC requests that the Commission clarify if vessels other than authorized purse seiners could carry out this recovery and under what circumstances, and considers, should it be necessary, an update of Resolution C-99-07 on FADs.

9. VULNERABLE SPECIES AND BEST HANDLING AND RELEASE PRACTICES (BHRPS)

(a) Unless or until official BHRPs are adopted, implement methods that prevent injuries as a minimum, in purse seine fisheries and leaving as little trailing gear on discarded species as possible in longline fisheries;

(b) That CPCs and other relevant stakeholders support the IATTC staff in a survey to gather details on national efforts or programs that can help elucidate post-release survival rates in fisheries and the identification of BHRPs for vulnerable species;

(c) That the Commission tasks the scientific staff with the preparation of guidelines for good handling and release practices for vulnerable species and development of standards pursuant to the relevant resolutions, including for other species, as appropriate;

(d) Prohibit the removal of shark fins on board vessels, requiring fins be naturally attached to the shark carcass until the first point of landing for consistency and compatibility throughout the Pacific Ocean, taking into account the measures adopted by the WCPFC (CMM 2022-04);

(e) Carry out further analysis on the length of trailing fishing gear within the EBWG with practical handling and release practices including crew safety during fishing operation;

(f) Regarding good practices on bycatch and bycatch fauna, that the IATTC scientific staff be asked to define for the tropical zone:

- Where it will be necessary to develop release procedures for seabirds in longline vessels greater than 20 meters in length and purse seine nets;
- Where it will be necessary to develop release procedures for marine mammals incidentally retained on longline vessels greater than 20 meters in length.

10. FISH SORTING GRIDS

(a) That observer programs record the use (or not) of fish excluder grids in each fishing set by tuna purse seine vessels, as well as any complementary information they may obtain, so that this information is available to the scientific staff and the SAC for their consideration and analysis;

(b) Continue with the methodological improvement workshops among scientific personnel, CPC, industry, captains, and experts to extend the results of the first workshop;

11. CLIMATE CHANGE

That climate change be included as a standing agenda item for SAC Annual Meetings going forward**.**

RECOMMENDATIONS AS ENDORSED BY THE SAC

A. *AD HOC* PERMANENT WORKING GROUP ON FADS

1. On Biodegradable FADs

1.1. Consider the following definition for Biodegradable: Non-synthetic materials[1] and/or bio-based alternatives that are consistent with international standards[2] for materials that are biodegradable in marine environments. The components resulting from the degradation of these materials should not be damaging to the marine and coastal ecosystems or include heavy metals or plastics in their composition.

1.2. The following are FAD categories, based on their degree of biodegradability (from non-biodegradable to 100% biodegradable), with the understanding that the respective definitions do not apply the electronic buoys that are attached to FADs in order to track them.:

- ✓ Category I. The FAD is made of fully biodegradable materials.
- ✓ Category II. The FAD is made of fully biodegradable materials except for plastic-based flotation components (e.g., plastic buoys, foam, purse-seine corks).
- ✓ Category III. The subsurface part of the FAD is made of fully biodegradable materials, whereas the surface part and any flotation components contain non-biodegradable materials (e.g., synthetic raffia, metallic frame, plastic floats, nylon ropes).
- ✓ Category IV. The subsurface part of the FAD contains non-biodegradable materials, whereas the surface part is made of fully biodegradable materials, except for, possibly, flotation components.
- ✓ Category V. The surface and subsurface parts of the FAD contain non-biodegradable materials.

1.3. Notwithstanding the above categories, the use of non-biodegradable materials, in particular nylon ropes, can be used exclusively to strengthen the structure of the floating or underwater component of the FAD categories I & II, if required and as a temporary solution.

1.4. That the Commission establish a gradual timeline for implementation of biodegradable FADs that take into consideration the results of ongoing research trials and the availability of materials.

[1] For example, plant-based materials such as cotton, jute, manila hemp (abaca), bamboo, natural rubber, or animal-based such as leather, wool, lard

[2] International standards such as ASTM D6691, D7881, TUV Austria, European or any such standards approved by the Members of the IATTC

1.5. Consider prototypes 1 and 2 [Document FAD-07-02] and the "Jelly FAD", and their improvements, as current potential examples for effective biodegradable FAD construction.

1.6. Reduce, to the extent possible and within the gradual process of biodegradable FAD implementation, the amount of material and the non-biodegradable components for their design and construction, provided that fishing efficiency is not compromised.

1.7. Fishers supported by ship-owners should continue trialling bioFAD designs in a continued effort, deploying systematically a percentage of their FADs made of biodegradable materials and sharing the results in the FADWG.

2. On non-entangling FADs

2.1. Revise Annex II of C-19-01 to require exclusively the design and deployment of non-entangling FADs.[3]

3. On stranding FADs

3.1. Consider alternative mechanisms to continue monitoring buoys that are leaving the convention area or fishing grounds and that are susceptible for deactivation, taking into account the implications with regard the limits on active FADs per vessel

3.2. To the extent possible, provide data to the Secretariat on the entire trajectory of FADs, even when transiting outside the convention area or the fishing grounds, monitored through new FAD marking systems, the FAD's buoy or other systems.

3.3. Consider putting in place a set of best practices for optimizing FAD retrieval.

3.4. Promote FAD recovery programs, both from the land and from the sea, and establish standards to ensure the effectiveness of these programs.

3.5. Create awareness of FAD strandings and encourage the expansion of the in-country data collection efforts on FAD strandings in the EPO to harmonize with SPC-WCPFC efforts in the WCPO.

3.6. Develop solutions to process/recycle FAD materials in ports.

4. On data collection

4.1. The scientific staff to provide feedback to those CPCs with fleet members providing incorrectly buoy data so that the issue can be corrected in as early as possible.

4.2. Organize workshops with fishing companies, captains and crew and buoy providers to try to showcase the correct reporting protocols for buoy data. And use these workshops also to collect first-hand direct information on the fishery dynamics.

4.3. Fishing companies and buoy providers to make available the historical buoy acoustic information to avoid losing data of enormous value for science, and in particular stock assessment.

5. On research

5.1. Increase Pacific-wide collaboration on drifting FAD research, in particular on the design of dFADs and the use of biodegradable materials. This includes higher WCPFC-IATTC 4communication on current and planned Non-entangling and Biodegradable FAD trials and other research projects; as well as homogenizing data collection processes, increasing non-confidential data exchanges and collaborating on data analyses.

5.2. Complement research on the buoy acoustic index with other acoustic tools available on tuna vessels

[3] A FAD that does not include any netting materials for any part of the FAD including both the surface structure (e.g., raft) and subsurface structure (e.g., tail) (Document IATTC-100-03 ADD.1, Section 2.2).

(e.g., sonar, echo sounders).

5.3. Continue the work on acoustic discrimination to improve buoy-derived abundance indices.

5.4. Conduct further tests to test and propose technology improvements to meet FAD marking requirements and better understand the life cycle of FADs.

B. WORKING GROUP ON ECOSYSTEM & BYCATCH

1. Deep Sea Mining. The Ecosystem and Bycatch Working Group (EBWG) recommends to the Commission:

- Be attentive to, and monitor the development of mining in the international seabed area in terms of its potential effects on the ocean ecosystem and populations of tuna and tuna-like species;
- Participate, as appropriate, in the process of discussions on the subject within the framework of the International Seabed Authority (ISA), as an observer and/or through appropriate collaborative mechanisms;
- Collaborate, in a manner consistent with its mandate, work program, and the financial, human, and material resources at its disposal, in research on the potential effects of mining in the international seabed area among others on the ocean ecosystem and populations of tuna and tuna-like species

2. Elasmobranchs.

- The EBWG recommends the adoption of new measures for best handling and release practices for elasmobranchs that are caught by longline gear and not retained, i.e. cutting the line as close to the hook as possible and such that the gear left is less than 1 meter in length, taking as a reference measures in CMM 2022-04 adopted by the Western and Central Pacific Fisheries Commission (WCPFC).
- The EBWG recommends that the IATTC scientific staff continues to develop improved data collection and reporting standards on elasmobranchs for Class 1-5 purse seine vessels (work already planned under project A.3.a), considering the work already done regarding longline vessels (document SAC-14-INF-Q) to obtain reliable catch, size composition, and other biological information for assessments of vulnerability and stock status.
- Noting shark conservation and management measures recently adopted by WCPFC and considering that scientific studies conclude that the percentage of the fin to body weight ratio varies, including differences in ratios among shark species, the types and the number of fins included in the calculations, the type of body weight used (whole or processed), the processing method used to separate the fins from the body (finning technique) and wet versus dry weight of fins; and at the same time, considering the need to improve the identification of shark species, knowing the need to improve the collection of data by species, and seeking the full utilization of the catches, the EBWG recommends the adoption of a conservation and management measure requiring sharks with fins naturally attached to the body at the point of the first landing.
- Consider adopting similar measures to ensure shark conservation is, to the extent practical, compatible throughout the Pacific Ocean.

3. **Sea Turtles.**

   - Based on the 1st Circle Hook Workshop outcomes, which identified variable results regarding circle hook sizes, and balancing interests in advancing sea turtle bycatch mitigation efforts with socioeconomic needs, the EBWG recommends that the IATTC staff co-host a follow-up workshop with the goal of exploring/expanding on topics of interest/data-knowledge gaps identified by the Bycatch Working Group to mitigate bycatch of sea turtles and to complete the outstanding requirements of Resolution C-19-04. The EBWG seeks to strike a balance between the objective of protecting vulnerable species such as sea turtles, seabirds, and sharks while maintaining the socioeconomic needs of fishing communities.

   - Noting the potential connectivity between known areas of drifting FAD deployment and sea turtle habitat, the EBWG encourages additional research on at-sea interactions between active or abandoned drifting FADs and sea turtles and deems it appropriate to have these topics be considered by the FAD Working Group.

4. **Seabirds**. The EBWG recommends the development of an action plan for seabird bycatch, including an update of Resolution C-11-02 within the next two years that reflect the best available science on seabird bycatch mitigation techniques with consideration of progress in other TRFMOs (particularly CCSBT and WCPFC).

5. **Best Handling and Release Practices**. The EBWG recommends the SAC and Commission consider the recommendations of paper EB-01-01, recognizing the need to address best handling and release guidelines, test new bycatch release devices, and collect more post-release survival data for various non-target taxa impacted by fisheries under the purview of the IATTC.

6. **Monitoring**. The EBWG recommends increasing monitoring of longline fishing and class 1-5 purse-seine activities, as this will facilitate understanding of and measures to address the impact of fishing activities on target species, non-target species, and the ecosystem. This may be achieved through increased observer coverage recommended by IATTC staff, which could be achieved by the use of electronic monitoring.

7. **Climate Change**. The EBWG recommends including the climate change topic as a permanent item on the agenda of this working group to ensure that the IATTC is prepared to address the possible effects of these changes on the target and non-target populations under its purview.

15. OTHER BUSINESS

There was no discussion under other business, as the item(s) proposed for this section were covered under other agenda items, including the topic of the functioning of the SAC, whose consideration had been requested by the European Union.

16. ADJOURNMENT

The meeting was adjourned on 19 May 2023.

ANNEX A. LIST OF ATTENDEES

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NOTE: IF YOUR INFORMATION IS INCORRECT, PLEASE LET US KNOW. THANKS. NOTA: SI SU INFORMACIÓN ES INCORRECTA, POR FAVOR DEJENOS SABER. GRACIAS.