INTER-AMERICAN TROPICAL TUNA COMMISSION

101ST MEETING

Victoria, B.C., Canada
7 - 11 August 2023

DOCUMENT IATTC-101-04

STAFF RECOMMENDATIONS FOR MANAGEMENT AND DATA COLLECTION, 2023

CONTENTS

A. MANAGEMENT

1. TUNAS

1.1. Conservation of tropical tunas: yellowfin, bigeye, and skipjack

Summary

Resolution C-21-04 establishes conservation measures for tropical tunas in the eastern Pacific Ocean during the triennial management cycle of 2022-2024. The strengthened package of management measures seeks to prevent fishing mortality from exceeding the *status quo* conditions[1]. In order to evaluate progress towards the objectives of these measures, the IATTC staff annually analyzes the effects on the stocks of their implementation, and recommends to the Commission, if necessary, changes to the measures in place to be applied in future years.

In 2023, the staff evaluated the status of the stocks relying upon various sources of scientific information. For bigeye and yellowfin, current stock status is evaluated based on comparisons of recent stock status indicators relative to results of the 2020 risk analysis, which reflect stock status during the *status quo* period (2017-2019). The status of skipjack is evaluated based on comparisons of recent stock status indicators relative to results of the 2022 *interim* stock assessment.

As a response to the tasks assigned to the staff under paragraphs 10 and 35 of resolution C-21-04, the staff is concerned about the resumption of the general increasing trend in the number of floating-object sets, but does not find an immediate need to recommend any modifications to the resolution. The effect of this increase on the status of the stocks needs to be evaluated with conventional stock assessments conducted for yellowfin, bigeye and skipjack. This will be done in the 2024 benchmark assessments to be conducted for the three species.

1.1.1. Background

Resolution C-21-04 establishes the conservation measures for tropical tunas in the eastern Pacific Ocean (EPO) during the triennial management cycle of 2022-2024. The resolution consists of a package of management measures designed to prevent fishing mortality from exceeding the *status quo* conditions, which are defined as the average fishing mortality (F) during the period 2017-2019. According to the overall results of the 2020 risk analysis for the management of the tropical tuna fishery in the EPO, the stocks of yellowfin, bigeye and skipjack were all assessed to be in a healthy condition at the start of 2020. To maintain the healthy status of these stocks, additional precautionary measures to prevent fishing mortality from exceeding the *status quo* conditions were recommended by the IATTC staff and the Scientific Advisory Committee (SAC), in particular measures related to the management of the floating-object fishery. Following these recommendations, Resolution C-21-04 extends most provisions of Resolution C-20-06 onto 2022-2024 (*e.g.,* 72-day closure for the purse-seine fishery, catch limits on the longline fishery), adjusts some related to the fishery on fish-aggregating devices (FADs) and adds new ones. The new measures were: 1) thresholds on individual purse-seine vessel annual bigeye tuna catch that, when breached, trigger additional closure days for a vessel; the adjusted measures were: 2) reduced limits on active FADs by vessel size-class, and 3) new FAD data provisions.

Per paragraph 10 of C-21-04, in the event that the *status quo* conditions are exceeded, despite the new measures, the IATTC staff shall propose to the Commission an update of its recommendations for these conservation measures. In addition, paragraph 35 tasks the staff to analyze the effects on the stocks of the

[1] Defined as the average fishing mortality (F) during the period 2017-2019.

implementation of these measures, and previous conservation and management measures, and will propose, if necessary, appropriate measures to be applied in future years. .

In 2023, the staff evaluated the status of the stocks relying upon various sources of scientific information, including whether the *status quo* conditions have been exceeded in 2022. For bigeye and yellowfin, current stock status is evaluated based on comparisons of recent stock status indicators relative to results of the 2020 risk analysis, which estimates stock status during the *status quo* period (2017-2019). The status of skipjack is evaluated based on comparisons of recent stock status indicators relative to results of the 2022 *interim* stock assessment.

1.1.2. Rationale for staff recommendations

The technical rationale underlying the staff's recommendations for the conservation of tropical tunas in 2023 is summarized below.

1.1.2.a Stock status: the *status quo* conditions (2017-2019)

In 2020, the staff conducted new benchmark assessments for bigeye and yellowfin (SAC-11-06, SAC-11-07). These assessments represent a fundamental change from the staff's previous 'best assessment' approach: they are the basis for a 'risk analysis' (SAC-11-08), using the methods described in SAC-11 INF-F, in which a variety of reference models are used to represent plausible alternative assumptions about the biology of the fish, the productivity of the stocks, and/or the operation of the fisheries, thus effectively incorporating assessment uncertainty into the management advice as it is formulated.

The results below summarize the stock status for the tropical tunas (yellowfin, bigeye and skipjack) at the start of 2020. The reported status of the stocks is associated with the average fishing mortality conditions for the tropical tuna in the EPO during 2017-2019 (the *status quo* period).

Yellowfin and bigeye: The overall results of the 2020 risk analysis, expressed in terms of the probabilities of exceeding the reference points specified in the harvest control rule (HCR) under Resolution C-16-02, are presented in **Table A**.

Table A. Stock status[2] of yellowfin, bigeye, and skipjack tunas, expressed in terms of the probabilities of exceeding the reference points specified in the HCR.

[2] Defined as the spawning biomass (S) at the start of 2020 or the average fishing mortality (F) during 2017-2019 estimated by the 2020 assessments.

	Probability (%) of exceeding RP		
Target RP	**Yellowfin**	**Bigeye**	**Skipjack[3]**
$F_{cur}>F_{MSY}$	9	50	<50
$S_{cur}<S_{MSY}$	12	53	<53
Limit RP			
$F_{cur}>F_{LIMIT}$	0	5	<5
$S_{cur}<S_{LIMIT}$	0	6	<6

For **yellowfin**, the overall results of the risk analysis, which include all 48 reference models, indicate only a 9% probability that the fishing mortality corresponding to the maximum sustainable yield (F_{MSY}) has been exceeded[4] (**Figure 1a**). There is a 12% probability that the spawning stock biomass corresponding to the maximum sustainable yield (S_{MSY}) has been breached. The probability that the F and S limit reference points have been exceeded is zero.

For **bigeye**, the overall results of the risk analysis, which include 44[5] reference models, indicate a 50% probability that F_{MSY} has been exceeded and a 53% probability that S_{cur} is below S_{MSY} (**Figure 1b**). Although resolution C-16-02 does not specify the acceptable level of probability of exceeding the target reference points, these probabilities are at about a reasonable arbitrary reference level of 50%, considering that, at F_{MSY}, S will fluctuate around the target reference point (S_{MSY}) due to interannual recruitment fluctuations. F will also fluctuate around the target reference point (F_{MSY}) under the days of closure management due to interannual fluctuations in catchability and distribution of purse-seine effort among set types. With respect to the limit reference points, the probabilities that the F and S limit reference points have been exceeded are not negligible ($P(F_{cur}>F_{LIMIT})$ = 5%; $P(S_{cur}<S_{LIMIT})$ = 6%), but they are below the 10% threshold for triggering an action specified in resolution C-16-02.

[3] A conventional stock assessment was not available for skipjack in 2020. Results inferred from PSA analysis indicate that the status of skipjack should be more optimistic than bigeye (see skipjack section below). Therefore, the probability of exceeding the reference points for skipjack should be lower than for bigeye.

[4] In this report, the terms "overfished" and "overfishing" are not used, because the Commission has not defined the threshold probabilities associated with those terms.

[5] Four of the 48 models did not converge for bigeye.

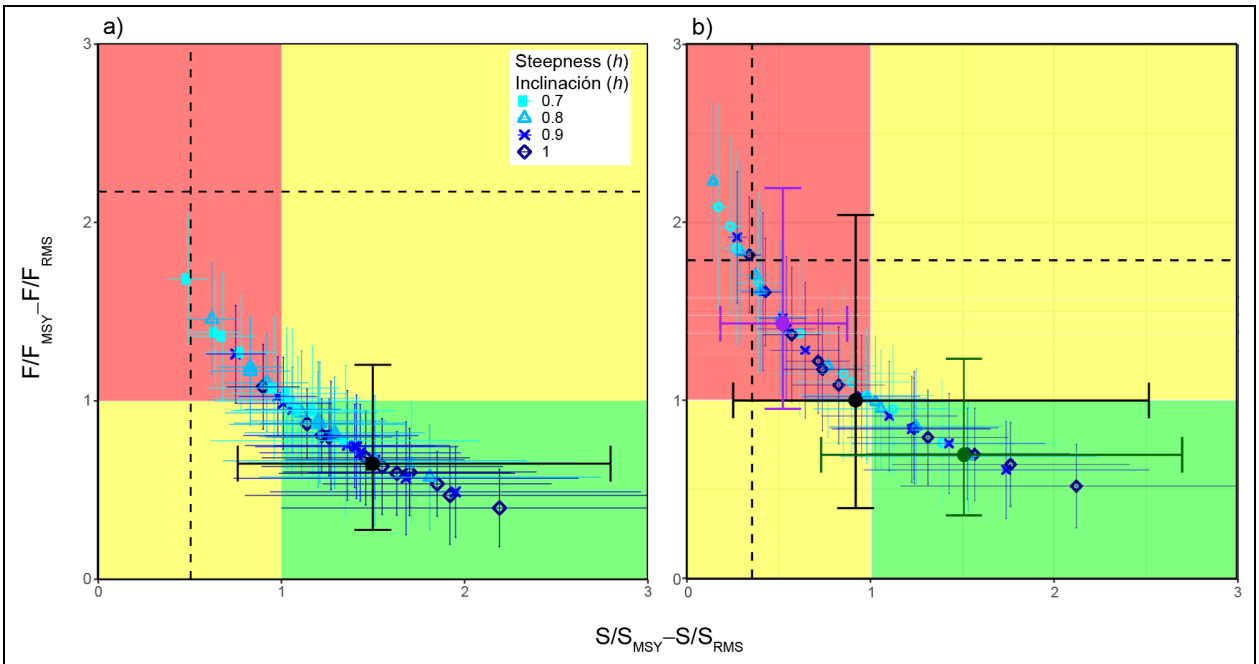

FIGURE 1. Kobe (phase) plot showing the current estimates of spawning stock size (S) and fishing mortality (F) of **(a) yellowfin** and **(b) bigeye tuna** relative to their MSY reference points. The colored panels are separated by the target reference points (S_{MSY} and F_{MSY}) and limit reference points (dashed lines). The center point for each model indicates the current stock status, based on the average fishing mortality (F) over the last three years. The solid black circle represents all models combined. For bigeye (b), the purple and green solid circles represent, respectively, the stock status for the 'pessimistic' and 'optimistic' states related to the bimodal pattern in the risk analysis (see section 1.1.2.c in SAC-12-16). The lines around each estimate represent its approximate 95% confidence interval.

Skipjack: The highly productive life-history of skipjack makes the development of any conventional stock assessment very challenging. This results from marked fluctuations in abundance along with uncertainty about the reliability of indices of abundance for skipjack. While no form of conventional assessment was available for skipjack in 2020, the IATTC staff relied on a Productivity and Susceptibility Analysis (PSA) rationale to make inferences about the stock status of skipjack. Through this PSA assessment rationale, since skipjack and bigeye have about the same susceptibility to the purse-seine gear in the EPO PSA (Duffy *et al*. 2019), and skipjack is the most productive of the two species, if bigeye is healthy skipjack can be inferred to be healthy. In 2020, the staff combined the PSA rationale with the quantitative elements of the risk analysis for tropical tuna in the EPO. This combined PSA-risk analysis assessment indicated that the skipjack stock status at the start of 2020, reflecting the stock status associated with *status quo* fishing mortality conditions (2017-2019), was healthy (**Table A**).

In 2022, an integrated statistical age-structured catch-at-length stock assessment was developed for skipjack tuna in the EPO using Stock Synthesis (SAC-13-07). The assessment is similar to those conduced for bigeye and yellowfin tuna and is fit to indices of relative abundance and length-composition data. Although the assessment is termed *interim* by the staff, the staff considers it reliable for management advice. The term *interim* results from additional improvements being expected on the skipjack assessment under the ongoing 2021-proposed methodology and workplan to develop a stock assessment for skipjack in the EPO that includes tagging data (SAC-12-06). There is substantial uncertainty about several model assumptions and sensitivity analyses were conducted and determined that the management advice is robust to the uncertainty.

MSY-based quantities cannot be estimated because the tradeoff between growth and natural mortality, in combination with the assumption that recruitment is independent of stock size, implies that fish should be

caught at the youngest ages to maximize yield, implying that the optimal fishing mortality should be infinite. Therefore, a conservative *proxy* for the target biomass of SBR[6] = 0.3 was proposed based on values for bigeye and yellowfin, and the fishing mortality corresponding to that biomass, are used as the target reference points. The reference model estimated that the 2021 exploitation rate was slightly above *status quo* (average level of 2017-2019) as did over half of the sensitivity models, which ranged from being only slightly above to being 10% higher (except one model that estimated high exploitation rates). The reference model and most of the sensitivity analyses estimate that the current biomass is above the target reference point and the fishing mortality is below the target fishing mortality (**Figure 2**).

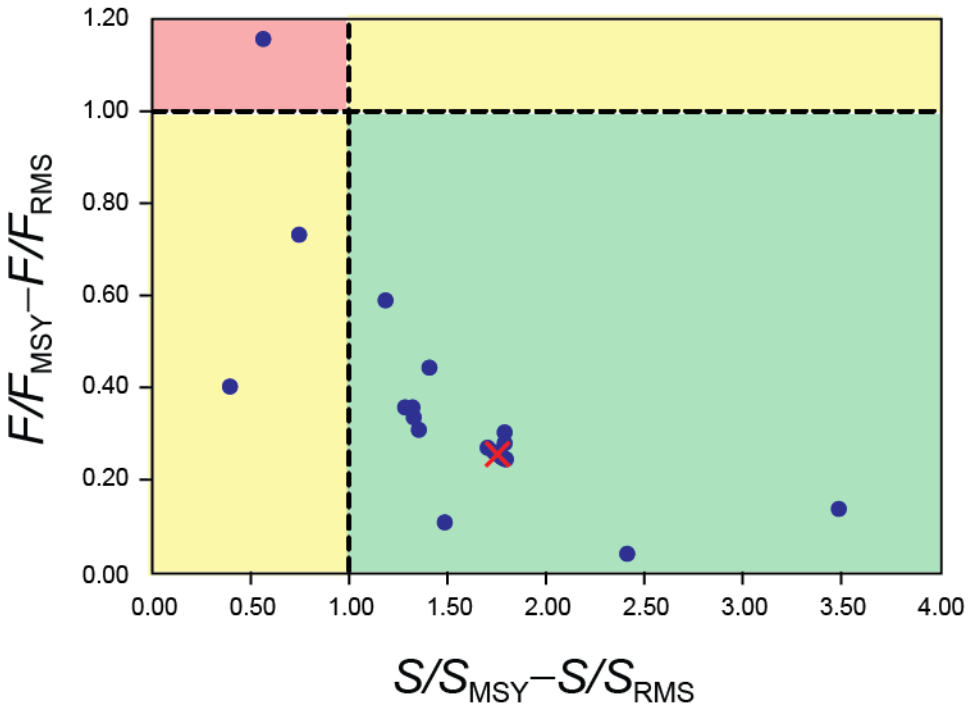

FIGURE 2. Kobe (phase) plot showing the current estimates of spawning stock size (S) and fishing mortality (F) of skipjack tuna relative to the proposed proxy MSY reference points. The cross represents the reference case (the model based on the assumptions that are considered most likely) and the circles represent the alternative models. The colored panels are separated by the target reference points (S_{MSY} and F_{MSY}). The point for each model indicates the current stock status, based on the average fishing mortality (F) over the last three years. More information on the reference points can be found in SAC-14-09.

1.1.2.b Current stock status and status relative to the *status quo* conditions of 2017-2019

In order to evaluate the current stock status of the tropical tunas in the EPO and status relative to the *status quo* conditions, in 2023 the staff is putting forward the following scientific work:

- The two 2020 **benchmark stock assessment reports**, for bigeye (SAC-11-06) and yellowfin (SAC-11-07), presenting the results from all reference models for each species (model fits, diagnostics, derived quantities and estimated parameters that define stock status in 2020);
- The 2020 **risk analysis** (SAC-11-08) specific for tropical tunas, using the methods described in SAC-11 INF-F, which assesses current stock status and quantifies the probability (risk) of exceeding target and limit reference points specified in the IATTC harvest control rule, as well as the expected consequences of alternative management measures in terms of closure days;

[6] Spawning biomass ratio: SBR; spawning biomass divided by the spawning biomass in the unfished state.

- **A 2022 stock assessment (*interim*) for skipjack in the EPO** (SAC-13-07);
- An update on the **investigation of potential bias** in the tropical tuna catch estimates caused by the COVID-19 pandemic (SAC-14 INF-D);
- **Stock status indicators** (SAC-14-04) for all three tropical tuna species (yellowfin, bigeye, and skipjack);
- The following **recommendations** by the staff for the conservation of tropical tunas which take into consideration all the above.

An important development from the implementation of C-21-04 is that the PSA rationale previously used by the staff to assess skipjack on an *interim* basis (see section 1.1.2.a) is no longer valid or needed. Since the additional measures established under C-21-04 were specifically designed to prevent the *status quo* conditions to be breached for bigeye (the species with the strictest need for stronger measures), these measures do not necessary prevent increased fishing mortality for the other two species, in particular skipjack. For example, the new per vessel catch threshold for bigeye catches could result in a change of fishing strategies by purse-seine vessels with increased fishing mortality for skipjack. Therefore, the stock status of skipjack can only be evaluated through a conventional stock assessment. In 2022, the staff has successfully developed a new stock assessment (*interim*) for skipjack as previously planned (IATTC-98 INF-F). Although the assessment is termed *interim* by the staff, the staff has considered it reliable for management advice (SAC-13-07). The term *interim* results from additional improvements being expected on the skipjack assessment under the ongoing 2021-proposed methodology and workplan to develop a stock assessment for skipjack in the EPO that includes tagging data (see Document SAC-12-06). Spatio-temporal modelling is used to analyze the recently available tagging data obtained by the IATTC multi-year Regional Tuna Tagging Program in the EPO (RTTP-EPO 2019-2020, Project E.4.a; SAC-14-07) and addresses the issues of incomplete mixing of the tagged fish. An update on the preliminary results of the spatio-temporal analysis will be presented at the 2023 SAC (SAC-14 INF-E), and the final benchmark assessment at the 2024 SAC. The inclusion of the information from the tagging data is expected to improve the assessment results. However, the staff believes that the *interim* assessment and the analyses to evaluate the robustness of the management advice to the model assumptions can be used for management advice for skipjack (SAC-13-07). A 1st external review of the IATTC staff's stock assessment of skipjack tuna in the EPO took place in October 2022. The review panel agreed that the basic stock assessment modeling approach was sound but had particular concerns about some aspects of the assessment. The staff will take into consideration the recommendations of the external review in the development of the 2024 benchmark assessment for skipjack.

As a response to the tasks assigned to the staff under paragraphs 10 and 35 of resolution C-21-04, the staff is concerned about the resumption of the general increasing trend in the number of floating-object sets. For the reasons specified below, the staff does not find any immediate need to recommend any modifications at least for the final year of application of Resolution C-21-04 in 2024. The effect of this increase on the status of the stocks will be evaluated in the 2024 benchmark assessments to be conducted for the three species of tropical tuna and that will serve as a reference and a basis for future recommendations on the measures to be adopted and applied in 2025 and beyond.

For the tropical tuna fishery in the EPO, in general:

1. The staff is particularly concerned about the resuming of the general increasing trend in the number of floating-object sets observed since 2005. 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, SAC-14-04), a number that exceeded the *status quo* level (~16,000 sets) by 11% (**Table B, Figure 3a**).
2. The 2020 and preliminary 2021 and 2022 data for total well volumes of purse-seine vessels show that the capacity of the purse-seine fleet operating in the EPO in these years was respectively 9%, 4% and 4% below the average capacity levels operating during the *status quo*

period (2017-2019) (SAC-14-03).

For bigeye:

3. The preliminary estimate for the bigeye catches on floating objects in 2022 is 46,487 tons, 30% below the *status quo* level of 65,937 tons. Therefore, there is no concern that the *status quo* catch level has been exceeded for bigeye in 2022 (**Table B, Figure 3b**). At this stage, the staff cannot determine if this decline is due to the expected reduction on the catches of bigeye from the establishment of the thresholds on individual purse-seine vessel annual catches that will trigger additional closure days under resolution C-21-04, adopted by the Commission for 2022-2024, or another factor such as weak bigeye recruitments recently entering the fishery. There is also concern about the continuing increase in number of floating-object sets as mentioned above. The 2024 benchmark stock assessment for bigeye will help better evaluate these recent trends.

For yellowfin:

4. There are no concerns with the stock status of yellowfin tuna. The risks of exceeding the established target and limit reference points under Resolution C-16-02 are extremely low.
5. The 2020 data for total well volumes of purse-seine vessels with DML show that fishing capacity for these vessels did not exceed the *status quo* levels. The preliminary 2021 and 2022 data show that fishing capacity for these vessels was at or exceeded the *status quo* levels by 8%, respectively.
6. The preliminary 2022 estimate of yellowfin catch on floating-object sets is 90,128 tons, 45% above the *status quo* level (**Table B**). 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 38.9% and 67.5% from 2021 to 2022, in bias adjusted weight and numbers, respectively; SAC-14-04). This trend should continue to be monitored with caution and further investigated in the 2024 yellowfin benchmark assessment.
7. In 2022, the number of sets on floating objects exceeded the *status quo* level by 11%. This resuming, as the effects of the COVID-19 pandemic diminish, of the general increasing trend in the number of sets in the floating-object fishery since 2005, combined with strong increase in the catches of yellowfin on floating objects (6), is a reason of concern and will be investigated by the staff as part of the 2024 yellowfin benchmark assessment.

For skipjack:

8. The preliminary 2022 estimate of skipjack catch on floating-object sets is 241,420 tons, 9% above the *status quo* level (**Table B**). The skipjack stock status indicators for other set types (dolphin and unassociated sets) show no consequential changes during 2020-2022 relative to the *status quo*.
9. A new stock assessment is available for skipjack tuna, which underwent external review and the staff considers reliable for use in management advice (SAC-13-07, WSSKJ-01). Despite the current fishing mortality is estimated to be higher than the *status quo*, the fishing mortality was estimated to be below the level corresponding to the target reference point in the 2022 assessment, and the target and limit biomass reference points had not been exceeded. In 2022, the number of sets on floating objects exceeded the *status quo* level by 11%, but a change of stock status is unlikely for skipjack. The stock status of skipjack will be revaluated with a benchmark stock assessment in 2024.

Table B. Purse-seine well volumes, in cubic meters, and estimated number of sets on floating objects during the *status quo* period (average for 2017-2019), and the years of 2020 - 2022. Two estimates for the retained catches (in metric tons) are also shown for each tropical tuna species in the years 2020 and 2021: the best scientific estimate (BSE; see Table A-7 of SAC-14-03) and the estimates adjusted for bias (BiasAdjst) due to the effect of the COVID-19 pandemic on the port sampling operations (see SAC-14 INF-D). The percent change of the yearly estimates relative to the *status quo* is shown at the bottom of the table.

Year	Capacity (m^3)	Sets OBJ	Catch OBJ (t)					
			Yellowfin		Skipjack		Bigeye	
			BSE	Bi-asAdjst	BSE	Bi-asAdjst	BSE	Bi-asAdjst
SQ (2017-2019)	263,923	15,998	62,050		221,474		65,937	
2020	241,331	12,151	44,461	53,924	191,399	190,243	78,208	69,901
2021	253,323	15,169	66,542	60,701	227,028	239,692	57,391	48,087
2022	253,071	17,699	90,128		241,420		46,487	
2020	-8.6	-24.0	-28.3	-13.1	-13.6	-14.1	18.6	6.0
2021	-4.0	-5.2	7.2	-2.2	2.5	8.2	-13.0	-27.1
2022	-4.1	10.6	45.2		9.0		-29.5	

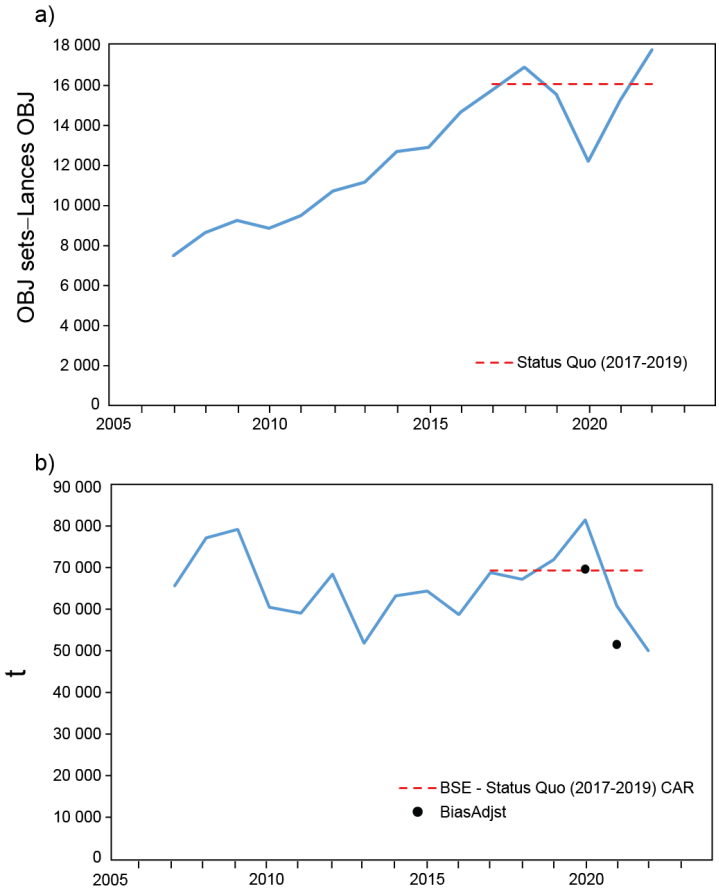

FIGURE 3. Number of sets on floating objects (a) and retained purse-seine catches for bigeye tuna (b, in metric tons). The *status quo* conditions (average in 2017-2019) are shown. Estimates for bigeye catches adjusted for bias (BiasAdjst) caused by the effect of the COVID-19 pandemic during 2020 and 2021 are shown (SAC-14 INF-D).

1.1.2.c Data improvements: enhanced species composition port-sampling program

Resolution C-21-04, adopted by the Commission at its 98th Meeting in 2021, contained new measures intended to address conservation concerns related to bigeye tuna, including the establishment of an annual, individual vessel threshold for catches of bigeye by purse-seine vessels, which if exceeded, triggers additional closure days for a vessel. To help monitor vessel catches relative to this threshold, the Resolution created an Enhanced Monitoring Program (EMP), which included a pilot study to develop and test port-

sampling protocols for the estimation of trip-level bigeye catch. The pilot study, which was conducted in the ports of Manta and Posorja, Ecuador, during September 2022 – February 2023, led to the development of a sampling design that is being implemented by the EMP, which began in March 2023. Preliminary results from the pilot study can be found in SAC-14-10 and SAC-14 INF-I. Among the key results of the pilot study is the indication that the estimates of trip-level bigeye tuna catch produced by the EMP should be more reliable, overall, than estimates from other data sources, highlighting the importance of the EMP in supporting the measures established in Resolution C-21-04. Moreover, the EMP estimates are the only estimates for which a measure of precision can be computed directly from available data. The EMP work-plan for the remainder of 2023, which is outlined in the documents mentioned above, includes a plan to produce Best Scientific Estimates (BSEs) of bigeye tuna catch of trips sampled by the EMP, and to continue to improve the sampling designs and their implementation. The collaboration of the vessel crew and unloaders will continue to be of upmost importance for the proper implementation of the EMP sampling protocol. Details of the EMP sampling protocol can be found in SAC-14-10 and SAC-14 INF-I.

1.1.3. Management advice

Based on the rationale presented above, in 2023 the staff makes the following recommendations for the conservation of tropical tunas:

RECOMMENDATIONS:

1. Maintain the provisions of the current resolution (C-21-04).
2. Continue the Enhanced Monitoring Program (EMP) for bigeye catches (see SAC-14-10 and SAC-14 INF-I for details) by:
   a. Securing funding for the continuation of the EMP operations in 2024.
   b. Continuing to assist the staff in the implementation of the EMP, including the refinement of sampling protocols for cargo net unloadings.

1.1.4. Future research

Future research should focus on: a) continuing to improve the risk analysis and the stock assessment models for bigeye and yellowfin, which also involves improvements of their data inputs, b) continue to improve the assessment for skipjack tuna based on recently collected tagging data, and c) evaluate management strategies for robustness to the main uncertainties, including the bigeye bimodality (MSE process).

1.1.4.a Improving the risk analysis and the stock assessment models

Matters that require further investigation and/or improvement include the bimodal pattern in the risk analysis of bigeye, more objective and transparent scoring in the risk analysis, continuation of the collaborative work to improve the longline indices of abundance, the ability to estimate yellowfin absolute abundance, the two-stock hypothesis for yellowfin, estimates of growth, selectivity, and natural mortality through tagging data, and a stronger involvement of industry stakeholders in the tagging program (*e.g.* facilitating access to tagging operations in offshore areas, aggregations on FADs, etc.). Implementation of Close-Kin Mark-Recapture should be evaluated as a way of resolving uncertainties in the stock assessments and be implemented as soon as practical, if appropriate.

Substantial knowledge has or will become available before the 2024 benchmark assessments. An independent review of the skipjack tuna stock assessment was conducted in 2022 and reviews of the yellowfin and bigeye tuna stock assessments will be conducted in 2023. The CAPAM workshop series, of which the IATTC has been the driving force, has had two recent workshops summarizing the accumulated advice on good practices for stock assessment modelling, one on stock assessments in general and one specific to tunas. The staff participated in review panels of tuna stock assessments from other RFMOs, when shared issues were addressed. This knowledge, in addition to the research specific to tropical tunas in the EPO, will be incorporated into the 2024 benchmark assessments.

1.1.4.b Integrate information from the tagging into the interim stock assessment

The *interim* stock assessment developed for skipjack tuna successfully estimated the status of the skipjack stock in the EPO. However, the *interim* stock assessment does not make full use of the available tagging data. These data are currently being analyzed as outlined in SAC-12-06 and will be used in 2023 to improve the assessment (SAC-14 INF-E). The exact details of the analysis and how the tagging information will be used in the assessment is part of the ongoing research.

1.1.4.c Management Strategy Evaluation

The staff acknowledges that there may always be unresolved issues in knowledge, and inherent limits of modelling complex and changing natural systems and their fisheries, which may impact the scientific advice for taking appropriate management actions. Management Strategy Evaluation (MSE) is a process that uses computer simulations to test the robustness of alternative management strategies (designed using stakeholder's input) to different sources of uncertainty. The MSE for tropical tunas is focusing on including additional sources of uncertainty (implementation uncertainty, management/institutional uncertainty, sampling uncertainty, projection uncertainty) to those included currently on the assessments. It is also, refining elements of the current strategy (e.g. specifying the harvest control rule, HCR), along with alternative ones (with different reference points and/or ways of estimating them), and devising performance metrics, with the goal of evaluating the robustness of the management advice and the likelihood of alternative strategies achieving desired management objectives. The models developed in the risk analysis are being used to develop operating (simulation) models for MSE. HCRs based on simpler models or empirical indicators that rely on trends in data, will be included in the MSE as an alternative or complement to the recent model-based approaches while both data and stock assessments are improved. An MSE workplan for tropical tunas (SAC 14 INF-F) is ongoing at IATTC (see recent Workshops), with an initial focus on bigeye and moving to the other tropical tuna towards the end of the current plan, in 2024 (funding is available until the end of 2023; funding for 2024 and beyond has not been secured yet).

RECOMMENDATIONS:

In collaboration with CPCs and relevant stakeholders:

1. Conduct independent reviews of the bigeye and yellowfin tuna assessments.
2. Continue improving stock assessments and risk analysis for tropical tunas.
3. Continue improving the stock assessment for skipjack, particularly making use of the recently collected tagging data following SAC-12-08 and integrate the recommendations from the external review (WSSKJ-01-RPT).
4. Continue the support and secure funding for the tropical tuna MSE for 2024 and beyond, following guidelines from C-16-02 and C-19-07.

1.2. Pacific bluefin tuna

The Pacific bluefin tuna working group of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) completed an update assessment of the species in 2022. The 2020 SSB was above the initial rebuilding target. While it is still below the second rebuilding target adopted by the WCPFC and IATTC, the stock recovery is faster than scheduled.

Resolution C-21-05 establishes management of Pacific bluefin tuna in the EPO for the period 2021-2024 defining total commercial catches and biennial catch limits for each CPC. No changes are needed to the provisions under Resolution C-21-05 for conservation and management of the stock.

The assessment includes several catch scenarios, with different increases in catch and different distributions of the catch between small and large fish. Catching larger fish increases the total catch in weight for a given level of rebuilding. Under all examined catch scenarios, the second rebuilding target will be met by 2029. If one of the alternative scenarios is chosen as the basis for future catch limits, the choice should take into account both

the desired rebuilding rate and the distribution of catch between small and large bluefin.

RECOMMENDATIONS:

1. No changes are needed to the provisions under Resolution C-21-05.
2. Increased catches based on the scenarios analyzed are possible under the harvest strategy prepared by the joint tRFMO working group. The choice of catch scenario should take into account the desired rebuilding rate and the distribution of catch between small and large bluefin.

1.3. North Pacific albacore tuna

The North Pacific albacore tuna is assessed routinely by the Albacore Working Group (ALBWG) of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The ALBWG is in the final stage of completing the 2023 benchmark stock assessment. The preliminary results indicate that:

1. The spawning biomass in 2021 (54% of $SSB_{current, F=0}$[7]) was higher than the threshold and limit reference points (30% $SSB_{current, F=0}$ and 14% $SSB_{current, F=0}$, respectively).
2. The average fishing mortality during 2018-2020 ($F_{59\%SPR}$; the fishing intensity that results in the stock producing a SPR[8] of 59%) was below the target reference point ($F_{45\%SPR}$; the fishing intensity that results in the stock producing a SPR of 45%).
3. The Working Group concluded that the north Pacific albacore stock is likely not overfished relative to the threshold and limit reference points adopted by the WCPFC and IATTC, and is likely not experiencing overfishing relative to the target reference point.

The Working Group has finished the Management Strategy Evaluation (MSE) for the North Pacific albacore stock. The first round of the MSE was reported in March 2019 (ISC/19/ANNEX/06), and a second round was completed during 2020 and the final report was finalized in 2021 (ISC/21/ANNEX/11). The MSE process included input from managers and stakeholders and extensive simulation work. Candidate harvest control rules (HCRs) were suggested by managers and stakeholders. All HRCs are model-based and include target, limit, and threshold reference points, which are computed using dynamic quantities (i.e., they take into consideration temporal variation in selectivity and recruitment, thus are based on recent years' estimates). Based on the estimated status of the stock, the HRC specifies whether a management action to control fishing is needed. The management actions tested were mixed control or Total Allowable Catch (TAC). Under mixed control, surface fisheries (EPO troll and pole-and-line, and Japanese pole-and-line) are managed via effort control, while longline fisheries are managed via a TAC. During 2021, several regional workshops took place to present and discuss the results of the MSE to stakeholders.

In 2022, the Commission adopted the objectives, the target, threshold, and limit reference points, the acceptable level of risk of breaching the limit reference point and the monitoring method for the stock (IATTC Resolution C-22-04). Also, under that resolution, the Commission is expected to adopt a harvest control rule with those elements in 2023. The overarching objective is to ensure the sustainability of North Pacific albacore tuna stock and current fisheries supported by the stock in the EPO. To reach the overarching objective, the following management objectives were established (C-22-04):

1. Maintain Spawning Stock Biomass (SSB) above the Limit Reference Point, with a probability of at least 80% over the next 10 years.
2. Maintain depletion of total biomass around historical (2006-2015) average depletion over the next 10 years.

[7] Dynamic spawning biomass in 2021 under no fishing.

[8] Spawning potential ratio is the female spawning stock biomass per recruit (resulting from a fishing mortality pattern) relative to the female spawning biomass per recruit in the unfished population. The fishing intensity can be measured as 1-SPR.

3. Maintain fishing intensity (*F*) at or below the target reference point with a probability of at least 50% over the next 10 years.
4. To the extent practicable, management changes (e.g., catch and/or effort) should be relatively gradual between years.

The reference points adopted are:

1. Target reference point (TRP) of $F_{45\%SPR}$, which is the fishing intensity level that results in the stock producing 45% SPR.
2. Threshold reference point (ThRP, $SSB_{threshold}$) of $30\%SSB_{current,F=0}$, which is 30% of the dynamic unfished spawning stock biomass.
3. Limit reference point (LRP) of $14\%SSB_{current,F=0,}$ which is 14% of the dynamic unfished spawning stock biomass. The acceptable level of risk of breaching the LRP based on the most current estimate of SSB shall be no greater than 20%. The resolution further stated that if the LRP is breached, a rebuilding plan should be adopted.

During the MSE process, sixteen HCRs were tested under several scenarios ranging from low to high productivity of the stock. Of those, six had the same LRP as the recently adopted one ($F_{14\%SPR}$), two of those had TRP of $F_{40\%SPR}$ and four had $F_{50\%SPR}$. HCRs with TRP of $F_{40\%SPR}$ were only combined with $SSB_{threshold}$ of 20% (**Table C**). The performance of the HCRs was measured through indicators consisting of quantitative representations of management objectives. Similarly to the tested HCRs, the one to be adopted should have provision for decreasing the fishing intensity as soon as the stock is at the ThRP, in a linear form related to the SSB/SSB0 (see Figure 1 in C-22-04). Unlike the tested HCRs, which maintain a constant low *F*, the action to be taken if the LRP is breached shall be specified in a rebuilding plan. Although none of the HCR tested had all the elements adopted in C-22-04 (**Figure 4**), the MSE results for HCRs with LRP of $F_{14\%SPR}$ may be useful as a guide for the decision on the final HCR; the results are summarized in **Table D**.

TABLE C. Harvest control rules (HCRs) tested in the MSE process that have a Limit Reference Point (LRP) equal to the adopted one (C-22-04) of 14% of the unfished Spawning Stock Biomass (SSB). A TRP of *F*50 would result in the SSB fluctuating around 50% of unfished SSB. The threshold reference point, $SSB_{threshold}$, also refers to the specified percentage of unfished SSB. The unfished SSB is dynamic and fluctuates depending on changes in recruitment. The fraction used to calculate total allowable catch (TACmin) or total allowable effort (TAEmin) refers to the fraction of the catch or *F* associated with the LRP.

HCR	Target reference point (TRP)	Threshold reference point ($SSB_{threshold}$)	Limit reference point (LRP)	Prob SSB > LRP	Fraction used to calculate TACmin or TAEmin
2	F50	30%	14%	0.9	0.25
4	F50	20%	14%	0.9	0.25
6	F40	20%	14%	0.9	0.25
10	F50	30%	14%	0.9	0.5
12	F50	20%	14%	0.9	0.5
14	F40	20%	14%	0.9	0.5

Source: Table ES2 in ISC/21/ANNEX/11.

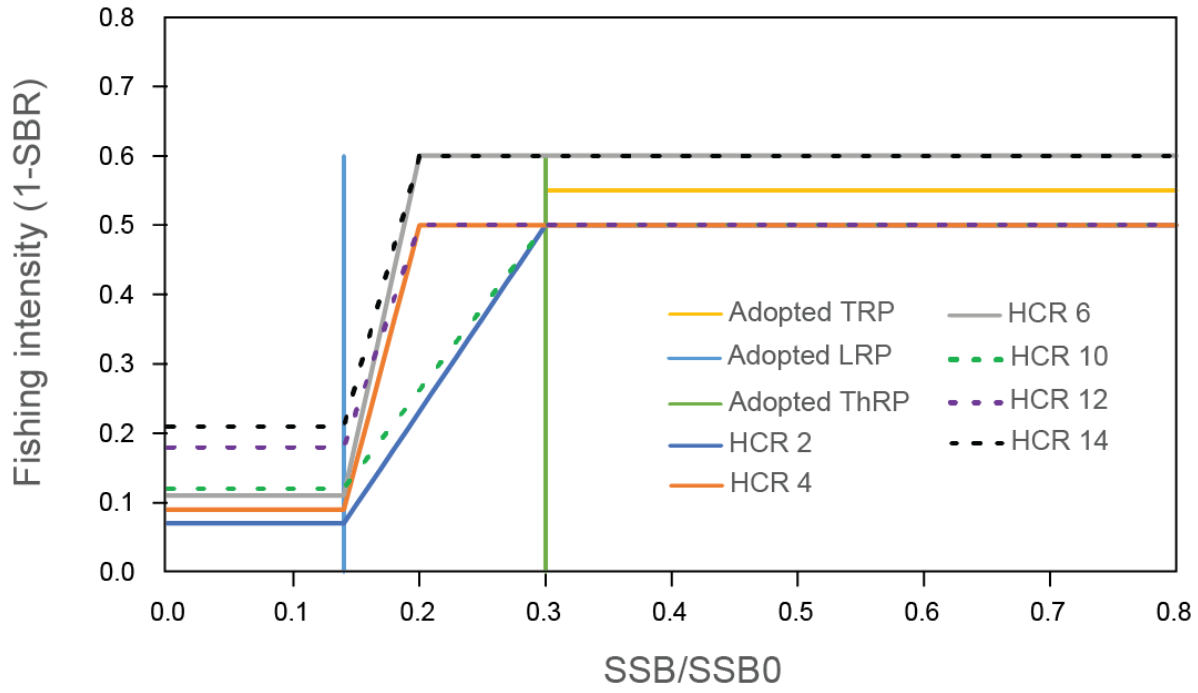

FIGURE 4. Harvest control rules tested in the Management Strategy Evaluation for the North Pacific albacore tuna stock that have limit reference points (LRP) equal to the adopted LRP (14%SSB0, dashed blue line, C-22-04) and indication of the adopted target (TRP) and threshold (ThRP) reference points. The continuous lines indicate the TRP for the tested HCR (at 0.6 or F40%SSB and 0.5 or F50%SSB). When the ThRP is breached (at 20%SSB0 or 30%SSB0 depending on the HCR), management action is triggered to decrease fishing intensity to avoid further declines in the population that could result in breaching the LRP. In the tested HCRs, the fishing intensity declines linearly from TRP to a minimum level, at the LRP. This level is maintained even if the stock decreases below the LRP. In the adopted elements for a HCR in C-22-04, a rebuilding plan should be implemented if the LRP is breached.

The six HCRs with LRP of 14%SSB0 tested in the MSE process had good performance (**Table D**). All were

almost certain to maintain the population above the adopted LRP as well as above equilibrium 7.7%SSB0, the IATTC LRP for tropical tunas. The main difference in the performance among those HCR is in the odds of no management change. HCR 2 and 10 had the lowest odds, i.e., management interventions are more frequent when the threshold reference point 30%SSB0 and the TRP is F50%. That is also the case for other HCRs where the LRP and ThRP are closer to the SSB associated with TRP (HCR 6 and 14).

TABLE D. Performance of indicators (under mixed control for the low productivity scenario) by management objective for harvest control rules that assume LRP of 14%SPR and were tested in the MSE process. Colors represent odds categories and associated risk levels as defined in the legend. The Ftarget/F indicator does not represent odds and so can be greater than 1. The LRP and ThRP are based on Spawning Stock Biomass (SSB) and refer to the specified fraction of unfished SSB (SSB0). Unless specified as equilibrium SSB0, the unfished SSB is dynamic and fluctuates depending on changes in recruitment. See Table S1 in ISC/21/ANNEX/11 for a detailed definition of performance indicators.

	Harvest control rule #	**2**	**4**	**6**	**10**	**12**	**14**
	Target reference point	F50%	F50%	F40%	F50%	F50%	F40%
	Threshold reference point (SSB/SS_0)	0.3	0.2	0.2	0.3	0.2	0.2
Management Objective	Performance indicator						
(1) Maintain Spawning Stock Biomass (SSB) above the Limit Reference Point, with a probability of at least 80% over the next 10 years	Odds SSB> LRP	0.97	0.97	0.91	0.97	0.97	0.91
	Odds SSB> equilibrium7.7%SSB0	0.99	1	0.98	0.99	1	0.98
(2) Maintain depletion of total biomass around historical (2006-2015) average depletion over the next 10 years;	Odds depletion[9] > Minimum Historical	0.82	0.82	0.77	0.82	0.82	0.77
(3) Maintain fishing intensity (F) at or below the target reference point with a probability of at least 50% over the next 10 year	Odds mean long term catch > historical catch	0.57	0.56	0.76	0.57	0.56	0.75
	Ftarget/F	0.77	0.77	0.82	0.77	0.77	0.82
(4) To the extent practicable, management changes (e.g., catch and/or effort) should be relatively gradual between years	Catch stability	1	1	0.99	1	1	1
	Odds no management change[10]	0.57	0.9	0.74	0.58	0.9	0.74

Odds
Almost certain 0.9 to <1
Highly likely 0.8 to 0.89
Likely 0.7 to 0.79
Better than even 0.6 to 0.69
Even 0.4 to 0.59

Source: modified from Table 10 in ISC/21/ANNEX/11

In the spirit of the MSE process in which the choice of an HCR is a product of the dialogue process among stakeholders, the staff is not recommending a particular HCR. The staff, however, notes that while all HCRs maintain the stock above undesirable levels, the HCRs with mixed control do so with higher probability, are more robust under low productive regimes and maintain a less variable stock biomass (ISC/21/ANNEX/11). In addition, current management measures in the IATTC for tropical tunas are based on mixed controls: effort control (temporal closures) for the purse-seine fleet and catch limits for the longline fleet, with the recent introduction of annual catch thresholds for bigeye caught in the purse-seine fleet.

The current conservation and management measures for North Pacific albacore (IATTC Resolutions C-05-02, C-13-03 and C-18-03; also WCPFC CMM 2005-03) are based on maintaining the fishing effort below the 2002-

[9] Depletion is defined as total biomass/total biomass in an unfished condition

[10] It is considered that there will be no management action if $SSB>SSB_{Threshold}$

2004 levels. The effort levels in the EPO for 2018-2020 are 63% and 65% of those in 2002-2004, for vessel-days and number of vessels, respectively (IATTC-100-01).

Given the relative stability in the biomass and fishing mortality in recent years, the staff considers that the current resolutions should be continued until a HCR is adopted by the Commission. The staff recommends that CPCs use the results of the concluded MSE process to choose a suitable HCR given the trade-offs among catches, frequency of management interventions and avoidance of undesirable stock levels.

RECOMMENDATIONS:

Given that the preliminary results of the 2023 benchmark assessment for north Pacific Albacore suggest that the stock is likely not overfished relative to the threshold and limit reference points, and is likely not experiencing overfishing relative to the target reference point, the staff recommends that:

1. CPCs should continue to implement Resolutions C-05-02, C-13-03, C-18-03, presently in force, until a harvest control rule (HCR) is adopted.
2. CPCs should adopt a HCR for North Pacific albacore tuna based on the results of the MSE.

2. NON-TARGET SPECIES

3.1. Silky sharks

The indices for large silky sharks, based on data from the purse-seine fishery on floating objects, have been updated through 2022 for the north and south EPO (**Figure 5**). Previous analyses (SAC-08-08a(i), Lennert-Cody et al., 2019) identified a correlation between north EPO indices, particularly those for small and medium silky sharks, and interannual variability in oceanographic conditions, and thus the indices for those size categories, and for all silky sharks, were not updated because of concerns about bias. Because of recent increases in the live release of silky sharks, two sets of indices for large silky sharks were computed, one including live release data and the other not. Taken together, the two sets of indices likely bracket the trend that would have resulted in both the north and south EPO if "finning"[11], shark handling, and data recording practices had continued unchanged since 1994. The real trend is considered to be closer to the index based on dead + live releases because sharks recorded as released alive in recent years would probably have been recorded as dead previously, and thus the dead + live release is likely a more consistent indicator. The terminal point of these indices suggests a relatively stable abundance level for over a decade, with the 2022 values similar to (south), or slightly above (north), the 2021 value, and thus no changes to management measures are recommended (**Figure 5**). However, the stock status is uncertain, and an assessment has not been possible due to the paucity of data, especially for the longline fleets of the EPO coastal nations, which are believed to have the greatest impact on the stock (SAC-05 INF-F, SAC-14 INF-L). Insufficient data for stock assessment is also a common problem for almost all shark species with which EPO fisheries interact. Therefore, in 2022 the staff used the ecological risk assessment method EASI-Fish to conduct the first comprehensive quantitative vulnerability assessment for 32 shark species caught in industrial and artisanal fisheries in the EPO (SAC-13-11). The assessment showed silky shark to be classified as "most vulnerable", having the second highest vulnerable rank among the 32 shark species assessed. In 2023, a focused EASI-Fish assessment was undertaken on silky shark and three hammerhead shark species to explore the potential efficacy of hypothetical conservation and management measures (CMM) (SAC-14-12), such as EPO-wide closures, and prohibition of the use of wire leaders. The assessment showed that the majority of measures reduced the vulnerability of silky sharks but no single CMM, or combined use of up to four CMMs in concert, resulted in silky shark being classified as "least vulnerable". As a result of handicapped stock assessment attempts and EASI-Fish outcomes, the staff has made recommendations for data collection as part of its work plan for addressing the stock assessments of sharks (see Section 4.1).

[11] Cutting the fins off sharks and discarding the carcass.

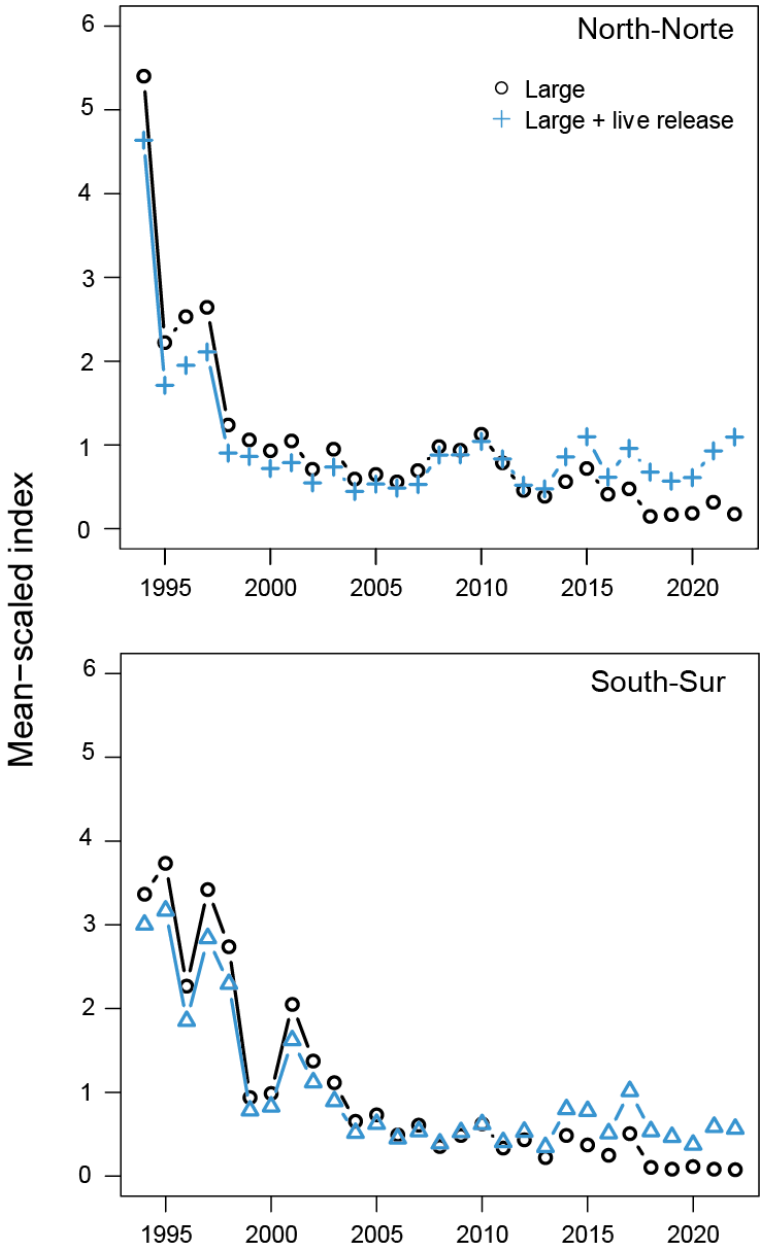

FIGURE 5. Mean-scaled standardized bycatch-per-set (BPS; in numbers of sharks per set) of large silky sharks in sets on floating objects, with and without live release, in the north (top) and south (bottom) EPO.

Paragraph 7 of Resolution C-21-06, which extends Resolution C-19-05 for another biennial period (2022-2023), requires CPCs to implement a three-month prohibition on the use of steel leaders in certain longline fisheries, and paragraph 8 requires the IATTC staff to present, at the SAC meeting in 2023, an analysis of the available data, including the shark fishery sampling program in Central America, with recommendations for improvement of the resolution, including adjustment of the prohibition period in paragraph 7. Resolution C-21-06 also directs the staff to consider the efficacy of the limits established by the resolution and if necessary, recommend revisions. However, the improved species-level catch and composition data required for this analysis are not yet available, so it remains a challenge for the staff to evaluate the efficacy of the limits.

Such persisting data limitations, among others, which apply to both target and non-target species, motivated the staff to review current Resolutions pertaining to data provision that underpin all of its research, in particular, the Resolution on data provision, C-03-05. To this end, the staff has prepared Document SAC-12-

09 (see Section 3) with the overarching goal of creating a revised Resolution C-03-05, which will improve the scope and quality of data provided for science, conservation and management, of both target and non-target species. As a result of this work, the staff proposed a recommendation to the SAC to hold a series of workshops, by gear type, on data provision (SAC-12-16 see Section B.3. "General Data Provisions"). This recommendation was endorsed by the SAC and the first data improvement workshop was organized in January 2023, addressing the industrial longline fishery. A background document (WSDAT-01-01) and workshop report (WSDAT-01-RPT) were produced. Recommendations from this workshop are included in Section 3 of this document.

As part of additional steps taken by the staff to address data limitations, significant progress has been made in recent years in developing the foundations for a sampling program for shark fisheries in Central America (see Section B.4.1, SAC-11-13, SAC-14 INF-L). Made possible through recent funds provided by the European Union, the sampling program in Central America has reached its completion in December 2021. The results supported a proposal that was presented at the 2021 98th Meeting (resumed) meeting of the Commission to establish a long term sampling program in Central America (IATTC-98-02c). Unfortunately, the necessary funds to implement the program are not available yet. If the sampling design of the current sampling program is expanded to other regions in the EPO (*e.g.,* South America, Mexico), both data collection and stock assessments for sharks in the EPO should improve. Very recently, resources to expand the Central American shark data collection improvements into other EPO coastal nations have been made available under a second part of the ABNJ project (SAC-14 INF-M).

The management of silky sharks is hindered by the lack of a reliable stock assessment due to the absence of reliable time series of data typically used in stock assessment (catch, CPUE, and sex/size composition). Management of silky sharks could therefore be greatly improved by implementing a close-kin mark-recapture study that would provide estimates of absolute adult abundance and adult natural mortality (SAC-12-14, SAC-14 INF-M). Until a reliable stock assessment can be undertaken, the staff plans to keep using data-limited assessment methods, such as EASI-Fish, to explore the potential efficacy of CMMs to guide managers in the intervening period (*e.g.,* CMMs specified under Resolution C-21-06) (SAC-14-12).

RECOMMENDATIONS:

Considering the recent improvements in shark fishery data collection in Central America (SAC-14 INF-L), as well as the upcoming opportunity to expand of these data collection improvement efforts into other coastal states (SAC-14 INF-M):

CPCs should enhance compliance with the following provisions of Resolution C-21-06 (to be extended in the new resolution):

1. Paragraph 7, prohibiting the use of steel leaders during a period of three consecutive months of each year for the relevant portions of their national fleets.
2. Paragraphs 11 and 12, which require notifying the Commission of the period of the prohibition, the number of vessels subject to the prohibition, and how compliance with the prohibition will be monitored.

Considering the potential benefits of Close-Kin Mark-Recapture:

3. Fund a workplan for Close-Kin Mark-Recapture starting with Project H.7.e: Feasibility and sampling design for close-kin mark-recapture analysis of stocks in the EPO.

3.2. Seabirds

Resolution C-11-02 should be revised to be consistent with the current state of knowledge regarding seabird mitigation techniques, as described in document SAC-08-INF-D. The two-column menu approach in C-11-02 should be replaced by a requirement to use at least two of three mitigation methods (line weighting, night setting, and bird-scaring lines) in combination, in a way that will meet the minimum standards recommended by ACAP and BirdLife International. Other mitigation methods should not be approved until their effectiveness is proven. Following Resolution C-19-04, the IATTC organized a workshop to discuss the minimum hook size that would reduce sea turtle mortality. The workshop also addressed the ecosystem-level concerns and potential trade-offs regarding the expanded use of circle hooks in longline fisheries and discussed the potential impacts of gear types on various taxa, including seabirds. However, the data are inconclusive to comment on any conservation value of circle hooks over other hook shapes or sizes to seabirds given a lack of empirical studies (WSHKS-01).

RECOMMENDATION:

Revise Resolution C-11-02 consistent with the current state of knowledge regarding seabird interactions and mitigation techniques (see Annex 1, EB-01-01).

3.3. Sea turtles

A revised resolution on sea turtles (C-19-04) entered into force on 1 January 2021 requiring EPO tuna fisheries to implement various measures designed to reduce the bycatch of sea turtles, in particular the use of circle hooks and finfish baits in shallow longline sets. The low encounter rates of sea turtles by fishing vessels make these 'rare event' data difficult to analyze using conventional approaches for assessing the status of sea turtle populations. Therefore, a collaborative research project (BYC-11-01) between the IATTC, the Inter-American Convention on the Protection and Conservation of Sea Turtles (IAC), and international sea turtle experts employed the EASI-Fish approach as an alternative means to assess vulnerability status and to simulate conservation and management measures (CMMs) that may mitigate fishery-imposed risks to the critically endangered East Pacific population of leatherback sea turtle. This project was extended in 2021-2022 with several model improvements (*e.g.,* a new species distribution model and updated fishing effort data for artisanal fisheries) (BYC-11-02). Proxies for fishing mortality ($\tilde{F}_{2019}$) and the breeding stock biomass per recruit (BSR_{2019}) exceeded precautionary biological reference points ($F_{80\%}$ and $BSR_{80\%}$), classifying the EP leatherback turtle stock as "most vulnerable" in the reference year (2019). Of the 70 CMM scenarios, use of circle hooks, finfish bait, and to a lesser extent best handling and release practices were each predicted to decrease vulnerability when examined individually, by far the most effective scenarios involved using these three measures in concert, followed by using circle hooks with either finfish bait or best practices.

RECOMMENDATION:

Revise Resolution C-19-04 consistent with the simulated efficacy of CMMs assessed in BYC-11-02.

3.4. Handling and release practices of vulnerable species

Concerns about the incidental capture (*i.e*., bycatch) of vulnerable marine species, including marine mammals, seabirds, sea turtles, and elasmobranchs, have resulted in increased efforts to develop conservation and management measures. These measures often require that no retention takes place and that the best handling and release practices (BHRP) are employed to reduce the impacts of fishing on these populations. However, developing safe and effective BHRP guidelines is often a complex and iterative process that involves understanding fishery characteristics, handling and discard methods, and post-release survival rates.

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.

A series of planned activities and research priorities have been identified by the IATTC staff for the next steps in the development of BHRPs in EB-01-01. The following are IATTC staff recommendations with regards the development of BHRPs:

RECOMMENDATIONS:

Several IATTC Resolutions call for CPCs to encourage their fishers to release vulnerable species in a manner that minimizes harm. Therefore:

1. 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.

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:

2. 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.
3. A small *ad-hoc* group of experts be established to begin drafting BHRPs for vulnerable species captured in IATTC 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:

4. 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.

3.5. Shark fins attached

The IATTC Resolution C-05-03, specifically paragraph 4, states that CPCs must ensure that their vessels carry onboard shark fins weighing no more than 5% of the weight of sharks onboard, up to the first point of landing. However, after 18 years, the implementation of this standard has been a source of concern. For example, the scientific merit of the 5% rule was evaluated in Document SAR-07-09, which found that the fin-to-dressed weight (DW) ratio varied significantly by species, ranging from 6.25% for short-fin mako to 16.05% for silky shark. The problematic nature of this variation is further exacerbated by the fact that C-05-03 does not specify whether the measure is to be calculated as the ratio of fins to whole weight, dressed

weight, or whether the fin weight is in relation to fresh or dried fins. Additionally, the measure does not account for variations in how fleets cut fins and which ones are retained and counted in the weighing process. Dried or drying fins are often stored separately from the frozen carcasses, making it diifcult to match sets of fins with corresponding carcasses at the point of first landing. These circumstances have led the IATTC staff to seriously question whether the fin-to-carcass ratio is effective in prohibiting shark finning and detecting instances where finning prohibitions may have been violated, ultimately undermining the conservation value of the measure.

In addition, the disassociation and processing of fins separate from carcasses make subsequent species identification challenging or impossible, potentially impacting the quantity and quality of data on sharks for use in stock assessments, risk analyses, ecological models, and other scientific endeavors. Therefore, the IATTC staff believes requiring fins remain naturally attached to their corresponding carcasses until the point of first landing will improve scientific data collection and compliance monitoring perspectives. The WCPFC has already taken a step in this direction, adopting a general requirement that fins be naturally attached while allowing for a narrow range of alternative measures that approximate the same result (CMM 2022-04). The IATTC-WCPFC MoU on cooperation calls for the promotion of harmonization and compatibility of conservation and management measures, including measures relating to monitoring, control, and surveillance. In this context, the IATTC staff believes that now is the appropriate time for the Commission to also move away from a fin-to-carcass ratio and towards a policy requiring sharks to be landed with fins naturally attached.

In summary, the current fins-to-carcass weight ratio requirement lacks a clear scientific basis as a conservation measure for sharks. Moreover, maintaining the use of the fins-to-carcass weight ratios undermines the collection of essential information on species level interactions with fishing fleets, which is crucial for accurate stock assessments and ecological studies for sharks, and complicates enforcement of the Resolution. The staff believes that requiring shark carcasses be landed with the fins attached would ensure that sharks are not finned, improving both science and compliance. Therefore, the staff makes the following recommendation:

RECOMMENDATION:

Prohibit the removal of shark fins on board vessels, requiring fins be naturally attached to the shark carcass until the first point of landing.

B. DATA COLLECTION

4. TUNA TAGGING

Conventional tagging experiments (capture-mark-release) are a useful tool in fisheries science for obtaining important biological information on exploited fish populations. This can range from routine data, such as movements, stock structure, and growth, to more complex information, such as exploitation rates, natural mortality, and, in some cases, abundance estimates. By including electronic archival tags (ATs) in these experiments, researchers can gain insights into daily movements, behavior, and habitat preferences. Combining information from both conventional and electronic tagging in stock assessments can reduce uncertainty, thus providing policymakers with more robust data for making management decisions.

Through financial support provided by the European Union and the IATTC, the multi-year Regional Tuna Tagging Project in the EPO was conducted by the IATTC during 2019-2023 (RTTP-EPO 2019-2020, Project E.4.a, SAC-14-07). The program consisted of a series of three tuna tagging cruises and aimed at advancing the biological information currently used in stock assessments and to help inform management decisions for the tropical tuna fishery in the EPO. The tagging data are being used to develop a spatiotemporal tagging model (SAC-14 INF-E) for skipjack tuna, where movement and length-based mortality rates are estimated. However, the incomplete mixing in the tagging data may introduce uncertainty into these estimates. To reduce this uncertainty, it is necessary to improve the spatial coverage of tag releases throughout the fisheries' operational range, derive estimates of tag shedding through double tagging experiments, and investigate instantaneous tagging mortality (tagging effect). These improvements may enable reliable

estimates of total abundance to be derived. Although the model was developed for skipjack, it is likely that the methods may be suitable for yellowfin and bigeye as well. These estimates can be integrated in the stock assessments of the three tropical tunas.

RECOMMENDATIONS:

1. Conduct tagging cruises at regular intervals over the next five years. These cruises should focus on developing stronger relationships with the tuna fishing industry, fostering collaboration to improve project outcomes.

2. In collaboration with the industry, conduct experiments to assess the feasibility of using the portable seacage as a possible platform for tagging tropical tunas in the EPO (see unfunded proposal in SAC-14-01c).

3. Consider the efficacy of using pole-and-line vessels fishing from coastal states for tagging tropical tunas in coastal areas of the EPO.

5. DATA FOR LARGE LONGLINERS

Recent challenges with the assessments of the target tuna fisheries demanded the use of sophisticated analyses that required fine-scale spatial and temporal resolution catch, effort and size data (SAC-11-06; SAC-11-07; IATTC-95-05) from the longline fleets operating far from the coasts and particularly in the high-seas, which in some cases, are not routinely available to the staff. Challenges are also encountered by the staff when producing assessments for tuna-like species, such as swordfish (SWO-01), due to a lack of data. CPUE data from Japan forms the basis for the index of abundance used in the current assessments of bigeye, yellowfin, and for the first time, skipjack (SAC-13-07), and it is key to address hypotheses of spatial structure for yellowfin tuna in the EPO. However, the magnitude and spatial extent of effort by the Japanese fleet has decreased markedly in the EPO, thereby deteriorating the quality of the indices of abundance. Recent collaborative work with Japan, Korea, Chinese Taipei and China has improved the understanding of their logbook data for developing new indices of abundance. Data for this work were only made available to the staff via multiple MoUs between the IATTC and each CPC, which are renewed annually. The data regularly submitted by the CPCs related to the Resolution C-03-05 on data provision are aggregated spatially (1° x 1° or 5° x 5°) and contain little or no gear configuration information, and no vessel identifiers, which are important factors for better understanding changes in catchability and species targeting (OTM-30), both of which influence abundance indices. Operational-level data (high resolution 'level 1' catch and effort data as defined in C-03-05) with corresponding size information are necessary to improve the indices of abundance routinely used in the stock assessments for bigeye and yellowfin tuna, and will become increasingly important for other commercially important species such as swordfish, other billfish and sharks. These data already exist for most, if not all, large longline fleets (and for some coastal longline fleets), and are currently submitted to other t-RFMOs by IATTC CPCs (WCPFC13), and are similar to the data available to the staff for the purse-seine fishery. Therefore, these equivalent longline data should be expected to be made available to staff on an annual basis for the purposes of improving the quality of data reporting and research to facilitate fulfillment of mandates by the Antigua Convention.

The staff has prepared an extensive workplan to address several uncertainties in the stock assessment of yellowfin, bigeye tuna and other species that will require high-resolution CPUE data with corresponding size information. The staff has routine access to high-resolution data for most of the purse-seine fleet, but not for the longline fleet from which indices of abundance are mostly derived. The quality of stock assessments of tuna and tuna-like species undertaken by the staff will therefore continue to be severely compromised without access to these high-quality existing data.

Additionally, the Antigua Convention entered into force over a decade ago and expanded the mandate of the Commission to include non-target, dependent and associated species, and the effects of the fishery on the ecosystem. The data provision has lagged both in pace and types of data reported to the IATTC. This in turn has affected the staff's ability to adequately fulfill its obligations under the Convention and objectives under IATTC's Strategic Science Plan (2019–2023, IATTC-93-06a). Therefore, the staff—under the

direction of a SAC- and Commission-endorsed staff recommendation (see SAC-12-16, General Data Provisions)—planned and facilitated the 1st workshop on improvements in data collection and provision with a focus on the industrial longline fishery (WSDAT-01) taking into consideration elements from SAC-12-09 on data gaps pertaining to all gear types. Preliminary staff recommendations to improve data collection and provision for the industrial longline fishery were presented at the workshop (WSDAT-01-01) to stimulate discussions on recommendations to revise resolution C-03-05. Input from workshop participants (WSDAT-01-RPT) was used to revise the staff's recommendations provided in SAC-14 INF-Q.

RECOMMENDATIONS:
See SAC-14 INF-Q for a compilation of all staff recommendations on data improvements for the industrial longline fishery, which were presented, discussed and revised based on input from workshop participants and consultations with individual CPCs.

6. SHARKS AND RAYS

6.1. Improving data collection and stock assessments for sharks

Paragraph 1 of Resolution C-16-05 requires the IATTC staff to develop a workplan for completing full stock assessments for silky and hammerhead sharks. As noted in SAC-05 INF-F, SAC-05-11a, and SAC-07-06b(iii), improving shark fishery data collection in the EPO is an essential prerequisite.

The first comprehensive quantitative ecological risk assessment for sharks in the EPO was completed in 2022 (SAC-13-11) using the EASI-Fish approach, which identified 20 of the 32 species assessed exceeding biological reference points, thus rendering these species "most vulnerable". Of the 20 most vulnerable species, silky shark and three species of hammerheads were ranked highest. In 2023, an EASI-Fish assessment was undertaken on four of the most vulnerable shark species, silky shark and three hammerhead shark species, to explore the potential efficacy of hypothetical conservation and management measures (SAC-14-12), such as EPO-wide closures, and prohibition of the use of wire leaders. The assessment showed that the majority of measures reduced the vulnerability of silky sharks but no single CMM, or combined use of up to four CMMs in concert, resulted in the species being classified as "least vulnerable". The EASI-Fish assessment and previous shark research undertaken by the staff have identified significant data deficiencies for vulnerable shark species, including silky and/or hammerhead sharks, in the EPO: 1) reliable catch and size composition data for coastal (*i.e.* 'artisanal') longline and gillnet fisheries (SAC-08-07b; SAC-08-07e), high-seas longline fisheries (SAC-08-07b; SAC-08-07e) and small[12] purse-seine vessels (SAC-08-06a), 2) basic biological information to parameterize EASI-Fish and stock assessments, such as length-weight and length-length relationships, maturity ogives and growth curves, and 3) species-specific and fishery-specific estimates of post-release survival. In particular, without data from a properly designed long-term sampling program for artisanal fisheries across EPO coastal States (a significant part of component (1)), the IATTC staff will not be able to meet this requirement of Resolution C-16-05.

As a first step toward developing sampling designs for catch and size composition in artisanal fisheries, and for size composition in industrial longline fisheries, a wealth of information has been collected in five Central American countries under Project C.4.a, funded by FAO-GEF through March 2019, and through March 2020 by the IATTC capacity-building fund (SAC-11-13). Made possible through recent funds provided by the European Union, the sampling program in Central America has reached its completion in December 2021. The results supported a proposal that was presented at the 2021 98th Meeting (resumed) meeting of the Commission to establish a long term sampling program in Central America (IATTC-98-02c). Unfortunately, the necessary funds to implement such long-term program are not available to date. If these funds to initiate the long-term sampling program in Central America are secured and these efforts are expanded to other regions in the EPO (*e.g.,* South America, Mexico), both data collection and stock assessments for

sharks in the EPO could improve. Resources to expand the Central American shark data collection improvements into other EPO coastal nations have very recently made available under part 2 of the ABNJ project (SAC-13-12, SAC-14 INF-M).

RECOMMENDATIONS:

1. Establish, or strengthen, data collection programs for artisanal fisheries in EPO coastal States to obtain reliable catch and size composition data and biological information for assessments of vulnerability and stock status.

2. Resume the IATTC Technical Meetings on Sharks to gather existing data and expert knowledge on data-poor sharks and fisheries, with the goal of improving population and ecological risk assessments (e.g., EASI-Fish) that can inform management decisions.

Given the scale and importance of the shark fisheries in Central America (SAC-14 INF-L) and the lack of fishery/biological sampling data from shark landings in that region (SAC-07-06b(iii)), the staff reiterates the following recommendation:

RECOMMENDATION:

Establish an IATTC field office in Central America near the port or ports where most shark landings occur.

Previous recommendations by the staff on data collection by observers on longline vessels and Class 1-5 purse-seine vessels are reiterated in Section 7.

7. ECOSYSTEM CONSIDERATIONS

7.1. Feasibility study to develop a sampling program for updating morphometric relationships and collecting biological samples for priority species in EPO tuna fisheries

Length-weight (L-W) relationships are the foundation to a variety of research projects including stock assessments, ecological risk assessments (*e.g.,* EASI-Fish) and for converting catch reported in numbers to weights, and vice versa. These relationships can vary markedly in space and time and can greatly influence stock and risk assessment model outcomes. Despite this, L-W relationships for tunas are outdated (*e.g.,* yellowfin: 1986, bigeye: 1966 and skipjack: 1959) or inadequate for many priority species (see SAC-13-11, SAC-09-12, IATTC Special Report 25). Catch estimations are also affected by imprecise and/or outdated L-W relationships. Furthermore, species and size composition of the catch and fishing strategies differ significantly between longline (LL) and purse-seine (PS) fisheries (*e.g.,* see IATTC-98-01). Additionally, basic life history data for assessment models are absent or inadequate for most bycatch species. A proposed feasibility study (Project F.3.a) addresses these issues and a background paper (SAC-14 INF-J) summarizes the staff's internal discussions, provides background information, describes data deficiencies in morphometric relationships and biological sampling, and identifies potential sampling opportunities in 3 gradual phases. In this paper, the staff seek to build upon Project F.3.a and develop a hierarchical phased-based approach to update morphometric relationships and biological sampling for tunas, billfishes, and prioritized bycatch species, through the collaboration of staff, CPCs, industry and other relevant stakeholders. This project is complementary to other data improvement projects (SAC-12-09, WSDAT-01-01, WSDAT-01 Report) and also aims to align with work conducted in the Western and Central Pacific Ocean through SPC's Oceanic Fisheries Programme on the collection of morphometric data to build a comprehensive database on various length and weight types and to establish collection of biological samples.

RECOMMENDATION:

In collaboration with CPCs and relevant stakeholders, develop a feasibility study (Project F.3.a)—which may be upscaled using a hierarchical phase-based approach (see SAC-14 INF-J)—for a fishery-dependent sampling program to collect morphometric measurements and biological samples from prioritized species.

8. FISH-AGGREGATING DEVICES (FADs)

The recommendations in this section are based on documents FAD-07-01, FAD-07-02 and FAD-07-03;

some of them were endorsed by the *ad-hoc* Working Group on FADs, SAC-09, SAC-10 and IATTC-97-01, among others.

8.1. Timely provision of FAD data

Resolution C-19-01 requires that CPCs provide data on FADs recorded by captains of purse-seiners without observers aboard for the previous calendar year "*no later than 90 days prior to each regular meeting of the SAC*", and that the IATTC staff present a preliminary analysis of that information to the SAC. However, given the many other tasks required of the staff in preparation for SAC meetings, this does not allow sufficient time for a thorough analysis of the data, and therefore more timely provision of data is desirable.

RECOMMENDATION:

CPCs should provide the FAD data from each fishing trip without an observer aboard to the IATTC staff as soon as possible after the trip terminates.

8.2. Provision of detailed buoy data

Under Resolution C-17-02 and C-20-06, CPCs were required to provide "daily information" on their active FADs, which was interpreted to mean a single data point per FAD per day, the selection criteria for which are unclear (*e.g.* no acoustic biomass information is required by the Resolution). This combination of low resolution and uncertain selection criteria meant that these data were of limited scientific utility. Also, CPCs were allowed to report data in different formats, sometimes highly summarized (without any information on FAD identification or trajectory), which again were of little use for science. Moreover, Resolution C-19-01 allows CPCs to use different methods for marking and identifying FADs. As a result, the data provided under C-17-02 and C-20-06 were inadequate even to allow connection of the various FAD-related IATTC. In recent years, the IATTC staff, the FAD-WG and even the SAC itself recommended the provision of raw buoy data as received by original users (*i.e.* vessels, fishing companies), including both trajectories and acoustic biomass information. Therefore, starting in 2022, under Resolution C-21-04, CPCs began to report this data following the format specified in Annex IV of C-21-04.

Although Resolution C-21-04 reduces the active FAD limits in 2022, compared to the 2018-2021 period, analysis of raw buoy data for 2022 (FAD-07-01) has shown an increase in the number of active FADs used by the fleet. However, the data available to the staff before and after 2022 are inconsistent in reporting rate and quality, and thus, the exact reasons for this increase remain unclear, but may range from improved data to actual increases in FAD usage.

Moreover, as noted by voluntary pilot studies using raw buoy data, including both trajectories and acoustic biomass information, at regional (*e.g.*, FAD-05-INF-E, FAD-06-03, FAD-07-03, SAC-13-07) and global (*e.g.*, IOTC-2020-WPTT20-14, SCRS/2019/075) scale, scientific studies require high-resolution, standardized long-time series data. Therefore, the staff recommends that CPCs provide the historic raw buoy data in order to conduct the appropriate scientific analyses, and in particular, to continue improving staff's understanding of FAD fishery dynamics and the assessment of skipjack (SAC-13-07) and other tropical tuna species.

RECOMMENDATION:

CPCs should provide to the IATTC staff the historic raw buoy data received by original users (*i.e.* vessels, fishing companies), including both trajectories and acoustic biomass information.

8.3. Biodegradable FADs

The purse-seine effort on the fish-aggregating device (FAD) fishery in the EPO has progressively increased since the early 1990s due to its efficiency in capturing tropical tunas that aggregate under FADs. Resolutions C-19-01 and C-21-04 require the IATTC staff to present recommendations on the use of biodegradable materials to mitigate the effects of FADs in the ecosystem, and in particular, entanglement of species, marine debris and pollution, and stranding events in vulnerable habitats. To this end, the staff, in collaboration with fishing organizations, has developed large-scale trials for testing biodegradable and non-entangling materials for the

tuna FAD fishery in real fishing conditions (project M.5.a; document FAD-06-02). Moreover, the staff has engaged with other research and initiatives conducted by other t-RFMOs, and stakeholders with the intention of sharing experiences, and discussing common goals and harmonization. The implementation of biodegradable FADs in the region deserves the consideration of a number of aspects, ranging from identifying suitable materials and designs for FAD construction, the adoption of a definition and characteristics for a biodegradable FAD, and updating data collection forms and procedures, among others. Currently no harmonized definition exists among t-RFMOs, although interim definitions have been proposed by the IATTC staff and the *ad hoc* Working Group on FADs that take into account elements such as international standards, the regulatory framework, and the minimum requirement conditions for materials, among others (see FAD-06-02 and IATTC-100-03-ADD, for details).

The large-scale biodegradable FADs project for the EPO has come to an end in 2023, with promising results (FAD-07-02). The study analyzed information from satellite-linked echo-sounder buoys, in addition to the data collected by observers, to gain a better understanding of the drifting behavior and biomass accumulation of the prototypes considered in the project. The results suggest that transitioning to biodegradable FADs to reduce negative impacts on the associated species and ecosystems may be possible without compromising the effectiveness of the fishing method.

Hence, the IATTC staff's recommendations are as follows (FAD-06-02):

RECOMMENDATIONS:

1. Consider current prototypes 1 and 2, and to a lesser extent prototype 3[13], as potential examples for effective biodegradable FAD construction.
2. Consider a gradual/stepwise process, including a timeline for the implementation of fully biodegradable FADs based on the current state of material availability.
3. Reduce, to the extent possible and within the gradual process of biodegradable FAD implementation, the amount of material and the non-biodegradable components of NED design and construction, provided that fishing efficiency is not compromised.

8.4. Traditional FADs

Purse seine fishers extensively deploy drifting FADs to aggregate and catch tropical tuna, with >25,000 FADs deployed in the eastern Pacific Ocean annually in recent years (FAD-07-01). Main concerns related to the loss and abandonment of FADs are i) marine debris and pollution; ii) the potential risk of entanglement of marine megafauna in FAD netting while drifting at sea or stranded; and iii) the potential to cause ecological damage to vulnerable ecosystems via stranding events, including reefs, beaches, and other essential habitats. A series of recent simulation experiments undertaken based on possible FAD drifting behavior, identified potential corridors of connectivity between industrial FAD fishing grounds and zones of important habitats. Although these connectivity patterns appear to be somewhat mitigated against by the current deployment distribution of FADs in the EPO, additional research and analyses are desirable to better understand interactions between FADs and sensitive species' populations, their potential entanglements; and the likely changes in connectivity and distribution of FADs under proposed different FAD designs and use strategies. As a response, the IATTC staff collaborated in the development of guidelines to reduce the impacts of FADs on sea turtles, including their essential habitats (FAD-07-04).

Hence, the IATTC staff's recommendations are as follows (BYC-11-05, FAD-07-04):

RECOMMENDATION:

Given the overlap of FADs with oceanic and coastal habitats of sea turtles, consider no netting materials for FAD construction and eliminating potential entanglement risks.

9. OBSERVER COVERAGE

9.1. Purse-seine fishery

9.1.1. Observer coverage of purse-seine vessels of less than 364 t carrying capacity

No formal, fleet-wide on-board observer program exists for Class 1-5 purse-seine vessels, and as a result, trips by many small[14] purse-seine vessels are not sampled by observer programs (SAC-08-06a; SAC-12-09, SAC-14-11). However, data collection has been improving due to a voluntary observer program, established in 2018. Initially, observer coverage was low due to the voluntary nature of the program. Therefore, vessel logbooks and cannery unloading records are the principal sources of data on the activities of these vessels. However, these data sources generally do not contain information on tuna discards, and the data are less complete and detailed than those collected by observers. In addition, bycatch information is only rarely recorded in logbooks, which hampers efforts to conduct assessments for such species. Electronic monitoring (EM) for this fleet component is currently being explored (Project D.2.a; SAC-10-12), and some capabilities of EM detected in the pilot study are detailed in Appendix 2 of SAC-11-11; however, EM data collection is not likely to begin at any significant level prior to January 2025, given the steps that need to be completed for implementation of an EM System in the EPO (SAC-12-10; SAC-12-11). Therefore, a formal, non-voluntary, fleet-wide observer program is recommended to routinely obtain the data necessary for estimating the quantity and species composition of bycatches by these vessels and to understand the strategies and dynamics of their operations. Based on a previous study of

[13] Full implementation of prototype 3 may require further research in collaboration with fishers.
[14] Carrying capacity ≤ 363 t.

EPO data for Class-6 vessels fishing on floating objects (IOTC Proceedings WPDCS-01-09, 4: 48–53), an initial sampling coverage of at least 20% of all trips of the small-vessel fleet component is recommended.

RECOMMENDATION:

Establish a formal, non-voluntary, fleet-wide observer program for purse-seine vessels of less than 364 t carrying capacity, with a sampling coverage of at least 20%.

9.2. Longline fishery

9.2.1. Observer coverage

Resolution C-19-08 requires that at least 5% of the fishing effort by longline vessels greater than 20 m length overall (LOA) carry a scientific observer. However, recent analyses undertaken by IATTC staff with the new operational-level data collected by observers onboard large longline vessels showed that, at such a low level of coverage, the data are not representative of the fishing activities of the entire fleet and cannot even be used to produce accurate estimates of total catch of target species such as bigeye tuna and yellowfin tuna (BYC-10 INF-D). Therefore, the staff concludes that 5% coverage is too low for calculating accurate estimates of the total catches of bycatch species caught by these vessels, particularly those species caught infrequently, such as sea turtles, seabirds and some sharks of conservation concern. In fact, several studies of sampling coverage for other longline fisheries have shown that 20% coverage is considered the minimum level required for estimating total catch of bycatch species. Both the staff and the SAC have recommended that this level of coverage be adopted for longline vessels over 20 m LOA (SAC-10 INF-H).

RECOMMENDATION:

The staff maintains its recommendation of at least 20% observer coverage of longline vessels over 20 m length overall.

9.2.2. Data standards and reporting

In 2019, the Commission replaced Resolution C-11-08 on scientific observers on longline vessels with Resolution C-19-08. Annex B to C-19-08 formalizes the minimum data standards for longline observer data collection approved by SAC-08 in 2017. Under these measures, all CPCs with qualifying longline vessels fishing in the EPO are required to report all operational data collected by their respective observer programs since 2013. However, several CPCs have not yet reported data for all relevant years.

RECOMMENDATION:

CPCs should 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.

10. ELECTRONIC MONITORING

10.1. Implementing an electronic monitoring system for the tuna fisheries

Electronic monitoring (EM) is increasingly being used worldwide to record the activities of fishing vessels, to complement human observer programs, and where on-board observer coverage is too low or non-existent. Accordingly, per request of the Scientific Advisory Committee during its 10th meeting in 2019, and pursuant to paragraphs 9 and 10 of Resolution C-19-08, the IATTC staff, at the 11th meeting of the SAC in 2020, presented the document SAC-11-10, containing information on the potential of an Electronic Monitoring System (EMS), a description and evaluation of the minimum standards of its components, and the actions that would be required for its implementation. To further discuss the elements contained in document SAC-11-10, the *1st Workshop on Implementation of an EMS in the EPO* was held in April 2021. Presented at this workshop, the document EMS-01-01 recommended several actions for endorsement by the Commission. Among these was a workplan formulated by IATTC staff (EMS-01-02-Rev), which proposed a series of workshops to consider and analyze the EMS components and subcomponents in a hierarchical and chronological order. The associated Terms of Reference of these EMS workshops and a set of

definitions were adopted through the Resolutions C-21-02 and C-21-03, respectively, during the 98th Meeting of the IATTC. In observance of Resolution C-21-02, and according with the workplan adopted for the implementation of an EMS in the EPO, the staff organized in fall 2021 the 2nd Workshop of an EMS in the EPO to discuss aspects on the institutional structure, goals and scope of the EMS (see EMS-02-01 and EMS-02-02 Rev.). A 3rd Workshop was organized in spring 2022 to discuss considerations related to the management of an EMS for the EPO (see EMS-03-01). During SAC-13, the staff presented a compilation of workshop participants' comments and concerns, revising its preliminary recommendations of the 2nd and 3rd workshop as necessary (SAC-13-INF-D). Subsequently, during the 100th IATTC Meeting, Resolution C-22-07, established an *ad hoc* working group on EM (EMWG), which creates a forum for Members to discuss and make recommendations on issues that could not be addressed in the EM workshops. However, the workplan, now with a more educational approach, continued with the planned workshops (EMS-02-01). A 4th Workshop took place in December 2022 to discuss matters related to technical standards and data collection priorities of an EMS (see EMS-04-01 and EMS-04-02). A 5th Workshop took place in Spring 2023 to discuss the financial considerations of an EMS (see EMS-05-01). The staff has compiled all the comments and concerns of the 4th and 5th workshop participants and revised its preliminary recommendations as necessary (SAC-14-INF-H). These interim staff recommendations will continue to be updated, as appropriate, and will be forwarded to the *Ad Hoc* Working Group on Electronic Monitoring for further consideration and development.

RECOMMENDATION:

See document SAC-14-INF-H for a compilation of all staff interim recommendations on EM, which were presented and discussed with the workshop participants. Where appropriate, the staff preliminary recommendations were revised.