**INTER-AMERICAN TROPICAL TUNA COMMISSION**

**SCIENTIFIC ADVISORY COMMITTEE**

**NINTH MEETING**

**La Jolla, California (USA)**
**14-18 May 2018**

# DOCUMENT SAC-09-15 REV 2

## STAFF RECOMMENDATIONS FOR MANAGEMENT AND DATA COLLECTION, 2018

**CONTENTS**



## A. MANAGEMENT

### 1. TUNAS

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

**Summary**


In order to fullfill the requirement in paragraph 22 of Resolution C-17-02, while taking into consideration the harvest control rule (HCR) defined in C-16-02, the IATTC staff conducted update assessments of bigeye (Document SAC-09-05) and yellowfin (Document SAC-09-06) tunas in the EPO. The results of the assessment of bigeye, specifically the *F* multiplier[1], suggest that the current 72-day seasonal closures should be extended to 107 days. However, the staff is recommending no change in the duration of the closures, for two reasons: 1) there is too much uncertainty in the current bigeye tuna assessment to support modifying the current management measure; and 2) the current fishing mortality for yellowfin is at about the level corresponding to the maximum sustainable yield (MSY). However, taking into account the continuing increase in fishing effort in the purse-seine fishery, in terms of the number of sets, the staff is recommending a limit on the total number of floating-object and unassociated sets.


**Background**

IATTC Resolution C-17-02 establishes the conservation and management measures applicable for tropical

[1] *F* multiplier = $F_{MSY}$ (the fishing mortality that will produce the maximum sustainable yield) divided by $F_{current}$ (the average fishing mortality for the three most recent years). An *F* multiplier of 1.0 means that the fishery is meeting the management goal of fishing at the level of the maximum sustainable yield ($F_{current} = F_{MSY}$); if it is below 1.0, fishing mortality is excessive ($F_{current} > F_{MSY}$).

tunas in the EPO during 2018-2020. Paragraph 22 of the resolution requires that:

> "In order to evaluate progress towards the objectives of these measures, in each year the IATTC scientific staff will analyze the effects on the stocks of the implementation of these measures, and previous conservation and management measures, and will propose, if necessary, appropriate measures to be applied in future years".

In Resolution C-16-02, paragraph 3, the Commission adopted the following harvest control rule (HCR) for the purse-seine fishery for tropical tunas:

a. "The scientific recommendations for establishing management measures in the fisheries for tropical tunas, such as closures, which can be established for multiple years, shall attempt to prevent the fishing mortality rate ($F$) from exceeding the best estimate of the rate corresponding to the maximum sustainable yield ($F_{MSY}$) for the species that requires the strictest management.
b. If the probability that $F$ will exceed the limit reference point ($F_{LIMIT}$) is greater than 10%, as soon as is practical management measures shall be established that have a probability of at least 50% of reducing $F$ to the target level ($F_{MSY}$) or less, and a probability of less than 10% that $F$ will exceed $F_{LIMIT}$.
c. If the probability that the spawning biomass ($S$) is below the limit reference point ($S_{LIMIT}$) is greater than 10%, as soon as is practical management measures shall be established that have a probability of at least 50% of restoring $S$ to the target level (dynamic $S_{MSY}$) or greater, and a probability of less than 10% that $S$ will descend to below $S_{LIMIT}$ in a period of two generations of the stock or five years, whichever is greater."

**Rationale**

For **bigeye**, the base case assessment (Figure 1a) indicates that the stock is not overfished ($S>S_{MSY}$; $S/S_{MSY}$ = 1.02), but that overfishing is taking place ($F>F_{MSY}$; $F$ multiplier = 0.87). Likewise, for **yellowfin**, the base case assessment (Figure 1b) indicates that the stock is not overfished ($S>S_{MSY}$; $S/S_{MSY}$ = 1.08), but that overfishing is taking place ($F>F_{MSY}$; $F$ multiplier = 0.99). However, in neither case does the base case assessment or the analysis of sensitivity to the steepness of the stock-recruitment relationship indicate that there is a 10% probability of exceeding the limit reference points for fishing mortality (Figure 1, and Appendix 1, Figures A.1 and A.2) or biomass (Figure 1, and Appendix 1, Figures A.3 and A.4), as specified in the harvest control rule.

***F* multiplier**

*F* multipliers are based on "current" fishing mortality ($F_{current}$), defined as the average of the most recent three years (2015-2017 in the case of the SAC-09 assessment), and in the past the IATTC staff has used the lower of the *F* multipliers for bigeye and yellowfin as the basis for its management advice. This year's assessment (SAC-09) estimated an *F* multiplier of 0.99 for yellowfin (SAC-09-06), similar to the 1.03 estimated in the SAC-08 assessment, whereas the *F* multiplier for bigeye, 0.87 (SAC-09-05), was much lower than the 1.15 estimated the previous year (SAC-08-04a). Although, as in previous years, there is a considerable overlap between the target *F* multiplier of 1.0 and the 95% confidence intervals (Figure 1; Appendix 1, Figure A.2, top) of this estimate, indicating that the evidence supporting a conclusion that fishing mortality is above $F_{MSY}$ is not definitive, this 24% decline is nonetheless the largest inter-annual difference in the *F* multiplier seen in an update assessment[2] for either species since the IATTC scientific staff initiated integrated stock assessments in 2000. The staff investigated the possible causes of this change, and

[2] "Update" stock assessment means that the base case model used in the assessment is the same as that used in the previous full assessment, and that only the data used in the model have been updated.

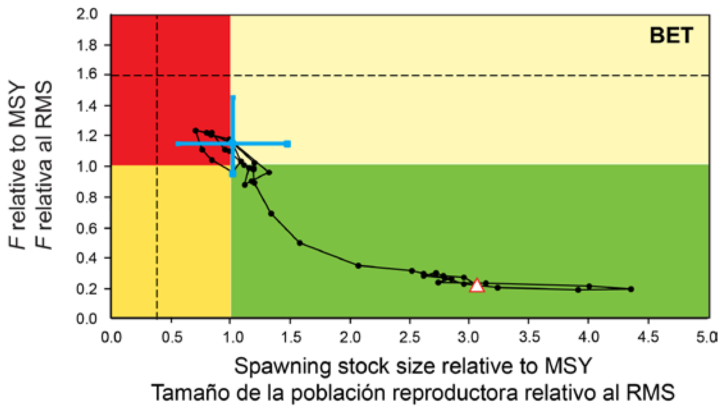


**Figure 1a.**

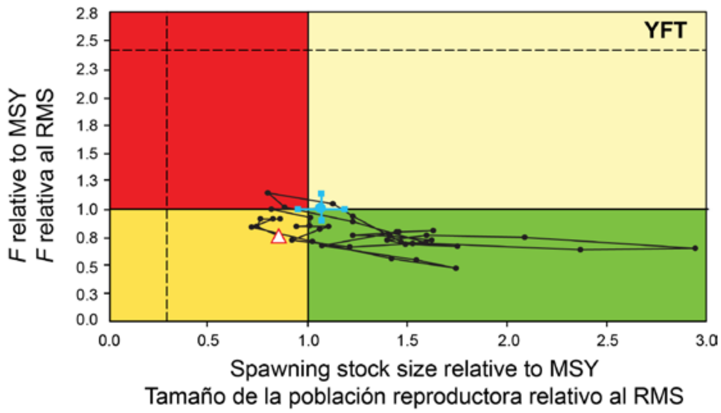


**Figure 1b.**

concluded that the model has become overly sensitive to new data and to previously-identified issues in the assessment (SAC-09 INF-B).

The *F* multiplier needs to be adjusted to take into account changes in fleet capacity. As of 25 March 2018, the capacity of the purse-seine fleet operating in the EPO, 260,289 cubic meters ($m^3$) of well volume, although slightly lower than the 2017 value of 263,018 $m^3$, represented a 1% increase from the "current" (2015-2017) average of 257,640 $m^3$ used to calculate the *F* multiplier. The adjusted *F* multipliers are therefore 0.86 and 0.98 for bigeye and yellowfin, respectively.

The staff considers, for the reasons noted in the management advice section below, that there is too much uncertainty in the current bigeye tuna assessment and the estimates of the *F* multiplier to support modifying the current management measure.

**Calculation of closure days**

In order to provide the same information as in previous years, the calculation of the number of days of closure corresponding to the adjusted *F* multipliers is presented below.

During the three-year period used as a basis for the calculation of the SAC-09 *F* multipliers, two resolutions were in force: C-13-01 during 2015-2016 and C-17-02 in 2017. Calculating the duration of these extended closures is more complicated than in previous years, because in 2015 and 2016 the closure lasted 62 days, but in 2017 it lasted 72 days[3]. With the adjusted *F* multipliers of 0.86 and 0.98, the closures corresponding to $F_{MSY}$ are 107 and 71 days for bigeye and yellowfin, respectively. This represents an increase of 35 days for bigeye, and a decrease of 1 day for yellowfin, with respect to the current 72-day closure.

Thus, the closures corresponding to the *F* multipliers adjusted for capacity increases are as follows:

| | Bigeye | Yellowfin |
|---|---|---|
| *F* multiplier from the stock assessment | 0.87 | 0.99 |
| Capacity increase | 1.0% | 1.0% |
| *F* multiplier adjusted for capacity increase | 0.86 | 0.98 |
| Days of closure[3] | 107 | 71 |

[3] The additional days of closure required to compensate for the *F* multiplier and increased capacity are added to the average days of closure for the period which the *F* multiplier is calculated (2015-2017). This average (65 days (62 + 62 + 72)/3) is less than the current 72-day closure. A 1% change in the *F* multiplier is approximately 3 days, therefore adding the necessary 6 days (3 days for the *F* multiplier and 3 days for the increase in capacity) for yellowfin to this average gives 71 days of closure.

**Management advice**

As noted above, the IATTC staff has used the lower of the *F* multipliers for bigeye and yellowfin as the basis for its management advice; this would mean recommending a 107-day closure for 2018-2020, when Resolution C-17-02 is in force. However, in this instance the staff is not basing its conservation recommendation on the *F* multiplier from the SAC-09 bigeye assessment, for three reasons. First, the large change in the *F* multiplier from the 2017 assessment to the 2018 assessment is implausible. Second, population projections under current fishing mortality have less than a 10% probability of exceeding the fishing mortality and biomass limit reference points, as specified in Resolution C-16-02, for both the base case and the sensitivity analysis (Figure 1; Appendix 1, Figures A.1-A.4). Third, the results of the stock assessment have become overly sensitive to new data and to previously-identified issues in the assessment, and the staff has developed a comprehensive plan to address these issues before Resolution C-17-02 expires (SAC-09 INF-A).

In recommending that the *F* multiplier for yellowfin from the SAC-09 assessment be used as the basis for management, the staff considered four factors: 1) the estimated *F* multiplier (0.99) means that the current fishing mortality is close to $F_{MSY}$, and $F_{MSY}$ is well within the confidence intervals of the current *F* (Appendix 1, Figure A.2, bottom); 2) the estimated fishing mortality in 2017 decreased from 2016 for all age groups (SAC-09-06, Figure 3); 3) the current capacity of the purse-seine fleet is less that the capacity that fished in 2017; and 4) the current closure is 10 days longer than the closures in effect in 2015 and 2016, which were used in the three-year average for calculating the *F* multiplier.

Since Resolution C-17-02 establishes management measures for 2018-2020, recommendations are not required this year to establish management, and since the limit reference points have not been exceeded, nor are they projected to be exceeded, no immediate action, as contemplated in paragraph 3b or 3c of Resolution C-16-02, is required. Resolution C-17-02 requires that appropriate measures be applied "if necessary"; however, "necessary" has not been defined except in terms of limit reference points, per paragraph 3b or 3c of Resolution C-16-02. Moreover, as noted above, as of 25 March 2018 the closure-adjusted capacity is not estimated to have increased, unlike in 2016 and 2017, so as of this date no changes to compensate for capacity increases are necessary.

**Increasing capacity and number of sets**

The increase in capacity prior to 2018 and the continuing increase in the number of sets, despite the longer closure in 2017, are a concern, for skipjack tuna as well as for bigeye and yellowfin, and need to be addressed. The staff will therefore monitor the stock status indicators for bigeye (SAC-09-16) and skipjack (SAC-09-07) to determine whether immediate action is required.

Recent recommendations for longer closures have been driven mainly by increases in fleet capacity, and it is therefore essential that it does not increase further, particularly if the current management measures continue unchanged for the next two years. However, the number of sets on floating objects has

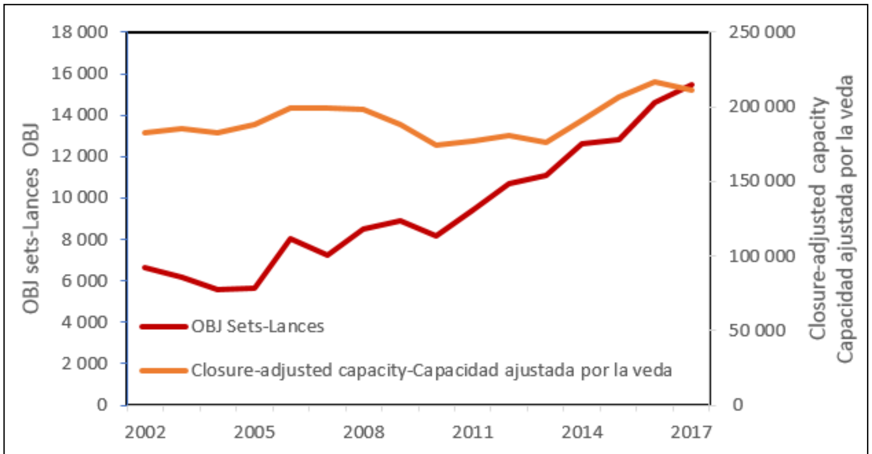


**Figure 2.**

| | DEL | | | OBJ | | | NOA | | |
|---|---|---|---|---|---|---|---|---|---|
| | ≤363 t | >363 t | Total | ≤363 t | >363 t | Total | ≤363 t | >363 t | Total |
| 2002 | 0 | 12,290 | 12,290 | 867 | 5,771 | 6,638 | 4,938 | 3,442 | 8,380 |
| 2003 | 0 | 13,760 | 13,760 | 706 | 5,457 | 6,163 | 7,274 | 5,131 | 12,405 |
| 2004 | 0 | 11,783 | 11,783 | 615 | 4,986 | 5,601 | 4,969 | 5,696 | 10,665 |
| 2005 | 0 | 12,173 | 12,173 | 639 | 4,992 | 5,631 | 6,109 | 7,816 | 13,925 |
| 2006 | 0 | 8,923 | 8,923 | 1,158 | 6,862 | 8,020 | 6,189 | 8,443 | 14,632 |
| 2007 | 0 | 8,871 | 8,871 | 1,384 | 5,857 | 7,241 | 4,845 | 7,211 | 12,056 |
| 2008 | 0 | 9,246 | 9,246 | 1,819 | 6,655 | 8,474 | 4,771 | 6,210 | 10,981 |
| 2009 | 0 | 10,910 | 10,910 | 1,821 | 7,077 | 8,898 | 3,308 | 4,109 | 7,417 |
| 2010 | 0 | 11,646 | 11,646 | 1,788 | 6,399 | 8,187 | 2,252 | 3,885 | 6,137 |
| 2011 | 0 | 9,604 | 9,604 | 2,538 | 6,921 | 9,459 | 2,840 | 5,182 | 8,022 |
| 2012 | 0 | 9,220 | 9,220 | 3,067 | 7,610 | 10,677 | 2,996 | 5,369 | 8,365 |
| 2013 | 0 | 10,736 | 10,736 | 3,081 | 8,038 | 11,119 | 3,064 | 4,156 | 7,220 |
| 2014 | 0 | 11,382 | 11,382 | 3,858 | 8,777 | 12,635 | 2,427 | 3,369 | 5,796 |
| 2015 | 0 | 11,020 | 11,020 | 3,455 | 9,385 | 12,840 | 3,116 | 6,201 | 9,317 |
| 2016 | 0 | 11,219 | 11,219 | 4,226 | 10,377 | 14,603 | 2,274 | 5,101 | 7,375 |
| 2017 | 0 | 8,864 | 8,864 | 4,341 | 11,147 | 15,488 | 2,017 | 4,959 | 6,976 |
| | Average-Promedio 2015-2017 | | | | | | | | |
| | 0 | 10,368 | 10,368 | 4,007 | 10,303 | 14,310 | 2,469 | 5,420 | 7,889 |

Number of purse-seine sets, by set type and vessel size class, 2002-2017 (SAC-09-03, Table A-7)

increased at a faster rate than capacity (Figure 2), and it is therefore also necessary to limit the number of such sets. Although the increase in the number of sets is due mainly to the floating-object fishery, it is not practical to limit that set type alone, so the limit would have to apply to floating-object and unassociated sets combined, and be based on the average for 2015-2017 (the period used to calculate the *F* multiplier), to ensure that fishing mortality does not increase beyond that level. In addition, Class 1-5 vessels rarely carry observers, and so cannot be monitored in real time; therefore, the closure would be implemented when the number of sets by Class-6 vessels reached the limit, but would apply to all purse-seine vessels, regardless of capacity.

The limit on the number of sets recommended by the staff needs to take into account the increase in the catch per set (CPS) due to improved efficiency of the purse-seine fleet. For example, the catch-per-successful-set (CPSS) has been shown to increase with the number of FAD deployments (SAC-09 INF-D). The obvious solution is to limit the number of FADs per vessel; however, the number of FADs owned per vessel is not known, the appropriate number of FADs per vessel cannot be determined with the available data, and there would be several issues associated with monitoring the number of FADs per vessel. Therefore, the staff applied a factor to adjust the annual limits on the number of sets to compensate for the increase in the number of FAD deployments (SAC-09 INF-G), which resulted in annual limits of 14,895 and 14,498 sets for 2019 and 2020, respectively.

**RECOMMENDATIONS:**

1. Maintain the provisions of the current resolution (C-17-02).
2. For the purse-seine fishery, limit the total annual number of floating-object and unassociated sets combined by Class-6 vessels in 2019 and 2020, the years covered by the Resolution C-17-02, to 14,895 and 14,498, respectively. Once the limit is reached, only dolphin-associated sets will be allowed, and all vessels without a Dolphin Mortality Limit must return to port.

### 1.2. Pacific bluefin tuna

The ISC Pacific bluefin tuna working group completed a new update assessment of Pacific bluefin tuna in 2018. Projections in which Resolution C-14-06 (and therefore Resolution C-16-08) was extended into the future predict that, even under a low-recruitment scenario, the stock will rebuild to the interim rebuilding targets. The assessment and auxiliary data suggest that the two most recent recruitments (2016 and 2017) were large. Projections that take the 2016 large recruitment into consideration predict that catch could be increased while still maintaining a high probability of meeting the rebuilding targets. Given that the second large recruitment was not used in the projections, these increased catches appear conservative.

The analysis include several catch scenarios, with different increases in catch and different distributions of the catch between small and large fish, which follow the harvest strategy prepared by the joint t-RFMO working group. In most scenarios, catching larger fish increases the total catch in weight for a given level of rebuilding. The staff considers that, while the most precautionary approach is to maintain the catch limits in C-16-08, some increases are possible without posing a danger to the rebuilding of the stock. If one of the 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. The current resolution (C-16-08) is adequate and, for this reason, no additional recommendations are made.
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 stock assessment of north Pacific albacore tuna (SA-WP-09), completed in April 2017 by the Albacore Working Group of the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC), concluded that the stock was not experiencing overfishing and was probably not overfished. The fishing mortality for the most recent years in the assessment ($F_{2012\text{-}2014}$) is below the level corresponding to MSY ($F_{2012\text{-}2014}/F_{MSY} = 0.61$) and the spawning biomass is above that level ($S_{current}/S_{MSY} = 3.32$), but those results are highly uncertain. The Working Group noted that there was no evidence that fishing had reduced the spawning stock biomass below thresholds associated with most potential biomass-based reference points, and that population dynamics in the stock are largely driven by recruitment, which is affected by both environmental changes and the stock-recruitment relationship (a measure of the degree to which biomass and recruitment are interdependent). The Working Group concluded that the north Pacific albacore stock is healthy, and that the productivity was sufficient to sustain recent exploitation levels, assuming average historical recruitment in both the short and the long term. A management strategy evaluation (MSE) is in progress.

The current conservation and management measures for north Pacific albacore are based on maintaining the fishing effort below the 2002-2004 levels (IATTC Resolution C-05-02, supplemented by Resolution C-13-03 and WCPFC CMM 2005-03). Given the relative stability in the biomass and fishing mortality in recent years, and in view of the ongoing MSE, the staff considers that the current resolutions should be continued.

**RECOMMENDATIONS:**

The current resolutions (C-05-02 and C-13-03) should be continued,

## 2. NON-TARGET SPECIES

### 2.1. Silky sharks

The indices for the silky shark, based on data from the purse-seine fishery on floating objects, have been updated through 2017 (SAC-09-13). In both the north and south EPO, the indices for large silky sharks (SAC-08-08a(i)) were similar to, or slightly greater than, their 2016 values, so no changes to management measures are recommended. 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 coastal nations, which are believed to have the greatest impact on the stock (SAC-05-11a). The staff has made recommendations for data collection (Section 3) as part of its shark work plan (SAC-09 INF-F), requested in paragraph 1 of Resolution C-16-05.

Resolution C-16-06 directs the staff to consider the adequacy and effectiveness of the silky shark limits established by the resolution and if necessary, recommend revisions. However, the improved species-level catch and composition data required for this analysis have not yet been provided by CPCs, so the staff could not perform the analysis.

Paragraph 6 of Resolution C-16-06 requires CPCs to implement a three-month prohibition on the use of steel leaders in certain longline fisheries, and Paragraph 7 requires the IATTC staff, in coordination with the SAC, to recommend the most appropriate period for this prohibition, based upon the analysis of data provided by CPCs. However, those data are not yet available, so the analysis could not be conducted. Nonetheless, the longline catch-composition information compiled for the recent dorado assessment (SAC-07-06a(i)) suggests that a prohibition would be most effective outside the dorado fishing season, which typically lasts from October through March. Therefore, the staff recommends that, where appropriate, each CPC prohibit the use of steel leaders during a period of three consecutive months between April and September, and continue the prohibition annually until sufficient data are available to change this recommendation.

**RECOMMENDATIONS:**

CPCs subject to the terms of paragraph 7 of Resolution C-16-06 should implement a prohibition on the use of steel leaders during a period of three consecutive months from April through September of each year for the relevant portions of their national fleets. Pursuant to Paragraphs 9 and 10, CPCs should notify the Commission of the period of the prohibition, the number of vessels subject to the prohibition, and of how compliance with the prohibition will be monitored.

### 2.2. Seabirds

Resolution C-11-02 should be revised consistent with the current state of knowledge regarding seabird mitigation techniques, as described in document SAC-05 INF-E. 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.

**RECOMMENDATIONS:**

Revise Resolution C-11-02 consistent with the current state of knowledge regarding seabird mitigation techniques

## B. DATA COLLECTION

## 3. SHARKS

### 3.1. 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 essential if conventional stock assessments and/or indicators of stock status are to be developed for these species.

There are continuing data deficiencies for three fishery components that catch silky and/or hammerhead sharks in the EPO: 1) coastal longline and gillnet fisheries (SAC-07-06b(iii); SAC-08-07e); 2) high-seas longline fisheries (SAC-08-07b; SAC-08-07e); and 3) small[4] purse-seine vessels (SAC-08-06a). Project C.4.a of the Strategic Science Plan is developing an experimental design for a long-term sampling program for component (1). Since shark fishery data are essential for an assessment, the staff recommends that funding be secured for implementing the sampling program after the pilot project is completed in 2019, and that a workshop series on data preparation for hammerhead sharks be conducted, as was done for the silky shark and dorado. Because data for hammerhead species are limited, the workshops may focus on compiling life history information.

**RECOMMENDATIONS:**

1. Implement a long-term sampling program for coastal longline and gillnet fisheries, to begin in 2020.
2. Conduct a workshop series on data preparation for hammerhead sharks during 2020-2021.

In addition, given the scale and importance of the shark fisheries in Central America 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 some of the ports where most shark landings occur.

As regards fishery component (2), Resolution C-12-07 requires that vessel captains record data on quantities of shark catches transshipped, but not by species. Species data are needed for accurate estimates of species-specific catches, so the staff recommends that vessel captains record transshipments of sharks by species.

**RECOMMENDATION:** Require vessel captains to complete the transshipment declaration forms of Resolutioin C-12-07 by species, for all shark catches.

Previous recommendations by the staff on data collection by observers on longline vessels and Class 1-5 purse-seine vessels are reiterated in Section 6.

## 4. FISH-AGGREGATING DEVICES (FADs)

The recommendations in this section are based on document FAD-03 INF-A.

### 4.1. Provision of data on FADs

CPCs are required by Resolution C-16-01 to provide data on FADs for the previous calendar year "*no later than 60 days prior to each regular meeting of the SAC*", and the scientific staff of the IATTC is required to

[4] Classes 1-5; carrying capacity ≤ 363 t

present a preliminary analysis of that information to the SAC. However, given the many other tasks required of the staff in preparation for the meeting of the SAC, this does not allow sufficient time for a thorough analysis of the data, therefore more timely provision of data is desirable.

**RECOMMENDATION:**

CPCs should provide the FAD data from each fishing trip to the IATTC staff as soon as they receive them at the end of that trip.

### 4.2. Updates of FAD data-collection forms

FAD form 9/2016 and the IATTC *Flotsam Information Record* are reasonable sources of data on FAD structures, characteristics, and associated catch, and they record a large part of the data necessary to assess the impacts of FADs on the ecosystem. However, they are not designed to track floating objects over time, and the resulting lack of tracking data is impeding scientific research.

**RECOMMENDATION:**

Modify FAD form 9/2016, and the observer program's Flotsam Information Record, to include new fields that will enable FADs to be tracked over time, as specified in document FAD-03 INF-A.

### 4.3. Provision of high-resolution buoy data

Under Resolution C-17-02, CPCs are required to provide "daily information" on their active FADs, which is interpreted to mean a single data point per FAD per day, the selection criteria for which are unclear. This combination of low resolution and uncertain selection criteria means that these data are of limited scientific utility. Moreover, they are inadequate even for analyses to determine the level of resolution that is actually required for an assessment of the FAD fishery. The IATTC staff therefore request the raw buoy data in order to conduct the appropriate scientific analyses.

**RECOMMENDATION:**

CPCs should provide to the IATTC staff the same raw buoy data received by original users (*i.e.* vessels, fishing companies).

### 4.4. Definition and standardization of terminology regarding FADs

Some terms and language in Resolutions C-16-01 and C-17-02 are unclear and/or undefined, or conflict with definitions used in other IATTC programs or other t-RFMOs. For example, the definition of a FAD in the AIDCP observer manual is different to that of Resolution C-16-01, the terms "active FAD" and "operator" in C-17-02 are not defined, nor is the distinction between "vessel" and "owner". Also, there are apparent assumptions made in the resolutions that should be clarified and resolved, and apparent oversights, such as not requiring unmonitored natural floating objects to be reported, that should be rectified. Some of these terms are listed in Annex 4 of document FAD-03 INF-A.

Some of this work could be carried out in coordination with the *ad-hoc* working group established under Resolution C-17-05 to review the legal and operative coherence of IATTC resolutions.

**RECOMMENDATIONS:**

1. Define and/or clarify terms and concepts used in instruments and documents related to FAD issues (Document FAD-03 INF-A, Annex 4).
2. As appropriate, standardize and harmonize the terminology related to FADs used in different ocean regions, specially within tuna RFMOs.

## 5. FISHING GEAR CONFIGURATIONS

Describing changes in gear configurations is important for monitoring changes over time in fishing strategies to improve stock assessments and management advice (SSP, Target J.1.).

**RECOMMENDATION:**

Require that vessels submit the purse-seine and longline gear description forms appended to Document SAC-05-05. Any significant modifications made to the gear subsequently should be reported on these forms prior to departing port with the modified gear.

## 6. OBSERVER COVERAGE

### 6.1. Purse-seine fishery

#### 6.1.1. Observer coverage of purse-seine vessels of less than 363 t carrying capacity

Trips by small vessels are rarely sampled by observer programs (SAC-08-06a), and vessel logbooks and cannery unloading records are the principal sources of data on the activities of these vessels. However, they generally do not contain information on tuna discards, and the data are less complete and detailed that those collected by observers. In addition, bycatch information is not always recorded in logbooks, which hampers efforts to conduct assessments for such species. Electronic monitoring is currently being explored (SSP, Project D.2.a) but it is not yet known whether this will provide data of sufficient quality. A full-time observer program is needed to obtain the data necessary for estimating the quantity and species composition of bycatches by small vessels, and understanding the strategies and dynamics of their operations. Based on a previous study of EPO data for Class-6 vessels fishing on floating-objects (IOTC Proceedings WPDCS-01-09, 4: 48–53), a sampling coverage of 20% is recommended. In the future, the level of sampling coverage will be re-evaluated with data from the recent Class-6 fishery and for all set types.

**RECOMMENDATION:**

Establish an observer program for purse-seine vessels of less than 363 t carrying capacity. The recommended level of sampling coverage is 20%.

### 6.2. Longline fishery

#### 6.2.1. Observer coverage

Resolution C-11-08 requires that at least 5% of the fishing effort by longline vessels greater than 20 m length overall (LOA) carry a scientific observer. However, 5% coverage is too low for calculating accurate estimates of the catches of species caught infrequently in those fisheries, such as some sharks of conservation concern; 20% coverage is considered the minimum level required for such estimates. Both the staff and the SAC have recommended that this level of coverage be adopted for longline vessels over 20 m LOA.

**RECOMMENDATION:**

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

#### 6.2.2. Data standards and reporting

Resolution C-11-08 requires that CPCs submit to the Scientific Advisory Committee, by 31 March of each year, information collected by observers on longline vessels on the previous year's fishery. The reports submitted by CPCs document compliance with the 5% observer coverage requirement, and include summaries of the data collected in the previous year. At its 8th meeting in May 2017 (SAC-08), the SAC recommended minimum standards (Recommendation 14) for collecting and reporting operational-level data by longline observer programs, including a standardized format. In August 2017 the staff requested that the relevant historical data for 2013-2016 (since the entry into force of C-11-08) be submitted by 31 December 2017, but the response to date has been very limited. A proposed format for the annual summary reports was circulated in March 2018, and can also be found in Attachment 2 to SAC-09 INF-A.

**RECOMMENDATIONS:**

1. CPCs should submit all operational longline observer data collected from 1 January 2013 to present, consistent with the recommendation by SAC-08.
2. Adopt a standardized format for the annual longline observer data reports by CPCs, such as the one proposed by the IATTC staff (see SAC-09 INF-A)

**Appendix 1.**

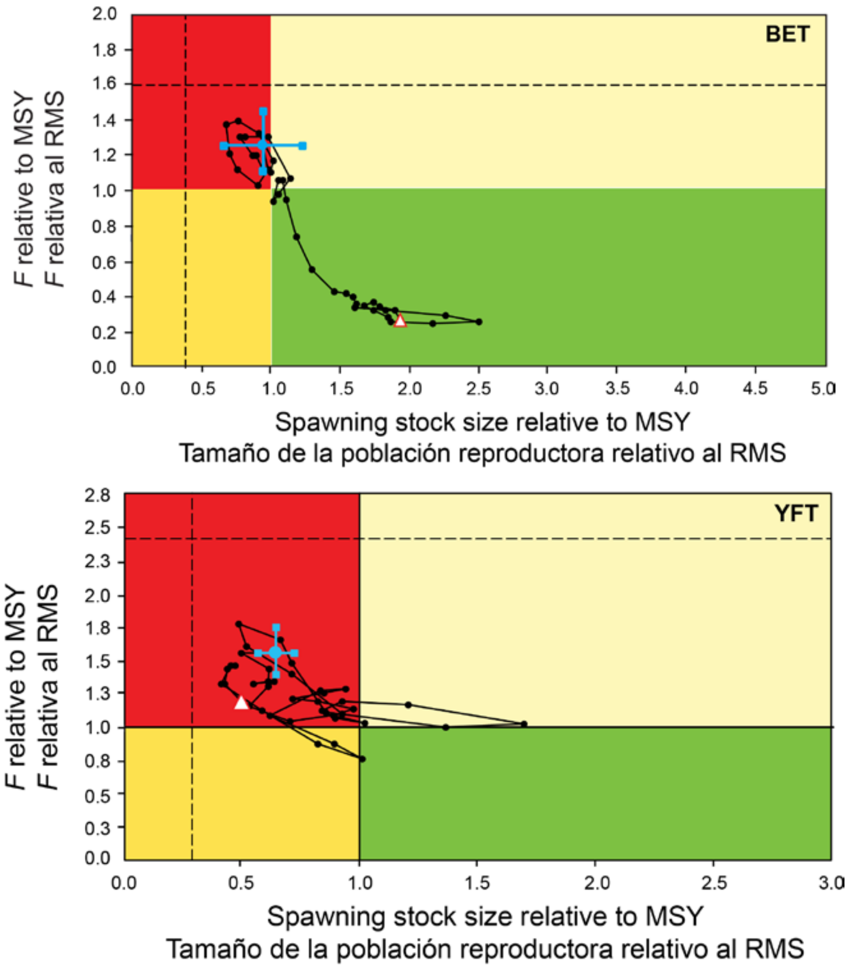


**FIGURE A.1**. Kobe (phase) plot of the time series of estimates of spawning stock size (top panel: bigeye; bottom panel: yellowfin) and fishing mortality relative to their MSY reference points for the sensitivity analysis that assumes a stock-recruitment relationship (*h* = 0.75). The colored panels represent target reference points ($S_{MSY}$ and $F_{MSY}$; solid lines) and limit reference points (dashed lines) of 0.38 $S_{MSY}$ and 1.6 $F_{MSY}$, which correspond to a 50% reduction in recruitment from its average unexploited level based on a conservative steepness value (*h* = 0.75) for the Beverton-Holt stock-recruitment relationship. Each dot is based on the average fishing mortality rate over three years; the large dot indicates the most recent estimate. The squares around the most recent estimate represent its approximate 95% confidence interval. The triangle represents the first estimate (1975).

**FIGURA A.1.** Gráfica de Kobe (fase) de la serie de tiempo de las estimaciones del tamaño de la población (arriba: patudo; abajo: aleta amarilla) y la mortalidad por pesca en relación con sus puntos de referencia de RMS correspondientes al análisis de sensibilidad que supone una relación población reclutamiento. Los paneles representan puntos de referencia objetivo ($S_{RMS}$ y $F_{RMS}$). Los paneles de colores representan puntos de referencia objetivo y ($S_{RMS}$ and $F_{RMS}$; líneas sólidas) y límite (líneas de trazos) de 0.38 $S_{RMS}$ y 1.6 $F_{RMS}$, que corresponden a una reducción de 50% del reclutamiento de su nivel no explotado medio basado en un valor cauteloso de la inclinación (*h* = 0.75) de la relación población-reclutamiento de Beverton-Holt. Cada punto se basa en la tasa de mortalidad por pesca media de tres años; el punto rojo grande indica la estimación más reciente. Los cuadrados alrededor de la estimación más reciente representan su intervalo de confianza de 95% aproximado. El triángulo representa la primera estimación (1975).

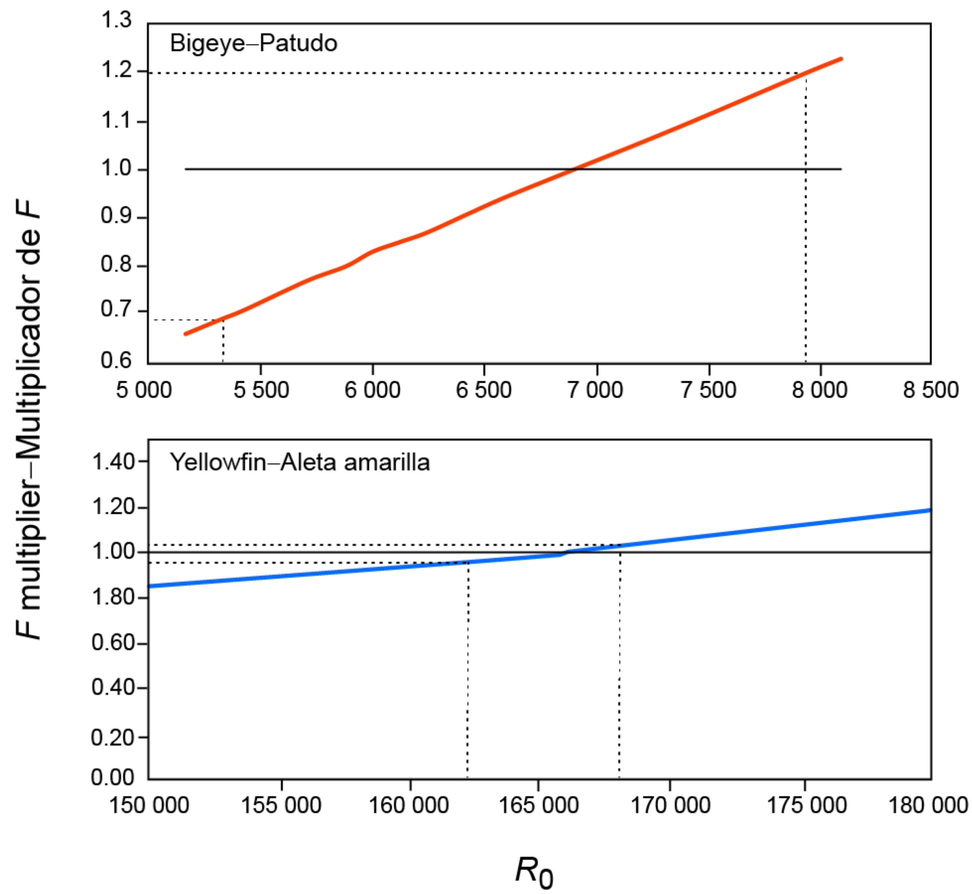


**FIGURE A.2**. Approximate 95% confidence intervals for *F* multiplier for bigeye (top) and yellowfin (bottom) tuna based on a likelihood profile for the virgin recruitment ($R_0$). The likelihood profile is an alternative method for estimating uncertainty in the *F* multiplier and takes into consideration the asymmetric nature of the confidence intervals. The vertical dashed lines indicate the 95% confidence intervals for $R_0$, and the horizontal dashed lines the corresponding confidence intervals for the *F* multiplier.

**FIGURA A.2**. Intervalos de confianza de 95% aproximados del multiplicador de *F* de patudo (arriba) y aleta amarilla (abajo), basado en un perfil de verosimilitud del reclutamiento virgen ($R_0$). El perfil de verosimilitud es un método alternativo para estimar la incertidumbre en el multiplicador de *F*, y toma en consideración la naturaleza asimétrica de los intervalos de confianza. Las líneas de trazos verticales indican los intervalos de confianza de 95% de $R_0$, y las líneas de trazos horizontales los intervalos de confianza correspondientes del multiplicador de *F*.

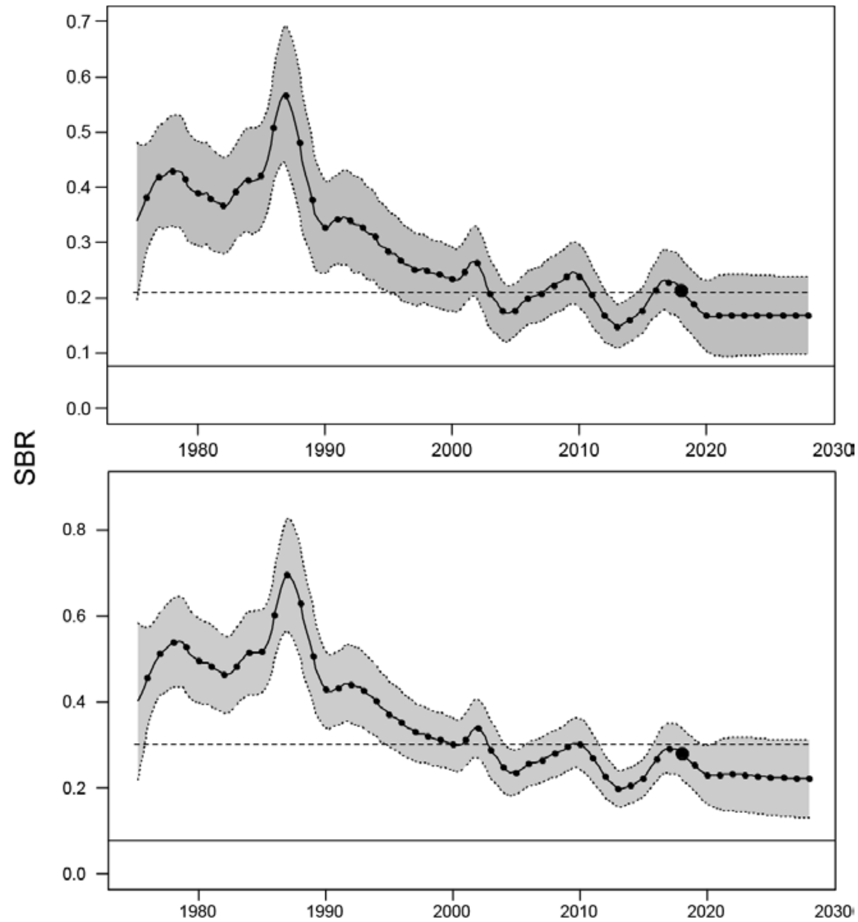


**FIGURE A.3.** Estimated spawning biomass ratios (SBRs) of bigeye tuna in the EPO, including projections for 2018-2028 based on average fishing mortality rates during 2015-2017, from the base case (top panel) and the sensitivity analysis that assumes a stock-recruitment relationship (*h* = 0.75, bottom panel). The dashed horizontal line (at 0.21 and 0.30, respectively) identifies the SBR at MSY. The solid line illustrates the maximum likelihood estimates, and the estimates after 2018 (the large dot) indicate the SBR predicted to occur if fishing mortality rates continue at the average of that observed during 2015-2017, and recruitment is average during the next 10 years. The shaded area represents the 80% confidence intervals, and the solid horizontal line represents the limit biomass reference point (*d* = 0.077, Maunder and Deriso 2007). If the shaded area extends below that line, the probability of exceeding the limit reference point is at least 10% (Resolution C-16-02).

**FIGURA A.3.** Cocientes de biomasa reproductora (SBR) estimados de atún patudo en el OPO, incluyendo proyecciones para 2018-2028 basadas en las tasas medias de mortalidad por pesca durante 2015-2017, del caso base (recuadro superior) y el análisis de sensibilidad que supone una relación población-reclutamiento (*h* = 0.75, recuadro inferior). La línea de trazos horizontal (en 0.21 y 0.30, respectivamente) identifica $SBR_{RMS}$. La línea sólida ilustra las estimaciones de verosimilitud máxima, y las estimaciones a partir de 2018 (el punto grande) señalan el SBR que se predice occurrirá si las tasas de mortalidad por pesca continúan en el promedio observado durante 2015-2017 y el reclutamiento es promedio durante los 10 años próximos. El área sombreada representa los intervalos de confianza de 80%, se y la línea horizontal solemne representa el punto de referencia límite de biomasa (*d* = 0.077, Maunder y Deriso 2007). Si el área sombreada se extiende por debajo de esa línea, la probabilidad de rebasar el punto de referencia límite es al menos 10% (Resolución C-16-02)

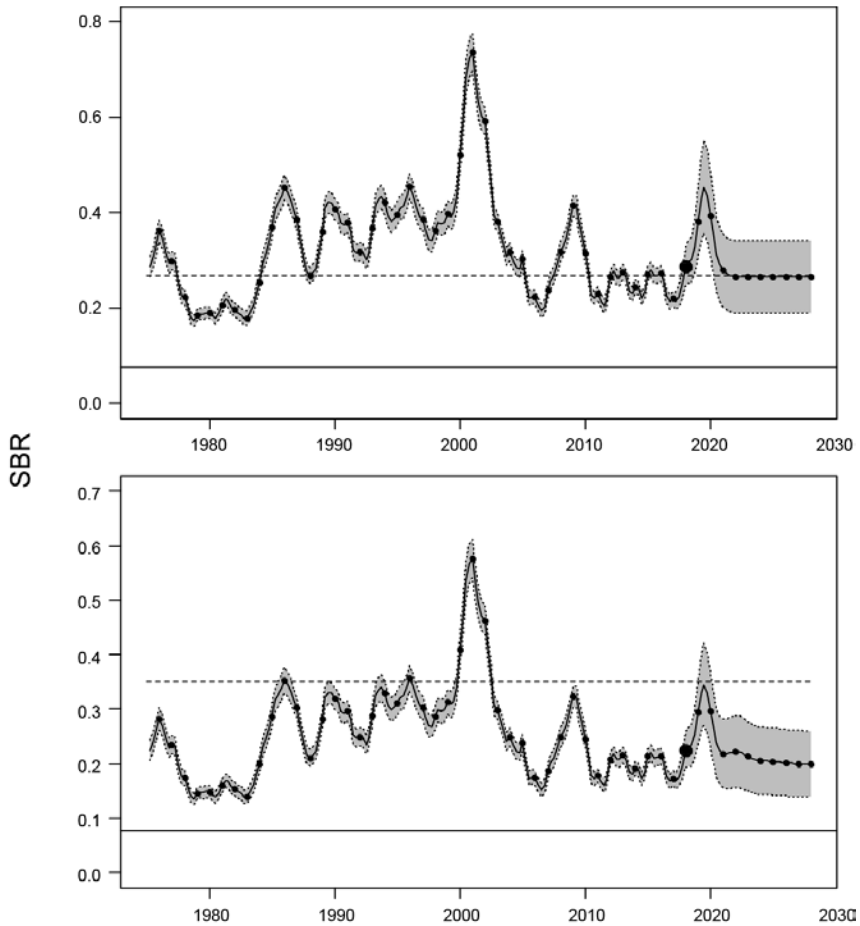


**FIGURE A.4.** Estimated spawning biomass ratios (SBRs) of yellowfin tuna in the EPO, including projections for 2018-2028 based on average fishing mortality rates during 2015-2017, from the base case (top panel) and the sensitivity analysis that assumes a stock-recruitment relationship (*h* = 0.75, bottom panel). The dashed horizontal line (at 0.27 and 0.35, respectively) identifies the SBR at MSY. The solid line illustrates the maximum likelihood estimates, and the estimates after 2018 (the large dot) indicate the SBR predicted to occur if fishing mortality rates continue at the average of that observed during 2015-2017, and recruitment is average during the next 10 years. The shaded area represents the 80% confidence intervals, and the solid horizontal line represents the limit biomass reference point (*d* = 0.077, Maunder and Deriso 2007). If the shaded area extends below that line, the probability of exceeding the limit reference point is at least 10% (Resolution C-16-02).

**FIGURA A.4.** Cocientes de biomasa reproductora (SBR) estimados de atún aleta amarilla en el OPO, incluyendo proyecciones para 2018-2028 basadas en las tasas medias de mortalidad por pesca durante 2015-2017, del caso base (recuadro superior) y el análisis de sensibilidad que supone una relación población-reclutamiento (*h* = 0.75, recuadro inferior). La línea de trazos horizontal (en 0.27 y 0.35, respectivamente) identifica $SBR_{RMS}$. La línea sólida ilustra las estimaciones de verosimilitud máxima, y las estimaciones a partir de 2018 (el punto grande) señalan el SBR que se predice occurrirá si las tasas de mortalidad por pesca continúan en el promedio observado durante 2015-2017 y el reclutamiento es promedio durante los 10 años próximos. El área sombreada representa los intervalos de confianza de 80%, se y la línea horizontal solemne representa el punto de referencia límite de biomasa (*d* = 0.077, Maunder y Deriso 2007). Si el área sombreada se extiende por debajo de esa línea, la probabilidad de rebasar el punto de referencia límite es al menos 10% (Resolución C-16-02).