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(by videoconference)

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DOCUMENT IATTC-98 INF-A

IMPLEMENTATION AND MONITORING OF BIGEYE CATCH LIMITS IN THE EASTERN PACIFIC OCEAN, INCLUDING AN INDIVIDUAL VESSEL LIMITS SCHEME: STAFF CONSIDERATIONS

SUMMARY

Several CPCs have proposed using individual vessel limits (IVLs) to ensure that fishing mortality for bigeye tuna does not exceed the *status quo* (2017-2019). The staff has provided advice on the use and implementation of IVLs in several documents over the past decade. Here we summarize this advice for the convenience of the CPCs. Staff considerations as regards implementation of IVL schemes, such as those currently proposed by several CPCs, are summarized in IATTC-98 INF-B.

The staff does not recommend an IVL scheme due to several issues that are difficult to overcome. First, it is difficult to calculate the overall catch limit that is desired. And second, it is difficult to monitor the catch limits, particularly since the infrastructure to do so is not currently in place.

1. BACKGROUND

The staff's 2020 risk analysis (SAC-11-08) for the tropical tuna fishery in the EPO indicated that the recent management measures (C-17-02, extended through 2021 with C-20-06) were adequate in the short term (see Document SAC-11-15). Although the staff did not recommend changes in the numbers of closure days, for precautionary reasons the staff did recommended additional measures to prevent fishing mortality from increasing beyond the *status quo* levels (see Document SAC-11 INF-M). From November 30 to December 4, 2020, the 95th Meeting of the IATTC produced no consensus on the adoption of additional precautionary measures recommended by the staff, which prevented the adoption of conservation and management measures for the tropical tunas in 2021 and beyond. An extraordinary 96th meeting of the Commission was held on December 22, 2020, and Resolution C-20-05 was adopted to extend the measures established in C-17-02 for the year of 2021, without adopting the additional precautionary measures recommended by the staff, to be recorded as Resolution C-20-06.

Three main goals were captured in C-20-05: 1) review the management measures for 2022 and beyond, no later than the annual meeting of 2021, with a view to ensuring long-term conservation of fish stocks in the Convention Area; 2) continue working on the development of comprehensive measures including, but not limited to, the management of FADs based on scientific advice and the precautionary approach; 3) to engage inter-sessionally in order to facilitate agreement at an extraordinary meeting of the Commission to be held at the latest in June 2021, and likewise at the annual meeting of the Commission in August of 2021, on comprehensive additional measures for the sustainable management of the tropical tuna fishery based of scientific advice.

At the 97th Meeting (extraordinary) of the IATTC from 7-10 June 2021, the staff reiterated its 2020 recommendation (SAC-11-15) that additional precautionary measures are needed to ensure that the *status quo* fishing mortality is not exceeded. There are several types of management measures that could be considered (e.g., measures summarized in SAC-12 INF-B). The staff reviewed the advantages and disadvantages of each option, as well as potential solutions to mitigate or compensate the disadvantages (e.g., SAC-11 INF-M). The staff also weighed the management benefits against data and infrastructure shortcomings (i.e., for monitoring and compliance) and concluded that an extended temporal closure, based on the previous year's number of floating-object (OBJ) sets (only if the *status quo* is exceeded), combined with individual-vessel daily active FAD limits, would be the best option to maintain the *status quo* and thus prevent an increase in F within the management cycle (SAC-12-08). The closure would be for both OBJ and unassociated (NOA) set types, and apply to all purse-seine vessels, except those that in recent years made mostly NOA sets (vessels that have made 75% or more of their sets on unassociated schools in each of 3 of the past 5 years (2015-2019)). In addition to the measures already established in C-17-02, and extended through C-20-06, these two additional precautionary measures would help control the two remaining aspects of the fishery that are not sufficiently constrained (OBJ sets and FADs at sea), which, if left unconstrained, might allow fishing mortality to increase. The detailed rationale for these recommended measures along with the description of the methodology used to obtain the best scientific estimate (BSE) of the total number of OBJ sets is provided in Document SAC-12-08.

Although various proposals were put forward by CPCs during the 97th Meeting of the Commission (see Annex 1 with summary of proposals), a consensus was not reached on additional measures and negotiations will continue towards the 98th Meeting of the Commission to be held virtually from 23-27 August 2021. One observation that has received significant attention by CPCs is that noted in proposal A-2. Specifically, that a small fraction of vessels is responsible for a large fraction of the bigeye catches. To target this issue, two proposals were presented by Members for an Individual Vessel (IVL) catch limit scheme for bigeye.

The staff concurs that, if implemented successfully, an IVL catch scheme could potentially address the issue at hand for bigeye, that is to prevent that the *status quo* fishing mortality is not exceeded during the next management cycle under consideration. In particular, an IVL scheme could stimulate good practices for minimizing bigeye catches. However, there some major challenges that need to be addressed with respect to implementation of such a scheme, in particular those related to monitoring and compliance. This paper consolidates views previously offered by the staff in different documents. We start with a discussion of global catch limits, since a IVL scheme would typically be designed to implement a global catch limit.

2. GLOBAL (TOTAL) CATCH LIMITS

Catch limits are easy to understand, are used worldwide, and the IATTC has a long history of working with catch limits. Basically, a decision is taken about how the fishery will be restricted or closed when the total global limit is reached. The simplest way to establish a global catch limit is to set one for the whole fleet. However, this global limit could be distributed, through some form of allocation, among different levels of fisher aggregation (e.g., by set type, CPC, catch limits based on catches in economic exclusive zones and the high seas, or IVLs). Section 3 of this paper will focus on IVLs, which are being considered in proposals A-2 and A-5. A review of the other forms of catch limits can be found in section 4 of SAC-12 INF-B.

The advantage of global catch limits is that they are not dependent on fleet or vessel capacity, and are therefore not sensitive to the issues related to calculating capacity or to changes in capacity. In general, if the capacity increases, the fishery will reach the catch limit earlier, resulting in an increased fishery closure. In addition, if the catch limits are by species they will automatically account for the possibility that an increase in capacity may primarily affect a certain set type because the main fishing methods (dolphin-associated sets and OBJ sets) catch different species and ages.

There are, however, disadvantages associated with global catch limits. For example, as often happens with catch limits, they could cause a "race to fish", with vessels rushing to catch as much as possible before the limit is reached; which in turn can result in an early closure of the fishery in a given year—a result that can be hard to accept from a political standpoint. The IATTC adoption of catch limits in 2017 highlighted some of the disadvantages of a catch limit approach. High catch rates were experienced in 2017 and the catch limit was reached well before the additional equivalent days of closure would have come into effect. The reaction to this result from CPCs resulted in a within-year reevaluation of management by IATTC staff, and ultimately, a decision to revert to extending the days of closure rather than maintaining the catch limits. The higher catch rates were probably caused by higher abundance due to good recruitment entering the fishery, which would have resulted in fishing mortality rates lower than F_{MSY}, rather than a race to fish. However, they could have also been due to increased catchability due to changes in environmental conditions or in fishers' behavior, and this would have resulted in fishing mortalities higher than F_{MSY}.

Reliability of reporting may also become a problem as the conservation measures become more complicated and stringent. There are challenges related to monitoring and compliance of catch limits (SAC-12 INF-B), particularly in real time, and these are addressed in Section 4 below. A comprehensive discussion of the advantages and disadvantages of catch limits, as well as a comparison with effort limits can be found in Squires et al. (2017).

2.1. Approaches for estimating the global catch limit

A global catch limit first needs to be determined, regardless of whether allocation to smaller fishery units is planned. Appropriate determination of the catch limit value associated with application of the F_{MSY} harvest control rule requires estimation of the stock biomass that is vulnerable to the fishery in the year for which the catch limit is to be applied. This differs from simply using the maximum sustainable yield (MSY), which is based on the average stock biomass, as a catch limit. The staff considered three methods which could be used to estimate a total catch limit for bigeye:

a) Stock assessment projection method: The first method which could be considered to determine the total catch limit is stock assessment projections. Although the stock assessments can project future biomass, projections have not been used to calculate catch limits by the IATTC staff. The management measures are currently set, in principle, in July or August for the following year(s) based on assessments using data from the previous year. This means that the population has to be projected two or more years (or four years, given that a 3-year multi-year management package is under consideration) into the future to calculate the appropriate catch limit. The uncertainty in these predictions includes parameter estimation uncertainty (as presented in the Kobe plots), model structure uncertainty (as presented in sensitivity analyses and the recently developed risk analysis; SAC-11-08), and future variation in recruitment (as accounted for in the confidence intervals of the projections), and uncertainty in catchability and effort levels. A comprehensive analysis of this uncertainty has not been carried out, but it is likely to be large as indicated by prior unpublished research for yellowfin tuna. In addition, since the OBJ fishery catches mostly juveniles, there will be no inertia in the biomass estimates and they will be based mainly on unobserved recruitments. These will be represented by average recruitment in the stock assessment model and may not predict the realized recruitment well. Improvements would be possible if recruitment could be predicted, but we currently do not have a good method to predict recruitment. Of particular concern is El Niño and La Niña events, which may have a large impact on bigeye recruitment. For these reasons, stock assessment projections are not the preferred method by the staff to estimate the total catch limit.

b) CPUE as proxy of abundance: As an alternative to using model projections of abundance, catch-per-unit-of-effort (CPUE) could be used as a proxy for abundance. This assumes that CPUE is proportional to abundance. This approach is similar to in-season catch increments used previously by the IATTC. However, there are a number of factors that may invalidate the proportionality assumption, including the measure of effort used (days fished, number of sets, etc.) and changes in catchability over time. In addition, the CPUE would have to be reasonably current to ensure it represents current abundance. The most up-to-date CPUE data available would be the catch-per-capacity-fishing data from the weekly reports provided by observers. The catch limits (CL) for 2022, for example, could be calculated by adjusting the average catch (C) during 2017-2019 by the ratio of the cumulative mid-year CPUE in 2022 to the average mid-year CPUE during 2017-2019. The CPUE is calculated as the cumulative catch in the IATTC weekly report (CWR) at the midpoint of the year divided by the sum of the weekly operative capacity during the first semester of the year (CPUE = CWR/sum(weekly capacity)). Thus:

$$CL2022 = [(C2017+C2018+C2019)/3]*CPUE2022/[(CPUE2017+CPUE2018+CPUE2019)/3]$$

This approach is affected by all the issues associated with defining capacity and how it relates to fishing mortality, as described above. Improvements could be made by using a more appropriate measure of effort, such as number of sets or days fished. For vessels with observers, this information is currently provided in, or might be estimated from, their weekly radio reports. For vessels without observers, a weekly reporting system would need to be established to obtain the necessary information in near real-time.

c) Average catch

The global catch limit could be based on average catch in the years used in the stock assessment to calculate the *F* multiplier. The catch limits used in 2017 were based on this method. The assumption is that, if the *F* multiplier in those years is close to 1, then the catch should be close to the level corresponding to the F_{MSY} harvest control rule. However, this assumes that the stock abundance in the year corresponding to the catch limit is the same as in the years used to calculate the *F* multiplier. Unfortunately, tropical tunas are short-lived, and their abundance fluctuates substantially, so the stock size can also vary substantially from year to year, influencing the appropriate catch levels. This is particularly true for fisheries that catch juvenile tunas (e.g., the OBJ fishery) and thus involve only a few cohorts, so that variations in recruitment have a substantial impact on the abundance of tuna vulnerable to the fishery.

The catch limit could also be adjusted for the *F* multiplier estimated by the assessment to make sure that the limit is equal to the application of the F_{MSY} harvest control rule. If the *F* multiplier is not equal to 1, then this implies that the average catch over the corresponding period does not correspond to application of F_{MSY}. The simplest method would be to assume that the catch should be adjusted in proportion to the *F* multiplier, although this assumption is not strictly correct.

Care needs to be taken in choosing the appropriate data set to calculate the catch limits to ensure that they are consistent with the data used to enforce the catch limit. For example, the species composition of the catch used in the stock assessments is based on port-sampling species-composition data (i.e., on the Best Scientific Estimate (BSE) of the species composition), but data that could be used for monitoring the catch limits in near real-time, such as those provided by observers, are not adjusted by the species-composition sampling. If there is a bias in the estimates of species composition from data sources available in near real-time, there will be a bias in determining when the limit has been reached. Thus, if monitoring of the catch limits is to be based on data provided by observers, or by vessel captains for vessels not carrying an observer, it would be appropriate to base the limits on annual catch summaries of observer and logbook data, such as are available from the IATTC Catch and Effort (CAE) database, with a correction for coverage, if necessary. It should be kept in mind that the catch estimates, by species, that can be made by the observer are less reliable than those obtained from port-sampling because an observer's access to the fish is limited; currently, observers often rely on consultation with vessel personnel to estimate catch composition.

3. INDIVIDUAL VESSEL CATCH LIMITS (IVLS)

IVLs to reduce the catch of bigeye tuna in the EPO purse-seine fishery have been discussed previously. Documents SAC-04-11 and IATTC-82 INF-A discuss the numerous logistical issues that have to be addressed before implementing IVLs (e.g., monitoring). Examples of the IVLs, their calculation, and further details are provided in Documents IATTC-90 INF-B Addendum 1, IATTC-91-03a, and IATTC-91-03a Addendum 1.

IVLs have most, if not all, of the issues related to global catch limits. For example, the limits should be based on the current stock abundance. The IVLs could be set as a proportion of the global limit so that they could be automatically adjusted every year using the approaches described for the global limits.

IVLs would give more flexibility to each vessel regarding its fishing strategies and could promote the development of techniques to avoid catching species that are more vulnerable (e.g., bigeye in the OBJ-set fishery). The limits could be based on catch history, fishing capacity, a mixture of historical catch and fishing capacity, or another criterion. Setting the limits on fishing capacity could be based on one of two scenarios that may occur when individual limits are implemented. The first scenario assumes that when a limit is given to a vessel it will change its behavior to catch that limit even if historically it did not catch that much of the species controlled by the limit. The disadvantage of this approach is that some vessels may have limits much lower than their historical catch, and if the other vessels are unable or unwilling to change their fishing strategy, the combined limit will be set too low. The second scenario assumes that vessels will fish in the same way as they did in the past so that they will not catch their limit if their historical catch was low. This approach will allow higher catch limits for all vessels and mainly restrict only those vessels that historically caught a large amount of the species controlled by the limit, but if vessels that historically caught little of that species are able to change their fishing strategy to catch more, the catch will be much higher than desired. In general, this method is not appropriate for the main target species (e.g., yellowfin tuna in the dolphin-associated fishery) because it assumes that vessels that did not catch their IVL in the past will not catch it in the future, even though in actuality it is likely that vessels will try to maximize their target catch relative to the IVL. In general, this is less of an issue for non-target species, but this may not always be the case. The total catch may need to be calculated and the limits re-evaluated on an annual basis to minimize the chance that the total catch limit is exceeded.

One benefit of the IVL system is that, if implemented appropriately, only vessels that historically caught large amounts of bigeye tuna relative to their capacity will have to reduce their catches the most. To prevent the IVL system from resulting in higher catch due to changes in fishing behavior, it could be combined with an overall catch limit, which could be by country or simply a global (total) fleet limit (see Section 2).

4. MONITORING COMPLIANCE

Most, if not all, of the compliance monitoring issues associated with global catch limits also apply to other types of catch limits. However, there are several practical difficulties with monitoring IVLs, including:

1. **Determining when a vessel has reached its IVL can be problematic**. The determination would necessarily be based on estimates of the vessel's year-to-date catch of bigeye; thus, both the quantity and the species composition of the catches have to be determined. The only real-time estimates are those made by the observer aboard the vessel, the observer has limited access to the fish to make estimates and must rely on visual methods such as a series of estimates of the catch by species during fish brailing and/or advice from the vessel's personnel. If the determination is made after the catch is unloaded in port, usually the only estimate available is that made by the cannery that receives the catch. If the vessel has been sampled by IATTC staff during unloading, those data will also be available, but the port-sampling program covers only a small percentage of the total catch and the current sampling program was never intended to estimate catch composition by trip.

   Possible solutions:

   At-sea sampling by the observer

   Observer sampling of the catch during brailing could be implemented to generate an independent data source with which to estimate the catch composition of each set. Although at-sea sampling by observers has been used in other oceans, it has not been attempted in the EPO and a sampling protocol would need to be developed. At-sea sampling would impact other data collection duties of the observer, and therefore the quality of the AIDCP observer data, unless a second observer was onboard every trip for which at-sea sampling was to occur. In order to estimate the cumulative amount of bigeye catch for the trip in near real-time, additional infrastructure may be required to allow the observer to send the catch composition data to the La Jolla office at least once per week. Computer resources and programming personnel at the La Jolla office would need to be supplemented to handle the near real-time influx of data and estimation. At-sea sampling would not be possible for trips without an observer. There is no comprehensive plan for at-sea sampling and therefore it is not feasible in the short-term. Any at-sea sampling program would have to be considered in the reorganization of the whole observer program including reevaluating the goals of the program or the addition of a second observer specific to sampling duties. Additionally, it is possible that at -sea sampling could require changes in how catch is brailed or slow the brailing down according to the needs of observers, which carries with it the possibility of increased tension between the vessel personnel and the observers. Observers do not currently have the authority to instruct a vessel to alter their operations to facilitate their work.

Increase the level of port-sampling

The current level of port-sampling is not adequate to estimate catch composition by trip, because it was designed to estimate the total fleet catch by species. However, the level of port-sampling could be increased for the purpose of monitoring IVLs. Increasing sampling for all trips might not be necessary, from the point of view of science, if trips can be selected in advance for sampling, using other information. For compliance, some level of increased sampling may be required for trips of all vessels, but in terms of helping CPCs estimate their vessels' catches relative to an IVL, the focus of this increased sampling would need to be on vessels likely returning with the largest catches of BET. Port-sampling data are not available in near real-time and therefore the estimated catch composition for the trip would only be available after the vessel unloaded in port, prohibiting near real-time monitoring. The time frame of the system used to evaluate the IVLs would need to be modified to accommodate this delay. The use of port-sampling data has the advantage that they can be obtained from trips without an observer and represent an independent source of data for monitoring IVLs. However, port-sampling data are not presently collected in all ports of unloading, and would be challenging to collect for vessels that unload in remote locations in the EPO or in the western Pacific. Although a protocol for the additional sampling remains to be developed, it is anticipated that it will likely involve substantially increasing the number of wells and trips sampled.

Cannery data

Cannery data could be used to monitor catch IVLs, although, as with port-sampling data, cannery data are not available in near real-time and, therefore, estimates of catch composition for the trip would only be available after the vessel unloaded in port, prohibiting near real-time monitoring. The use of cannery data has the advantage that they can be obtained from trips without an observer and from trips that unload in ports where port-sampling is not possible. However, cannery data are currently not provided to the IATTC staff by all canneries, and the data that are provided are shared on a voluntary basis. If cannery data were to be used for help in monitoring of IVLs, improvements in both the provision of the data to the IATTC and the timing of that provision are needed and the CMMs adopting the use of IVLs would need address this and make it compulsory. Additionally, it is noted that cannery data do not represent an independent source of information on catch composition, which may compromise the reliability of those data for monitoring IVLs.

2. Impact of IVLs on observer data quality

Monitoring IVLs with data currently collect by observers has the potential to promote observer harassment and incentivize data misreporting because at present observers' estimates of catch composition includes discussion with vessel personnel; agreement between observer and the vessel on catch composition is important for tuna tracking. Implementation of IVLs can be expected to disturb this working relationship because now the captain and crew, that normally might help with estimates, would also have motivation to underestimate BET catch. On the other hand, asking observers to come up with these estimates completely independent of other input could also result in reduced accuracy—at least among some subset of observers. Additionally, it is possible that the implementation of IVLs could result in increased pressure on observers to misreport other data such as set types. This could in turn have a trickle-down impact on other data collection programs like the port-sampling program, as the process for selecting wells for sampling relies on observer data. Tuna tracking could be impacted as well. Negative impacts on the port-sampling program would, in turn, negatively impact the BSE catch estimation and stock assessments, etc.

3. The consequences of exceeding an IVL need to be determined

A vessel that has exceeded its IVL could be penalized in a subsequent year, by the reduction of its

IVL or by some other means. Vessels identified as exceeding the limit in the current fishing year could be allowed to continue fishing during that year, but be restricted to setting on other set types (dolphin-associated tunas and unassociated tunas only), or they might be prohibited from further fishing altogether. They could also be required to retrieve all their FADs that are active at the time the limit is exceeded. There are also several other possible consequences which should be accounted for when developing an IVL scheme (SAC-12 INF-B).

Solution: To be addressed and decided by Members.

5. CONCLUSION

The staff does not recommend an IVL scheme due to several issues that are difficult to overcome. First, it is difficult to calculate the overall catch limit that is desired. And second, it is difficult to monitor the catch limits, particularly since the infrastructure to do so is not currently in place. However, if a IVL scheme is implemented, INF-B outlines some “minimum standards” that will address, to some extent, the issues of the staff.

Annex 1. Recommendations (by the staff and the SAC) and proposals for the conservation of tropical tuna introduced by CPCs during the 97th Meeting of the IATTC.

	Measures	Recs		Proposals				
		Staff	SAC	COL-EU (A1)	VEN (A2)	US (A3)	JPN (A4)	ECU (A5)
OVERALL	Period	2022-2024	2022-2024	2022-2024	2022-2024	2022-2024	2022-2024	2022-2024
PURSE SEINE	Temporal closure (all set types)	72 days	72 days	72 days	72 days	90 days	72 days	72 days
	Extended closure	OR* (FAD and NOA sets)	Consider OR* among others				OR* (FAD and NOA sets)	10 days** (FAD sets by CPC)
	Corralito	Y	Y	Y	Y	Y	Y	Y
	Other spatial				FADs: 4N-3S/110-150W (Feb-Jun)			
	Force majeure (changes)					Y	Y	
	BET Catch limits				IVL/Global			IVL/Global ****
FADs	Limits – active FADs	IVL (2018-2019)		-30% reduction		-17-29%	IVL (2018-2019)	-30%***
	Limits – FAD sets							By CPC (2018 FAD sets)
	Buoy raw data provision	Y	Y	Y (Annex 2)		Y		
	FAD definitions					Y		
LONGLINE	BET catch limits	Y	Y	Y	Y	Y	Y	Y

*OR – Staff's proposed operational rule (SAC-12-06)
** Based on 2018 CPC "limit" on FAD sets
*** Except if using > 20% bioFADs – no reduction
**** Alternative to ** introduced at the meeting