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EVALUATION OF A TOTAL ALLOWABLE CATCH SYSTEM FOR THE PURSE-SEINE AND LONGLINE TUNA FISHERIES IN THE EASTERN PACIFIC OCEAN

1. INTRODUCTION

Excess fishing capacity is a concern worldwide, and the eastern Pacific Ocean (EPO) is no exception. Purse-seine fishing capacity has been increasing in recent years, and some members of the Commission consider that excess fishing capacity makes it more difficult for governments to agree on and implement effective conservation and management measures for the tuna fisheries of the EPO. The scientific staff was asked to consider the use of complementary management options, along with the established capacity limits and seasonal closures of the fishery, in order to insure that these fisheries are conducted at a sustainable level, and to align the economic incentives of fishermen and governments with the common overall goal of sustainability, conservation of biodiversity, economically viable fisheries, and net socioeconomic benefits. Management systems involving the use of catch allocations may have certain advantages, but it is important to identify and evaluate the potential problems associated with such allocation systems, and to propose modifications that might effectively overcome some of the major objections to their implementation.

The use of allocation systems in the EPO fishery for tropical tunas is complicated by the fact that there are more than 20 different national fleets fishing for tunas, with two main types of fishing gear, purse-seine nets and longlines,. There are three main modes of purse-seine fishing – for unassociated schools of tunas, tunas associated with dolphins, and tunas associated with floating objects – and more than one species is frequently caught in a single set. In 2010 the purse-seine fishery caught 461,079 metric tons (t) of the three principal species of tunas: yellowfin, (252,124 t; 98% of the total catch of yellowfin), bigeye (58,398 t; 72%) and skipjack (150,557 t; 99%); the longline catch was 26,332 t, or 6% of the total catch: 3,339 t of yellowfin (1% of the total catch of yellowfin) and 22,993 t of bigeye (28%). In 2010 all twenty members of the Commission were involved in these fisheries: Ecuador, Mexico, Venezuela, Panama, and Colombia had the largest number of purse-seine vessels, and together accounted for 85% of the purse-seine catches, while Japan, the Republic of Korea, and Chinese Taipei had the largest number of large longliners (over 24 meters length overall), which account for about 90% of the longline catches. Most of the purse-seine vessels fish both in national Exclusive Economic Zones (EEZs) and on the high seas, whereas the large longline vessels operate exclusively on the high seas.

The IATTC operates under the Antigua Convention which includes, *inter alia*, an obligation to take

measures to ensure the long-term sustainability of tuna stocks affected by the fishery in the Agreement Area (EPO), based on the best scientific evidence available, and apply the precautionary approach, and that such measures shall be designed to maintain or restore the biomass of harvested stocks at or above levels capable of producing the maximum sustainable yield (MSY). Therefore, the MSY can be used as a basis for developing long-term fishing limits for the allocation system. However, the current status of a stock may not permit the taking of its long-term MSY if the objective of sustainability of the stock is to be met. The catch projected for 2011 when fishing at the level of fishing mortality (F) that produces the MSY (F_{MSY}) would be more appropriate for the near term. Under the current (2010) status, the estimated MSY for yellowfin is 263,418 t (Document SAC-02-06), obtained by assuming that there is no stock-recruitment relationship and based on average fishing gear selectivity during 2008-2010, and for bigeye it is 80,963 t (SAC-02-07), obtained by assuming that there is no stock-recruitment relationship and based on an average selectivity pattern for all fisheries combined during 2008-2010. Table 1 shows the projected 2011 catch (t) when fishing at F_{MSY} in 2011; it assumes the same relative fishing mortality in the purse-seine and longline fisheries as the 2008-2010 average, but rescales those mortalities to match the F_{MSY} level of mortality. Also included in the table is the estimated F multiplier[1] (defined as F_{MSY}/ average 2008-2010 F).

Table 1: Total allowable catches (TACs) based on F_{MSY} based catches for 2011; F multiplier included.

	Purse-seine	**Longline**	**Combined**	F_{mult}
Yellowfin	240,059	5,669	245,728	1.16
Bigeye	64,915	24,293	89,208	0.93
TOTAL	304,974	29,962	334,936	
Percent	91%	9%	100%	

Due to the high and variable productivity of skipjack (*i.e.* annual recruitment is a large proportion of total biomass), annual catches are highly variable, and the main concern with the species is the constantly increasing exploitation rate. However, the data- and model-based indicators have yet to detect any adverse consequence of this increase.

It is clear, then, that yellowfin and bigeye tuna need to be considered if an allocation management system is adopted. Because skipjack are apparently not fully utilized in the EPO, there is no control proposed in the level of harvest in the alternative measures. Allocations for skipjack would be implied by the various measures. The evaluation of allocation measures in the purse-seine and longline fisheries can be based on different options: an overall Total Allowable Catch (TAC), Individual Fishing Quotas (IFQ), national TACs; national TACs with IFQ allocated to vessels, catch limits for small yellowfin and bigeye, and for large bigeye. Also, buy-back programs can be useful for their potential effect on the reduction of the excess fishing capacity. The EPO fishery includes a variety of fishing gears and methods of operation which require the implementation of new creative management regulations adapted to this complexity. An evaluation of the possible allocation programs needs to consider which is the most beneficial and feasible. This document analyzes the use of effective rights-based management that takes into account the changes that have taken place in the fishery in terms of efficiency and distribution of the fishing effort among flags, tuna species, and fishing methods.

2. FISHING CAPACITY

The EPO purse-seine fleet has been steadily increasing for the last twenty years. In the early 1990s total operative capacity was about 123,000 cubic meters (m^3) of well volume. By the end of 2005 capacity had increased to more than 214,000 m^3, and in 2010 the estimated capacity was 209,600 m^3**.** The most recent increments of capacity are a product of good tuna catches in 2002 and 2003 when skipjack was unusually abundant in the EPO during years when the use of FADs was much greater than usual. In 2002 the

[1] The number of times effort would have to be effectively increased to achieve the MSY in relation to the average fishing mortality during a given period (in this case 2008-2010).

Commission adopted Resolution C-02-03 on fleet capacity, which maintains purse-seine vessel capacity at the same level as it was at time of adoption of the resolution and which requires vessels to be listed on the IATTC Regional Vessel Register (RVR), which would serve as a basis for defining purse-seine vessels that are qualified to participate in a management system based on allocation. Regarding longline capacity, to date the Commission has not adopted any regulations except for catch limits for the four principal fleets (China, Japan, Korea, and Chinese Taipei), and in general all large-scale longline fleets are to be regulated unilaterally consistent with Recommendation C-10-01 on tuna conservation. In 2004, a regional capacity plan was adopted, with a goal of reducing the capacity of both purse-seine and longline fleets to a level consistent with scientific recommendations, but this goal has not been achieved. For longline vessels it is possible to set a limit on capacity in a manner similar to purse seiners. The list of authorized longline vessels greater than 24 meters length overall in the RVR contains 1,175 vessels of 19 participant governments[2]. This number of large longline vessels represents a problem to the development of a system of allocation based on IFQs.

3. ADOPTED MANAGEMENT MEASURES

Since 2004, conservation measures have become increasingly restrictive in the EPO to control fishing mortality levels. The measures implemented restrict purse-seine fishing effort by limiting the number of fishing days allowed, and also limit longline catches of bigeye. Each year the purse-seine fishery for yellowfin, skipjack and bigeye has been closed during two separate periods, with each participating government deciding which of the two closure periods its fleet must observe. For 2011-2013, Recommendation C-10-01, which calls for a 62-day closure to fishing by the purse-seine fleet plus other measures, was agreed by most members. Vessels can choose to comply with the closure in each of these years in either one of two periods of the year. Having two closure periods offer vessels flexibility to schedule their closure optimally in terms of economic and operational benefits, with the advantage of a continuous flow of catches to canneries and more continuous employment. Also, fishing is prohibited in a high-seas area of the EPO between 96° and 110°W and from 4°N to 3°S, from 29 September to 29 October. The total annual longline catches of bigeye for 2011-2013 are also limited for the four principal longline fleets operating in the EPO, whose governments undertake to ensure that the total annual catches of bigeye tuna by their large longline vessels do not exceed country-specific limits. All other governments undertake to ensure that the total annual catches of bigeye tuna by their longline vessels in the EPO during 2011-2013 do not exceed the greater of 500 metric tons or their respective catches of bigeye tuna in 2001.

The adopted time closures for the purse-seine fleet and the catch limits for the longline fleet match the management objective for tunas in the EPO of keeping stocks at levels capable of producing MSY by the use, as a reference point, of the fishing mortality that produces the MSY (F_{MSY}). While the system of management measures in place does establish measures that restrict catches, both the capacity limits and the closure of the fishery should be considered as a global allocation scheme in which the days of fishing is estimated from the ratio of current fishing mortality to F_{MSY}. During the difficult negotiations that took place to establish a capacity limitation scheme, one approach which was extensively considered was a system of national capacity limits. However, it was not possible to reach an agreement on this basis, and consequently that approach was abandoned in favor of a scheme that controlled vessel access via the RVR.

[2] Defined as members of the IATTC and States, regional economic integration organizations, and fishing entities that have applied for membership of the Commission or that cooperate with the management and conservation measures adopted.

3.1. Alternative allocation schemes

3.1.1. Limiting total catch through an overall TAC

The basic measure could consist primarily of an overall TAC for the EPO, to be taken on a first-come, first-served basis, in a system similar to those applied by the Commission to the yellowfin fishery during 1962-1979. The participants in the fishery would compete for shares of the predetermined overall TAC. The Commission might adopt as a TAC for yellowfin and bigeye the sum of the 2011 projected catch when fishing at F_{MSY}. The overall TAC could be applicable to all purse-seine vessels of IATTC capacity classes 4 to 6 (greater than 212 cubic meters carrying capacity) fishing for yellowfin, bigeye, and skipjack tunas, and to large longline vessels that fish in the EPO. Pole-and-line, class 1-3 purse seiners, and sportfishing vessels would not be subject to this TAC limit. Each year (or any other time period) the adopted TAC should be evaluated in the context of the results of the stock assessments; depending on the recommendation by the scientific staff, the TAC for the next year could be ratified or adjusted.

It needs to be well understood that the establishment of an overall TAC system open to the participants in the fishery for the three principal species of tropical tunas by itself does not establish what vessels are allowed to participate in the collective TAC. Access to the fishery needs to be determined by the RVR, which establishes the definitive list of purse-seine vessels authorized by the participants to fish for tunas in the EPO. One option is to allow access to the overall TAC only to authorized active vessels, as defined in the current system under Resolution C-02-03, and any purse-seine vessel fishing for tunas in the EPO that is not on the list of active vessel would be considered disqualified to participate in the shared TAC. The overall TAC for 2011 could be set at 334,936 t based on the sum of the 2010 estimated yellowfin and bigeye F_{MSY}-based catch, with 91% of this amount assigned to purse-seine vessels and 9% to longline vessels, based on the percentages in Table 1 above. Another option is to share the overall TAC, but with the bigeye limit for the longline to be that established in the Recommendation C-10-01; in that case, the 334,936 t would be distributed as 274,886 t for purse-seine fleet and 60,050 t (C-10-01 bigeye quota of 54,381, plus yellowfin TAC of 5,669 t) for the longline fleet.

In the EPO most of the catches are made by the purse-seine and longline fleets. The IATTC has detailed and timely records of the catches of most of the purse-seine vessels that fish for yellowfin, bigeye and skipjack in the EPO because of data collected by the onboard observer program, which covers all vessel of carrying capacity greater than 363 t. However, for small purse-seine vessels the record of catches is completed approximately six months after the fishing year because the principal source of information is the vessel logbooks. The inclusion of these small vessels in the TAC system could cause considerable logistical problems. The Commission has records for most large (overall length >24 m) longline vessels that fish in the EPO, which are obtained from quarterly governmental reports; moreover, since 2008 most tunas caught in the EPO by longline are recorded by the transshipment observer program. Even with this information, the catches of the longline fleet are more complicated to follow than those of the purse-seine fleet.

In the event that annual catches by the purse-seine fishery exceed the species-specific TAC for either bigeye or yellowfin, all sets on those species, individually or in mixed schools containing either species, should cease for that year. When the catch during the year plus the amount of fish taken by vessels at sea exceeds the TACs adopted for yellowfin and bigeye, the restricted period (closure of the fishery) should begin. Once the overall TAC limit is reached, all fishing by class-4 to -6 purse-seine vessels in the EPO should cease immediately. When the closure begins, classes 4-5 purse-seine vessels at sea without an observer on board could be allowed to continue to fish without restriction until their current trips finish, and those that are in port could be prohibited from going fishing. Since the catches of class-4 and -5 purse seiners are relatively small, the effect of a large portion of this fleet arriving in port shortly before the beginning of the restricted period with the intention of quickly unloading and returning to sea to make one more trip may not pose a big problem. Other purse-seine vessels of IATTC capacity classes 1-3 (< 213 cubic meters carrying capacity) could be allowed to make fishing trips during the entire year, including

the closure period. The total annual longline catches of yellowfin and bigeye tuna in the EPO could be regulated to not exceed the TAC assigned to this type of vessel, but implementation would require more frequent reporting of catches to the IATTC. One option is the implementation of a weekly reporting system similar to that for the large purse-seine vessels.

The expected closures of the yellowfin and bigeye purse-seine fisheries would be expected to differ if the base case *F* multiplier for each species is followed exactly because the *F* multiplier differs between species. An important caveat regarding these calculations is that they assume that vessels will not alter their behavior (such as species targeted, area fished, gear efficiency) as compared to their average behavior in recent years. The calculated expected closures are based on the average fishing mortality during 2008-2010. The purse-seine fishery has been closed on average during 2008-2010 for 56.33 days (calculated based on EPO closure plus the closure of the high-seas area) and therefore open to fishing 308.67 days. During those open periods, fishing mortality relative to F_{MSY} was sufficient to generate the *F* multipliers in Table 1. The open period for bigeye would be reduced in accordance with the base case *F*mult of 0.93, thus 308,67*0.93 = 207 open days, for an expected closure of 158 days. For yellowfin, the *F* multiplier is 1.16, thus 308.67*1.16 = 358 open days, for an expected closure of 7 days.

The second option, in which the overall combined species TAC in Table 1 is retained, but the bigeye limit for the longline fleets is that established in Recommendation C-10-01 (*i.e.* longline TAC = 54,381 t). The purse-seine TAC for yellowfin is not affected, and thus the expected closure for yellowfin fishing would be the same as given above. The purse-seine TAC for bigeye is affected if overfishing of bigeye is to be prevented. If the bigeye TAC remains as in Table 1 (89,208 t), then the purse-seine TAC would be 89,208-54,381 = 34,827 t, which is 54% of the 64,915 t purse-seine bigeye TAC shown in Table 1. That means that the number of days open to fishing would be 54% of the days calculated in the previous paragraph, and thus the new expected closure would be 253 days. A more precise estimate of the new expected closure date would require a recalculation of the *F* multiplier that would apply in the case of a change in gear composition between longline and purse-seine fishing that accommodates a longline TAC of 54,381 t (the amount in C-10-01). The purse-seine TAC for that case has not been calculated, but it would be expected to be larger than the 34,827 t shown above, but not as large as the 64,915 t in Table 1.

Another caveat to the closure estimates given above is that they assume that the average operational fleet capacity will remain at its 2008-2010 level of 219,541 m^3. In fact, capacity has decreased in 2010, and again so far in 2011 to the most recent estimate of 208,160 m^3, 95% of the previous three-year average. This reduction in capacity is sufficient to lower the expected closure in the first option for bigeye to 62 days, coincidentally matching the recommended closure in C-10-01, and eliminate the closure for yellowfin. Given the imprecise nature of the calculations for option 2, they have not been recalculated for reduced fleet capacity.

It is possible to anticipate the approximate closure date based on the available information provided by the observers in the required weekly reports. To avoid exceeding the quota, the IATTC Director would establish a system for notifying all participants with vessels fishing in the EPO when three-quarters of the overall TAC was reached. He would also notify them at least two weeks in advance of the closure date for the fishery, in order to give them sufficient time to implement the closure of the fishery. The reason for bypassing the Commission in this decision is that, because of the large size of the fleet, only a few days' difference in the closure date could change the total year's catch by several thousand tons, and it would not be feasible for the Members to act sufficiently quickly for the closure date to be set at the proper time. To improve the result of the measure, it is necessary to define limits on incidental catches of tuna caught by any vessel allowed to continue to fish. After the closure of the fishery, any vessel can be permitted to fish for tunas not included in the TAC, such as Pacific bluefin tuna, albacore tuna, bonito, black skipjack, billfishes, and sharks, but any bycatches of yellowfin and bigeye during these activities would be subject to regulation. The incidental catch of yellowfin and bigeye would not be allowed to exceed 15 percent of the weight of the total catch for any individual trip made by vessels (purse-seine and longline) fishing for other species. It is not necessary to include skipjack in the incidental catch.

3.1.2. Use of the overall TAC to assign Individual Fishing Quotas (IFQs)

This system is similar to the overall TAC, and the principles applied for defining the amount allocated and the participants are the same, therefore the qualified vessels which would receive an IFQ are the active vessels in the RVR. Also, the IFQ should be applicable only to all purse-seine vessels of IATTC capacity classes 5 and 6, and to all large longliners, that fish for tunas in the EPO. The harvesting rights to all or part of the allowable catch would be distributed as an IFQ under the responsibility of the vessels. IFQs could be allocated using a system similar to that used for assigning Dolphin Mortality Limits (DMLs) under the Agreement on the International Dolphin Conservation Program, in which case each participating government would provide to the Director, prior to October 1 of each year, a list of qualified vessels under its jurisdiction that are expected to operate in the EPO during the following year; the estimated allowable catches would be shared among the vessels, based on the active list of the RVR. Additionally, with the aim of maintaining the stability of the system, transferring the capacity of small purse seiners to class-5 and -6 purse seiners would not be allowed.

The establishment of a system based on IFQs consistent with the tuna purse-seine TAC cap, requires that lists of vessels be provided to the Director for estimating the IFQs, compliance with the requirements of the RVR and with the program for tracking and verification of tuna harvested under this system of allocations. The Director would, by a certain deadline, inform the Commission of the estimated IFQ and the list of vessels used in the calculation. Any vessel assigned an IFQ that did not fish for tuna in the EPO during that year would lose its right to be included in the calculation of the IFQ for the next year, unless its flag government requested an exemption due to *force majeure* or extraordinary circumstances, as agreed by the Commission. Therefore, all qualified purse-seine vessels would have fished in the EPO during the year, and the application of this rule would remove any vessels without real fishing activity; this would have a real effect in the reduction of excess fishing capacity. It might be difficult to get the participants to accept this rule, in view of the limited access of yellowfin from the EPO to some markets, the existence of subsidies that distort the profitability of the industry, and the capacity assigned by Resolution C-02-03 to countries without fleets.

In 2010, 168 class-5 and -6 purse-seine vessels under the jurisdiction of IATTC members, with a total capacity of 201,414 m^3, fished in the EPO. The IFQs for this fleet, based on the number of vessels and on their capacity, would be calculated as follows:

By number of vessels: TAC/number of active class-5 and -6 purse-seine vessels = IFQ, thus:
304,974/168 = 1,815 t, or,

By total capacity: TAC/total capacity of active class-5 and -6 purse-seine vessels = IFQ, thus:
304,974/201,414 = 1.5 t/m^3

When a vessel's catch during the year reaches its assigned IFQ, the restricted period for that vessel begins. Despite the efficiency of the observer program, the weekly reports, and the AIDCP tuna tracking system (TTS), it is impractical to predict the approximate closure date of all the different IFQs.

This system offers some advantages, such as avoiding the problem of allocating resources distributed into the EEZs, and gives some property rights to the vessels, nevertheless some problems need to be solved if this approach is applied. For example, any participant may request that the Director assign IFQs to vessels under its jurisdiction which are inactive (*i.e.* not on the active list of the RVR) but want to fish in the EPO, or which are not eligible for an IFQ at the time of the deadline for IFQ requests, but become eligible subsequently and want to fish during the year for which the IFQ is requested. Such IFQs could be assigned only if procedures are developed for maintaining a reserve of IFQs or for reallocating IFQs during the year, or if some other system is developed that would permit the assignation of IFQs to reactivated vessels. This reserve could be made up of IFQs forfeited by vessels that do not fish for tuna and do not qualify for a *force majeure* exception. As is the case with DMLs under the AIDCP, after April 1 of each year, any IFQ which the Director determines will not be utilized or which has otherwise been

forfeited could be reallocated to the vessels. Such additional IFQs could be reallocated by the Director among qualified vessels, subject to any limitations and conditions adopted.

The transferability of IFQs also needs to be addressed. For purse-seine vessels, IFQs may be transferred only between qualified vessels and/or between an active and an inactive vessel. An IFQ transfer between qualified vessels means that a vessel can transfer only part of its IFQ to other vessels and still be considered active and thus qualified to request a new IFQ the following year; the transfer of the total IFQ converts the vessel to inactive. The implementation of the transferable amount would require rules about how much quota can be transferred; for example, transfers could be permitted only for quota amounts that total less than 25% of the vessel's well capacity. A total IFQ transfer between active and inactive vessels means that the inactive vessel substitutes the active vessel, subject to the RVR rules.

In the case of longliners, the number of vessels in the RVR is much greater than is required for catching the quota allocated to this gear, and despite the recent reduction in fishing effort, the size of the fleet represents an obstacle to defining longline IFQs.

3.1.3. Limiting total catch using national TACs

National TACs have been proposed as a possible method for determining who is to harvest the tuna resource in the EPO. The practicality of national allocations cannot be evaluated without first determining how the system of allocations would be organized. As with the overall TAC, the system should be based on the total allowable catch that can be distributed, and the number of participants among whom the TAC will be allocated. The participants include both States bordering the EPO and governments with fleets fishing for tunas in the area; evidently, for a system of national TACs, the Commission would determine which are considered to be qualified for an allocation.

As mentioned above, during the negotiations of Resolution C-02-0, one approach which was extensively considered was a system for allocation of national capacity limits. However, it was not possible to reach agreement on such a system. The principal difficulty was the lack of agreement on the criteria to be used for the allocation. Several possibilities was explored, such as national fishing capacity, installed processing capacity, historical catches within zones of national sovereignty or jurisdiction, landings of tuna, contribution to the conservation program, the catch of national fleets during a particular period of years, reduction of dolphin mortality, and other factors. In order to reduce the discussion on the base criteria for national TACs and the different weights that could be assigned to each of them, it is important to reduce to a minimum the number of criteria to apply in the allocation.

The use of economic criteria would be very complicated to assess, bearing in mind the possibility that coastal states may express an interest in acquiring fishing vessels and/or constructing tuna-processing facilities, thus adding to the difficulty of weighting for this criterion. Other criteria, like the total amount of catch historically taken in the EPO as a whole, are relatively easy to quantify but very complicated to negotiate under the current conditions of the sovereign rights of coastal States. About 40 percent of the catch of tunas in the EPO comes from the EEZs of coastal states and about 60 percent from the high seas (Table 2); also, access to the tuna resources in an EEZ is not available in all coastal states, and when it is allowed it is via a fishing license issued by the coastal state.

The two criteria that can be quite easily used to define national TACs are national fishing capacity and historical catches by national fleets during a particular period. National fishing capacity could be established through the RVR, which solves the serious problem of new entrants to the fishery by the procedures of the RVR, and the catches by the national fleet could be separated into those made in EEZs (regardless of the fishing vessels' flag) and those made on the high seas. However, the sizes of the shares calculated on that basis would depend upon the years which were selected for determining historical participation; once that is agreed, the catches could be estimated from the historical data in the IATTC's records. The estimated catches in a national EEZ would be the national TAC (EEZ TAC) reserved for use by the coastal state for its own fleet or for fishing licenses for vessels of other flags. The sum of all EEZ

TABLE 2. Total retained purse-seine catches within and outside EEZs in the EPO, in metric tons and percentages

	In EEZs			%		Outside EEZs			%	
	YFT	BET	SKJ	YFT+BET	All	YFT	BET	SKJ	YFT+BET	All
2000	117919	7204	78925	35.4	36.6	152827	75513	124804	64.6	63.4
2001	142174	1742	21761	32.6	28.4	245098	52689	119307	67.4	71.6
2002	147244	2381	42712	32.4	31.0	269148	42426	117079	67.6	69.0
2003	190029	1692	91183	42.7	40.2	209427	48161	162749	57.3	59.8
2004	133533	740	61165	40.2	36.7	144476	55020	137207	59.8	63.3
2005	147512	1290	134011	46.9	48.3	117171	51183	134173	53.1	51.7
2006	91475	3865	111181	38.7	37.7	88807	62435	190325	61.3	62.3
2007	80384	2057	88183	35.1	38.9	100547	52026	115125	64.9	61.1
2008	89172	7037	147520	37.0	43.5	104797	59122	152557	63.0	56.5
2009	79743	3259	83643	27.2	30.4	163217	59234	158870	72.8	69.6
Avg	121919	3127	86028	36.8	37.2	159552	55781	141217	63.2	62.8

TACs, as a percentage of the total catches, would be subtracted from the estimated total TACs for yellowfin and bigeye, and that amount of available tuna resource used as a basis for calculating the high-seas national TAC (HSN TAC). In addition to the definition and distribution of the HSN TAC, it is important to define whether the TACs can be redistributed or sold outside of the original flag. Therefore, if these aspects are to be considered, they should be evaluated jointly with their effect on compliance and enforcement by the participants. The HSN TAC for longliners would be the catches of yellowfin and bigeye tuna in the EPO assigned to the participants for that gear. The HSN TACs would be based on catches outside the EEZs, and would be calculated as follows:

TAC * (percentage of catches outside EEZs) = HSN TAC, thus

304,974 x 63.19/100 = 192,172 t

The HSN TAC of 192,172 t would be applicable only to purse-seine vessels of IATTC capacity class 6 and to all large longline vessels that fish for tunas in the EPO, using the proportion of the catches by species by the two gears in 2010 (94.4% and 5.6%, respectively). Once the allowable catch is defined, the harvesting rights to all or part of the allowable catch are distributed as HSN TACs among the participants. The estimated allowable catches would be shared among the participants based on the number of each participant's vessels on the RVR active list. The Director would, by November 1 of each year or any other agreed deadline, provide to the Commission the amount of the estimated EEZ TAC and the list of vessels used in the calculation of the HSN TAC. Any vessel for which the RVR was used to assign an HSN TAC and does not fish for tuna in the EPO during that year would lose its right to be included in the calculation of the HSN TACs of the next year, unless a participant, on behalf of any of its vessels, requests an exemption due to *force majeure* or extraordinary circumstances, as agreed by the Commission.

When the catch during the year plus the amount of fish taken by vessels at sea at the closure date amounts to the adopted TAC, the restricted period would begin. To select a closure for each one of the fisheries, the catch could be divided in two categories: that taken in the EEZs by all vessels fishing in those areas (national or with license) and that taken by vessels operating in waters beyond their national jurisdiction. The closure date for the EEZ TAC would be based upon data obtained during the period of first-category catch, and the closure date for HSN TAC would based upon data obtained during the period of second-category catch. Considering the numbers of participants and the many factors that could affect the catch in both categories, it is easy to see how difficult it is to manage a system based on national TACs; for example, a fleet can exhaust its EEZ TAC and continue to fish with its HSN TAC, or vice versa. Despite the effectiveness of the observer program and the Tuna Tracking System, it is impractical to anticipate the approximate closure date of all these different TACs.

The potential drawback of the national TAC include complications in enforcement of closures, difficulties

in estimating the catches in excess of the TACs, race to catch the largest portion of the TAC before it is exhausted, and possible landing of tunas offside the EPO. In order for this approach to work, there must be transparency in the enforcement of the closures and a system for keeping track of compliance by vessels.

3.1.4. Limiting total catch through national TACs, with IFQs allocated to vessels of each nation

As with national TACs, the same two allocation criteria can be used for defining the TACs and subsequently developing IFQs to be allocated to the vessels of each nation. Similarly, the separate catches of the national fleet could be used to define a national quota that can be shared among that nation's vessels. The estimates of EEZ TAC would be reserved for use by the coastal state, which can choose to distribute the TAC as IFQ proportionally to all vessels under its flag or keep it for sale as licenses. The HSN TAC should be applicable only to class-6 purse-seine vessels and to large longline vessels, in a proportion of 94.4% for purse seine and 5.6% for longline, as is currently the case, or any other percentage. For this high-seas IFQ (HS IFQ) assignment, an allocation system similar to that used for DMLs under the AIDCP can be applied, by which each participant provides to the Director, prior to October 1 of each year, a list of qualified vessels under its jurisdiction that expect to operate in the areas beyond national jurisdiction in the following year, then the estimated allowable catches would be shared among the participants, based in the number of qualified vessels registered under its flag in the active list of the RVR. The rule prohibiting transfers of capacity from small purse-seine vessels to the class-6 purse seiners would still apply.

The HS IFQ is calculated by dividing the amount of the HSN TAC by the total number of qualified vessels. The distribution of TACs among participants would be determined by multiplying the HS IFQ by the number of qualified vessels operating under the jurisdiction of each participant. Next to the definition and distribution of the IFQ, it is important to define whether the IFQs can be redistributed, sealed, or traded to vessels of the same flag and/or of other flags. Transferring the HS IFQ outside the original flag can be complicated, and can affect compliance and enforcement and, if allowed, would require clear procedures for when it is transferred, to define how it should be recorded, how to address the status of the HS IFQ, the right to apply for an HS IFQ for the next year, and which flag government is responsible for enforcement and compliance. Transfers within a flag create other concerns: the potential increase in fishing effort due to the utilization of that flag's entire fishing capacity, including vessels that sooner or later are stopped by repairs, maintenance, mechanical problems, unexpected failures, and market or financial problems. In both types of transfer, if they are permitted, each participant would, no later than February 1 of each year, notify the Director of the initial allocation of its transferred IFQ among the fleet. No vessel could begin fishing for tunas in the EPO until the Director received such notification.

Participants with qualified vessels that will transfer IFQs must ensure that this is done in a responsible manner, and that individual vessels shall receive an IFQ only for the current year. The transfer of an IFQ does not transfer the right to the receiving vessels to apply for an IFQ for the next year. Any vessel assigned an HS IFQ and that does not fish for tuna in the EPO during that year, would lose its right to be included in the calculation of the HS IFQs for the next year, unless its HS IFQ was not transferred and the participant in question had requested an exemption due to *force majeure* or extraordinary circumstances.

Should the total catches of the fleet of any participant meet or exceed the total amount of the EEZ/TAC or the HSN TAC distributed to its fleet, fishing for tuna by that fleet would cease.

In view of the large number of longliners in the RVR, the assigned TAC for this type of vessel cannot be distributed as IFQs, and thus they are still a national TAC.

3.1.5. Limiting purse-seine catches of small yellowfin and bigeye and longline catches of adult bigeye through TACs and IFQs

It would be desirable, from a yield-per-recruit standpoint, to reduce the catches of small bigeye and yellowfin. One option is to limit these catches by ceasing to make purse-seine sets on schools of tunas

associated with floating objects (FADs) during the year after reaching a global limit for the purse-seine catches of bigeye. This approach has the advantage that it does not establish a limit on the numbers of FADs deployed. A similar regulation for bigeye was adopted for 1998-2000, by which, once the limit was reached, all purse-seine vessels were prohibited from setting on FADs until the end of the year. The purse-seine catch of bigeye in some years was less than the limit, and there were no restrictions on sets on floating objects during the year.

Catches of yellowfin also can be limited by restricting the catch in the area with a greater proportion of juveniles, in a system similar to that applied by the Commission to the fishery in 1962-1979, when was a coastal "Conservation Yellowfin Regulatory Area" (CYRA) was adopted. At that time it was stated that, "since yellowfin in the area west of the … CYRA … and east of 150°W are of such a size that limiting the catches in that area is currently not necessary," the quota would apply only to the CYRA. More recently, regulations for yellowfin were in effect again in 1999, when purse-seine and pole-and-line vessels were barred from fishing for yellowfin in two areas, one off Baja California and the other off northern South America, during the restricted period.

A "restricted period," for FAD deployment began on the date on which the purse-seine catch of bigeye reached the established quota for this species. For yellowfin the restricted period began on the date at which yellowfin in the equivalent area to the CYRA or any other agreed area reached the adopted quota.

To restrict the longline catches the total annual longline catches do not exceed the TAC established by Resolution C-10-01 of 54,381 t of bigeye or 60,050 t (54,381 t plus the yellowfin TAC of 5,669 t). The transferability of TACs between purse-seine and longline vessels also needs to be addressed. However the differences in the age-specific pattern of selectivity between the two fisheries and the great number of large longline make the definition of transferability difficult, and also changes in the selectivity modify the estimated MSY and consequently the allowable catch.

3.1.6. Reducing fishing capacity in the EPO by buyback programs

The implementation of buyback programs faces problems similar to the use of allocation. It is necessary to define the target level, in terms of the amount of financial resources that would be invested and/or in terms of the desired fishing capacity. Other aspects also need to be clarified, such as the criteria for defining qualified vessels and fishing rights, and assent to participate in the buyback program. A vessel's eligibility for a buyback scheme could be determined by means of the RVR; however, the RVR offers several options for defining qualified vessels, *inter alia*, the entire RVR list, the active list, the active and inactive list, and any other option resulting from the rights established by Resolution C-02-03. The principal difficulty for defining the fishing rights for use in buybacks is the great heterogeneity in the allowed rights to harvest tuna under the different jurisdictions of flag states that have different rules for different types of companies and vessels. Several types of access permits exist in the region: concessions and fishing permit that can be characterized as usufructuary rights, fishing licenses that allow access to the fish resource temporarily, fishing permit that allow vessels to flying the flag of the nation that has the usufructuary rights, and any other possible combination of these types of rights. Furthermore, fishing rights can be reserved exclusively for nationals of the flag state, for associated companies regardless of their nationality, or for any person or company regardless of their nationality. Moreover, fishing rights are subject to modification at any time due to political changes and/or principles, and benefits expected by the country that granted the fishing rights.

In order to reduce the difficulties of establishing a buyback program for purse-seine vessels, one option is to allow access to the program only to purse-seine vessels of IATTC capacity classes 5 and 6 on the RVR active list that are actually fishing in the EPO, regardless of flag. Therefore any purse-seine vessel in the EPO that is not on the active list cannot be considered for inclusion in the buyback program, in which case the qualified vessels would be the active registered vessels on the RVR fishing in the EPO during the current and previous years at the time the buyback program was initiated. Additionally, the participants commit to not allow transfers of capacity from small purse-seine vessels to class-5 and -6 purse seiners

and to impede increases in fishing capacity beyond their jurisdictional waters through the reactivation of vessels, the use of the unutilized rights established by Resolution C-02-03, and/or permitting small purse-seine vessels to fish on the high seas. The choice of the active list as basis for the buybacks has some advantages, such as avoiding the problem of expending all the funds on vessels that have been inactive for long time and do not represent a real reduction in at-sea fishing capacity, and the application only to vessels that operate beyond national jurisdictional waters to avoid the problem of usufructuary rights under national legislations.

Nevertheless, some problems need to be solved if this approach is applied. In 2010 there were 159 class-5 and -6 purse-seine vessels on the RVR active list, with well volumes between 401 m^3 and 3264 m^3, with an average of about 1,242 m^3 per vessel. Not weighting vessels by well volume can produce inequality, and also a deviation of the financial resources to the smallest vessels without the expected decrease of the excess fishing capacity. Furthermore the RVR contains purse-seine vessels authorized to fish not only in the EPO but also in other oceans, and this can block the scrapping of the bought-out vessels, given the advantage to these vessels that the buy-back is of the license rather that the vessel, with all the problems related to the different types of fishing rights. Selecting the most favorable option involves reviewing the effects of the different vessel categories and fishing rights in contrast with the available financial resources.

The potential drawbacks of a buy-back program include ensuring that bought-out vessels are scrapped, since otherwise they can continue to fish for species other than tunas with potential bycatches of yellowfin and bigeye, transferring fishing rights related to species other than tunas from the bought-out vessels to more than one vessel, with the potential increase of fishing capacity in other fisheries, and the disbursement of financial resources on less efficient vessels in a course of action that gives one more subsidy to the vessels that maintain their presence on the active list of the RVR thanks to a large amount of subsidies. In order for this approach to work, all the vessels that qualify for the buy-back program must be scrapped, and all their fishing rights, regardless of the species, withdrawn with the vessel.

Also, the buy-back program could be applicable to all large longline vessels that fish for tunas in the EPO. However, the large number of such vessels in the RVR, without any definition of whether they are active or not, represents an obstacle to applying such a program.

4. CONCLUSION

In all the options explored for allocations, the system consists primarily of an overall catch quota for the EPO. The Commission might adopt a catch limit and, in accordance with the Antigua Convention, the use of the MSY as a basis for defining the limit seems to be the best option. However, estimates of the MSY are sensitive to the age-specific pattern of selectivity that is used in the calculations, and different allocation schemes for fishing effort among fisheries would change this combined selectivity pattern. Thus, the question of an "optimal" MSY for allocation depends to a large extent on the dominant fisheries. Moreover, in the EPO, any system of allocation of rights, even if for each vessel individually, faces the problem of the two fishing gears (purse-seine and longline) and the different fishing modes of purse-seiners targeting different species of tunas, because those differences are not only the result of fishing technology but also a consequence of the differences in the actual management.

It is understood that the establishment of an allocation system by itself does not establish which vessels are allowed to participate in the sharing of the TAC. Access to the fishery needs to be determined by the adoption of transparent procedures based on the available framework of the Commission's RVR. The use of IFQs based on the different types of fishing poses difficulties for defining the IFQs in a form that can be used by the vessels, An IFQ for a single species or for both species mixed, with a percentage of tolerance for each one, or with the secondary species as bycatch, will be complicated to agree not only because of operational differences and rules, such as vessels with a DML, but also because different species of tunas have different prices in the market, and IFQs are assigned by species, regardless of their economic value.

The main problem for developing an allocation system is how to assign the fishing rights. The Commission has had limited success in resolving these allocation issues because it is not clear what criteria can be used for assigning national TACs and the different weights that could be give to each of them. One new approach is the use of the RVR, since requests for capacity can be resolved by the method recommended by the Permanent Working Group on Fleet Capacity at its meeting in April 2011, and the implementation of allocation can work reasonably well. However, the potential increase in fishing capacity in the EPO is the principal obstacle for the adoption of an allocation system. Other procedures that need to be developed in the RVR are those regarding IFQ transfers, enforcement responsibility, and ownership of fishing rights if a vessel changes flag, and also how to deal with countries that maintain their aspirations to add purse-seine vessels to the RVR after the allocation. The use of a buyback program could be a beneficial approach to reduce the excess fishing capacity if the principles are defined and the resources are available.

A new management system for the EPO based on allocation of rights, compared to the measures that are currently in place to limit fishing mortality (*e.g.*, closure periods and areas, catch limits, and the RVR and capacity resolution requirements) does not by itself represent an improvement, while the system of measures agreed must be considered as an overall allocation based in days of fishing estimated from the F_{MSY}. However, the use of allocations, together with the already used management measures, can help the tuna fisheries in the region to be conducted at a sustainable level and to align the economic incentives of fishermen and countries and net socioeconomic benefits. It is possible to reach an agreement on this basis, and consequently the control of vessel access via the RVR cannot be abandoned in favor of the proposal to establish a system of management based on the fishing rights

How to solve the problem of the lack of agreement on conservation measures is difficult to predict; in recent negotiations, bilateral political problems have obstructed agreement, and a solution needs to be to request for, and disputes about, fishing capacity. These problems are the principal obstacle for advancing in fishing capacity rights.