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TARGET CAPACITY FOR THE TUNA FLEET IN THE EASTERN PACIFIC OCEAN

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1. INTRODUCTION

The first meeting of the Permanent Working Group on Fleet Capacity, in September 1998, examined the question of the size of the purse-seine fleet that fishes for tunas in the eastern Pacific Ocean (EPO). The document *Considerations regarding limiting the growth in capacity of the international tuna purse-seine fleet in the eastern Pacific Ocean*, prepared for that meeting, concluded that "the current carrying capacity of the fleet, 135,000 metric tons (t), is large enough to generate the amount of fishing effort or mortality required to catch the [average maximum sustainable yield (AMSY)] of yellowfin and the recommended catch of bigeye from the EPO. It is also capable of generating the amount of fishing effort that produced the highest catch of all species combined in the history of the fishery."

This figure, expressed as 158,000 cubic meters (m^3)[1], has been used since 1999 as the target capacity for the purse-seine fleet in various documents and resolutions of the Commission, including the *Plan for Regional Management of Fishing Capacity* and the *Resolution on the capacity of the tuna fleet operating in the Eastern Pacific Ocean* of June 2002.

At the 4th meeting of the Working Group, in July-August 2000, the target figure was extensively discussed, and alternative numbers arising from different management regimes were considered. At the 6th meeting of the Working Group, in March 2002, this target figure was again discussed, taking into account especially the developments in the fishery since 1998, particularly the increased catches of skipjack. The 69th meeting of the IATTC in June 2002 endorsed this capacity level in the resolution approved at that meeting.

At its 7th meeting, in February 2004, the Working Group requested that target sizes for both the purse-seine and the longline fleets be discussed by the Working Group on Stock Assessments, which met in May 2004. This document, prepared originally for the meeting in May, reviews again the question of the size of the purse-seine fleet, and offers some views on a possible target size for the longline fleet that fishes for tunas and billfishes in the EPO. That Working Group agreed that an edited version of this

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[1] Calculated as 135,000 metric tons x 1.17 (or 37.5 cubic feet per short ton). This conversion factor, used in 1998 and prior years, was developed taking into account of, among other things, the density of fish packed in wells. The IATTC began to use well volume as the primary measure of the capacity of the purse-seine fleet in 2000. A conversion factor of 1.4, which is more in keeping with today's practices, is being used on a temporary basis for purposes of vessel assessments for the AIDCP, but not in connection with fleet carrying capacity. The 9th Meeting of the Parties of the AIDCP, in June 2003, noted that "the 1.4 conversion factor was for the purpose of vessel assessments only, and would not affect the information on vessel capacity in the IATTC Regional Vessel Register."

document should be provided to the 72nd meeting of the IATTC.

2. METHODOLOGICAL CONSIDERATIONS

It is difficult to establish a size to which a fleet should be limited. One approach would be to keep it at a size that can take the maximum harvest from the fishery, while at the same time ensuring the sustainability of each stock. In the EPO this is complicated by the fact that there are two main fishing gear types (purse-seine and longline) and three main modes of purse-seine fishing (for unassociated schools of tunas and for tunas associated with dolphins and with floating objects), and that more than one species is frequently caught in a single set.

Likewise, the interaction between the concept of maximum harvest and the objective of sustainability of each stock may create a management inconsistency that might be resolved only by developing independent species-specific fishing methods and management objectives. Thus, the question of an "optimal" fleet size depends to a large extent on management objectives. It is clear, however, that excess fishing capacity precludes the implementation of effective and efficient regulatory measures.

For the EPO, however, given the current mix of fishing gears, set types, and species in the fishery, it is logical and prudent to take into account in the establishment of target figures the status of the yellowfin stock and the fishery-related connections between the bigeye and skipjack stocks, particularly considering that a large part of the fleet is not targeting yellowfin, and that the catches of skipjack tuna have increased considerably since 1995, and especially in 1999 and 2000.

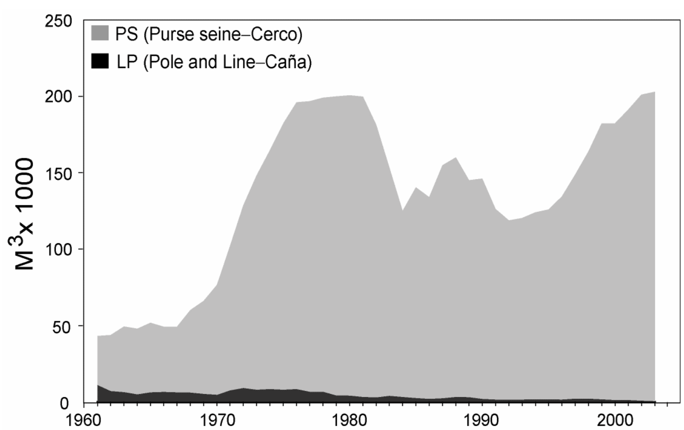
Another important consideration is the efficiency of the fleet. Because improvements in fishing gear, equipment, and techniques generate more effort and more fishing mortality, any figure for "current" optimal fleet size must be considered an upper limit for the desired target. In the case of the purse-seine fisheries, it also depends largely on the composition of the fleet, as vessels of different capacity classes usually have different fishing efficiencies.

The target fleet capacity will also clearly depend on the productivity of the stocks, which changes over time.

3. TARGET CAPACITY FOR THE PURSE-SEINE FLEET

One general idea in limiting the size of the fleet is that otherwise the catches per vessel will decline, and the economic pressures on individual vessels will be so great that it would be very difficult to sustain an efficient conservation program. In general, two approaches to establishing a target size for the purse-seine fleet could be considered, one based simply on historical fleet size and its management repercussions, and the other on data on catches and indicators such as catch per unit of effort, yield per recruit and total spawning biomass.

In the first approach the management of the purse-seine tuna fisheries in the EPO is considered in relation to historical fleet size. Fleet size increased rapidly in the early 1970s, reaching about 196,500 m^3 in 1980-1981. It then fell to 121,650 m^3 in 1984, and remained at an average of about 135,000 m^3 until the mid-1990s, when it began to increase again, mirroring the growth of the early 1970s. Fleet size was about 183,800 m^3 in 1999-2001, in 2002 was at 200,075 m^3, and the preliminary figure for 2003 is 202,301 m^3, an historical maximum.



Carrying capacity, in cubic meters of well volume, of the purse-seine and pole-and-line fleets in the EPO, 1961-2003

Restrictions on fishing for yellowfin in the Commission's Yellowfin Regulatory Area (CYRA) made the fishing season shorter during the late 1960s, and by 1970 and through 1977 the fishery was open to unrestricted fishing only 3 or 4 months per year. This clearly coincided with the period of fleet expansion during those years. The length of the fishing season increased gradually during the late 1970s, and there were no restrictions from the early 1980s until 1997. Again, this coincided clearly with the drastic reductions in fleet size followed by a period of relatively low fleet size. Tellingly, when the size of the fleet began to increase again in recent years, there was a need for restrictions once more, beginning in 1998.

Although there are variations in the closures by species and set types, restrictions averaging about 58 days have been recommended for each year since 1999, the year in which the fleet size grew considerably beyond the target capacity of 158,000 m^3, to 180,009 m^3. This would indicate that the purse-seine fleet is at least 16% (58/365) above the size that would produce the effort necessary for the season to last the whole year. The average fleet size during 1999-2002 was 190,758 m^3; reducing this by 16% would result in a total capacity of 160,236 m^3, which is very close to the target level of 158,000 m^3.

As the closures are the result of the interaction of stock status and fleet performance, the results of this simple analysis are consistent with, and confirm the validity of, the original conclusion that a maximum fleet size of about 158,000 m^3 is capable of producing the amount of effort that would keep the fishery and the stocks in good condition. If the purse-seine fleet size were at the levels of the early 1980s and early 1990s, there would be no need to shorten the fishing season to conserve yellowfin tuna.

This simple approach could be refined if the number of sets that the purse-seine fleet makes is considered as a proxy for purse-seine capacity. During 1999-2003 about 40% of purse-seine effort or 10,800 sets per year, was directed at tunas associated with dolphins. This mode of fishing is conducted exclusively by large vessels[2], and the catches (221,800 t on average) consist predominantly of medium to large yellowfin. Reducing this by 16% would bring the annual number of sets on tunas associated with dolphins to about 9,000, a level commensurate with the 158,000 m^3 total capacity target.

During the same period, almost 40% of the effort (10,300 sets per year) targeted fish in unassociated schools. This type of set is conducted by a mixture of small (55%) and large vessels (44%), and the annual average catch of 150,500 t is also a mixture of small yellowfin (60%) and skipjack (39%). Very little bigeye tuna is taken in this mode of fishing. Reducing this by 16% would bring the annual number of sets on unassociated schools to about 8,700, also a level commensurate with the 158,000 m^3 total capacity target.

During the same period, purse-seiners that fish for tunas associated with floating objects accounted for about 21% of the effort, or about 5,800 sets per year (13% on natural objects, 85% on fish-aggregating devices, or FADs). Almost 90% of this mode of fishing is carried out by large vessels, and the catch (232,500 t on average) is a mixture of the three main species (18% small yellowfin, 63% skipjack, and 18% small bigeye). It is in this mode of fishing, and especially for large vessels fishing on FADs, that increased reduction in capacity is needed to conserve bigeye. Recent analyses indicate that a 16% capacity reduction is not enough: a 50% reduction would be precautionary for this sector of the purse-seine fleet, according to the most recent assessment, reducing the number of sets per year to around 2,900.

The resulting total of about 20,600 sets represents a reduction of about 23% from the annual average of 26,900 sets of all types during 1999-2003. Applying this reduction to the average annual fleet capacity during 1999-2002 yields a target fleet size of about 146,000 m^3, a level more in line with the results of recent assessments, especially for bigeye and yellowfin tuna.

4. TARGET CAPACITY FOR THE LONGLINE FLEET

What is usually considered the longline tuna fleet in the EPO consists mostly of industrial vessels over 24

[2] Defined as of carrying capacity greater than 363 t

m in overall length, with freezing capability, referred to in recent IATTC resolutions and other documents as LSTLVs (large-scale tuna longline vessels).

The problem of establishing a target capacity for this fleet is in some respects similar to that for the purse-seine fleet. However, the data for the purse-seine fleet are much more extensive and detailed; for example, only recently have catch and effort data been available for all the major longline fleets fishing in the EPO, and those only for the last few years, annual data for some large-scale fleets and for the numerous artisanal vessels in the EPO are unavailable, and the Commission's Regional Vessel Register is more complete for purse-seine vessels than it is for longline vessels. However, even if it were complete, the Register in many cases simply lists all longline vessels authorized to fish in the EPO, and would not be useful for determining which vessels were actually fishing in the EPO.

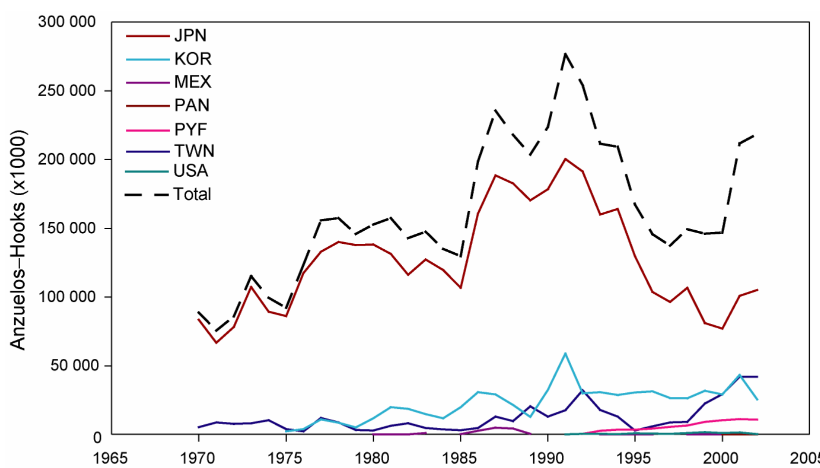
One important difference between the purse-seine and longline fisheries is that the latter generally catch large fish, so most of their catches in the EPO consist of bigeye tuna and, to a lesser extent, yellowfin and albacore tuna. Skipjack is seldom taken by the longline fleet. Billfishes are also an important target of this fishery, especially swordfish and marlins, as well as several types of sharks.

Although the issue of longline effort has been discussed extensively in recent years, the question of the number of LSTLVs and of the "optimal" longline capacity has not been approached formally. However, the declining catch and catch rates, and the status of the main stocks, have led some governments to seek ways to reduce longline capacity. In this regard Japan's initiative to reduce the number of LSTLVs in its fleet by 20% by scrapping 132 vessels, in accordance with the FAO International Plan of Action for the Management of Fishing Capacity, is noteworthy. In recent resolutions by the Commission, States, and fishing entities with LSTLVs have been encouraged to undertake similar initiatives and to not increase their fishing effort in the EPO. Korea, Chinese Taipei, and others with longline vessels have taken, or are considering taking, similar steps.

Annual longline catches of bigeye tuna by the Japanese fleet, the largest component of the fishery, fluctuated around 50,000 t during 1970-1985. Catches increased during the late 1980s and the early 1990s, reaching a peak of 101,373 t in 1991 for all fleets combined (85,011 t for Japan). Thereafter they declined, to a low of 30,116 t in 1999. In 2001 the combined catch of bigeye tuna was 62,287 t, and in 2002 50,347 t. The annual combined catch of yellowfin remained relatively stable during 1985-1999, averaging about 20,000 t; in 2001 it was 25,005 t, and in 2002 13,643 t.

The nominal effort by the Japanese fleet reached a peak of 200,360 thousand hooks in 1991. Subsequently it declined to a low of 77,000 thousand hooks in 2000, and then increased to 105,100 thousand hooks in 2002. Over the same period the combined effort of all longline fleets showed a similar decline from 1991 to 1996, and subsequently increased, most rapidly between 2000 and 2001, to its current level of more than 218,000 thousand hooks.

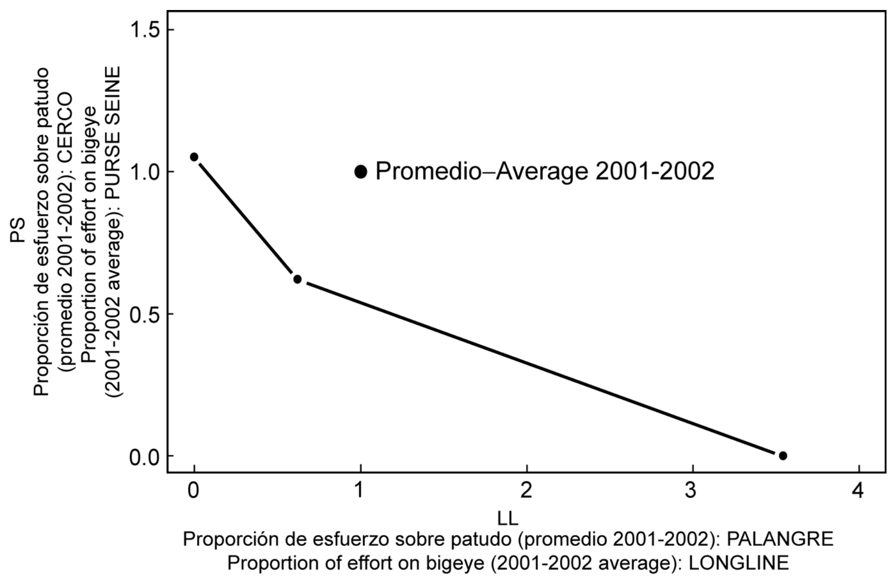
In considering a target capacity for the longline fleet in the EPO, the approach of calculating that capacity based on recent closures used for the purse-seine fleet would not work, as, until recently, there have been no restrictions on the longline fishery in the EPO. The first management measure of this kind is being implemented in 2004, with the objective of ensuring that the annual longline



Fishing effort of the longline fleet in the EPO, 1970-2003 catch of bigeye tuna in the EPO will not exceed the level of 2001.

Simulations varying the effort of the purse-seine fleet have consistently shown that the bigeye yield in the longline fishery would increase if the purse-seine effort on floating objects were reduced, while the longline yields of yellowfin would increase appreciably if the purse-seine effort were drastically reduced. In general, for bigeye and yellowfin tuna, reducing purse-seine effort on small fish would increase the spawning biomass, the yield per recruit, and the catches taken by the longline fleets. However, such a reduction would also reduce significantly the purse-seine catch of skipjack.

The 2004 assessment of the bigeye tuna stock, which takes into account low levels of recruitment and increased mortality, considers effort reductions for purse-seines and longliners, separately and together, providing insight into the interactions of the two gears. The projections indicate that, if fishing mortality rates continue at their recent (2002 and 2003) levels, longline catches and spawning biomass will decrease to extremely low levels. Presently the purse-seine fishery on floating objects has the greatest impact on the bigeye stock. Various combinations of levels of purse-seine and longline effort could be used to produce the average MSY (AMSY). Reductions of 50% in purse-seine effort on bigeye tuna would allow the stock to rebuild toward the AMSY level, but restrictions on both longline and purse-seine fisheries are necessary to rebuild the stock to the AMSY level in 10 years.



Optimal fishing effort effort for bigeye tuna

The figure shows the optimal fishing effort for bigeye tuna for the purse-seine and longline fisheries. For any given level of longline effort, the graph shows the corresponding purse-seine effort that would allow the AMSY to be taken, and *vice versa*. If only the purse-seine fishery were operating, the AMSY would be considerably less, but the current effort would be about the level corresponding to the AMSY. This suggests that if there were no longline fishery, the current purse-seine effort would be near optimal. If bigeye were caught only in the longline fishery, the AMSY would be almost double that estimated for all gears combined. To achieve this AMSY level, longline effort would need to be considerably increased, to near the levels observed in the late 1980s and early 1990s. This suggests that, prior to the expansion of the purse-seine fishery on floating objects, the bigeye stock was probably near a level that would have produced an AMSY of over 100,000 t.

The level of fishing effort by all gears corresponding to the AMSY is about 62% of the current (average for 2000 and 2001) level of effort, assuming that fishing mortality is proportional to fishing effort, and the current patterns of age-specific selectivity in both fisheries are maintained. Reducing effort by 38% would increase the long-term average yield of bigeye by about 8%, and would increase the spawning biomass of the bigeye stock by about 156%.

The choice of what changes to make in each of the fleets to reach an optimal position on the graph is a management decision to be made by the Commission. Greater sustained yields are obtained with a larger reduction in purse-seine effort.

The implications for fleet capacity depend on how reductions in effective effort are made. The main target species for longlines is bigeye, and changes in effort will be roughly proportional to changes in the number of vessels or hooks. The purse-seine fishery catches mostly skipjack, and it may be possible to reduce effective effort on bigeye by changing fishing practices. Simply reducing the fleet size is probably not the best way of reducing effective fishing effort.

5. CONCLUSION

It is clear that tradeoffs of many types must be carefully considered in establishing a target capacity for both the purse-seine and longline components of the EPO tuna fleet, because, at least in respect of bigeye tuna, the optimal size of one fleet depends on that of the other. However, it is clear that the current capacity of the purse-seine fleet, estimated at over 202,000 m^3 in 2003, is well above the level that would result in longer fishing seasons and economic benefits, and facilitate management and conservation of bigeye and yellowfin tuna. Similarly, it is clear that the current longline fleet size is considerably above the level that would facilitate management and conservation of bigeye tuna, given the current fishing practices of the purse-seine vessels using FADs.

A target capacity of 158,000 m^3 still seems appropriate from the point of view of optimizing the purse-seine fleet to fish for yellowfin tuna.

For bigeye tuna the situation is more complex, both because longline and purse-seine fishing are important, and because it may be that the effective effort on bigeye could be reduced by means other than reducing the capacity of the fleet. The choice of what reduction in fishing effort should be used as a target is one the Commission should make. However, if equal reductions were to be made in both the purse-seine effort and the longline effort, the target capacity for the longline fleet would be 62% of the 2001-2002 average, or a fleet that could deploy about 133,000 thousand hooks.

It is also clear that a different set of considerations would be needed if the purse-seine fleet were to be optimized to fish for skipjack. With current fishing practices, a target fleet capacity in that case would need to take into account the interactions between bigeye and skipjack in the purse-seine fishery, and the large recent catches of skipjack.

Considering the limited data available, especially for the longline fleet, the composition of the fleet, by individual vessel, possible future changes in efficiency, and bycatch issues, the optimal capacity for both will continue to be a moving target. The management choices regarding these targets should be made by the Commission.