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REVIEW OF THE TARGET SIZE FOR THE PURSE-SEINE FLEET FOR THE TUNA FISHERIES IN THE EASTERN PACIFIC OCEAN

1. INTRODUCTION

The first meeting of the Permanent Working Group on Fleet Capacity on 3-4 September 1998 examined the question of fleet size for the tuna fishery 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, is large enough to generate the amount of fishing effort or mortality required to catch the [maximum sustainable yield] 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."

The figure of 135,000 metric tons (mt) has been converted recently into cubic meters (m^3) using a standard factor of 1.17051. The resulting rounded figure of 158,000 m^3 has been used since 1999 in several documents and resolutions of the Commission as the desired target capacity for the purse-seine fleet, including the draft *Plan for Regional Management of Fishing Capacity* and the draft resolution on the capacity of the tuna fleet operating in the EPO of 8 March 2002.

At the 6th meeting of the Permanent Working Group on Fleet Capacity on March 7-8 2002, the target figure of 158,000 m^3 for the purse-seine fleet was discussed, especially taking into account the developments in the fishery since 1998, particularly the increased catches of skipjack. Accordingly, this document reviews the question of the size of the purse-seine fleet for the tuna fishery in the EPO.

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 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 are frequently caught in a single set.

Likewise, the interaction between the notion 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.

For the EPO, however, given the current mix of set types and species in the fishery, it is logical and prudent to take into account in the establishment of a target figure the status of the yellowfin stock and the fishery-related connections between the bigeye and skipjack stocks.

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. It also depends to a large extent on the composition of the fleet, as vessels of different capacity classes usually have different fishing efficiencies. The figure of 158,000 m^3 is based on the current composition of the fleet.

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

3. TARGET PURSE-SEINE FLEET SIZE

The 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. There are two general approaches to establishing a target size for the purse-seine fleet, one based on historical fleet size and its repercussions, the other on fisheries data on catches and indicators such as yield per recruit and spawning biomass.

In the first approach the past management of tuna fisheries in the EPO is considered in relation to historical fleet size. Figure 1 shows the capacity of purse-seiners in the EPO from 1961 to 2001. Fleet size increased rapidly in the early 1970s, reaching a historical maximum of about 196,500 m^3 in 1980-1981. It then fell drastically 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 180,400 m^3 in 1999-2000, and in 2001 is at 189,430 m^3, near the historical maximum.

Figure 2 shows the history of restrictions on fishing for yellowfin in the CYRA from 1966 to 2001. The length of the fishing season became shorter during the late 1960s, and by 1970 and through 1977 the fishery was open 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 closures of the CYRA once more, beginning in 1998.

Although there are variations in the closures by species and set types, on average the fishing season has been restricted for about 55.4 days 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. The fleet is therefore about 15.2% (55.4/365) above the size that would produce the effort necessary for the season to last the whole year.

The average fleet size during 1999-2001 was 183,416 m^3; reducing this by 15.2% would result in a total capacity of 159,011 m^3. Alternatively, reducing the 2001 fleet size of 189,430 m^3 by 15.2% would result in a total capacity of 160,663 m^3. Both figures are very close to the target level of 158,000 m^3.

As the closures are the results 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 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 fleet size were at levels of the early 1980s and early 1990s, there would be no reason to shorten the fishing season.

The second approach to establishing an optimal size for the purse-seine fleet involves simulating various levels of fishing mortality for the three set types, and examining fishery indicators such as yield per recruit, spawning biomass and catches of the three main tuna species (yellowfin, bigeye and skipjack) in the different set types. This approach was used in an analysis prepared for the 68th meeting of the Commission of the maximum number of sets on floating objects the fishery could support, and in a study of alternatives to the proposed target of 158,000 m^3 reported in the background paper for the 4th meeting of the Permanent Working Group on Fleet Capacity, held in Panama on 31 July-2 August 2000.

Estimates of sustained yields were calculated for each of the three species, for both surface and longline fisheries, because management decisions taken for the purse-seine fleet would affect other components of the fishery. The estimates for yellowfin and bigeye were made using the A-SCALA stock assessment model, while a simpler procedure that assumes that yield is proportional to fishing effort was used for skipjack.

The 1999 levels of fishing effort were used as the base case, and the effort that maximizes yellowfin yield was calculated using a combination of various levels of effort for the three modes of fishing. In another set of simulations, effort levels for the three set types of 40% over the 1999 level and 40% below the 1999 level were used.

The results of the two approaches are consistent. For example, the capacity of the part of the fleet fishing only for tunas associated with dolphins could increase by 90% and still be sustainable. However, this would reduce the spawning biomass to only 16% of its unexploited level, increase the catch of yellowfin tuna by only 5% (11,000 mt), and reduce the average catch per vessel fishing for tunas associated with dolphins by about 50%. Thus, while the fishery would still be sustainable if the capacity of the fleet fishing for tunas associated with dolphins were allowed to increase, the catch per vessel would be significantly reduced.

If in addition the effort on floating objects and unassociated schools were reduced to 75% of the 1999 level, the catch of skipjack would decrease by about 66,000 mt, while that of bigeye would increase by only 2,000 mt. The simulations also showed that the bigeye yield in the longline fishery would increase moderately if the effort on floating objects were drastically reduced, while the yellowfin yields would increase appreciably if the effort on unassociated tunas and dolphins were drastically reduced.

Because the curve that relates yield to fishing effort for yellowfin tuna is very flat near the maximum sustainable yield, increases or decreases in fleet size would have relatively little effect on the sustainable yield of yellowfin. Thus, these results show that there are advantages for the fishery in maintaining a fleet size that maximizes the combined catch of yellowfin, bigeye and skipjack while keeping catch per vessel and longline yields at healthy levels. A total capacity of 158,000 m^3 for the purse-seine fleet would achieve this result.

4. CONCLUSION

It is clear that the current fleet size (preliminary estimates for 2002 are around 195,000 m^3) is well above the level that would result in longer fishing seasons and economic benefits and facilitate management and conservation of the tuna stocks. With current technology, composition of the fleet, and condition of the stocks, a reasonable upper limit to achieve these objectives, consistently indicated by different independent approaches, is about 158,000 m^3. The optimal precautionary target is probably lower.

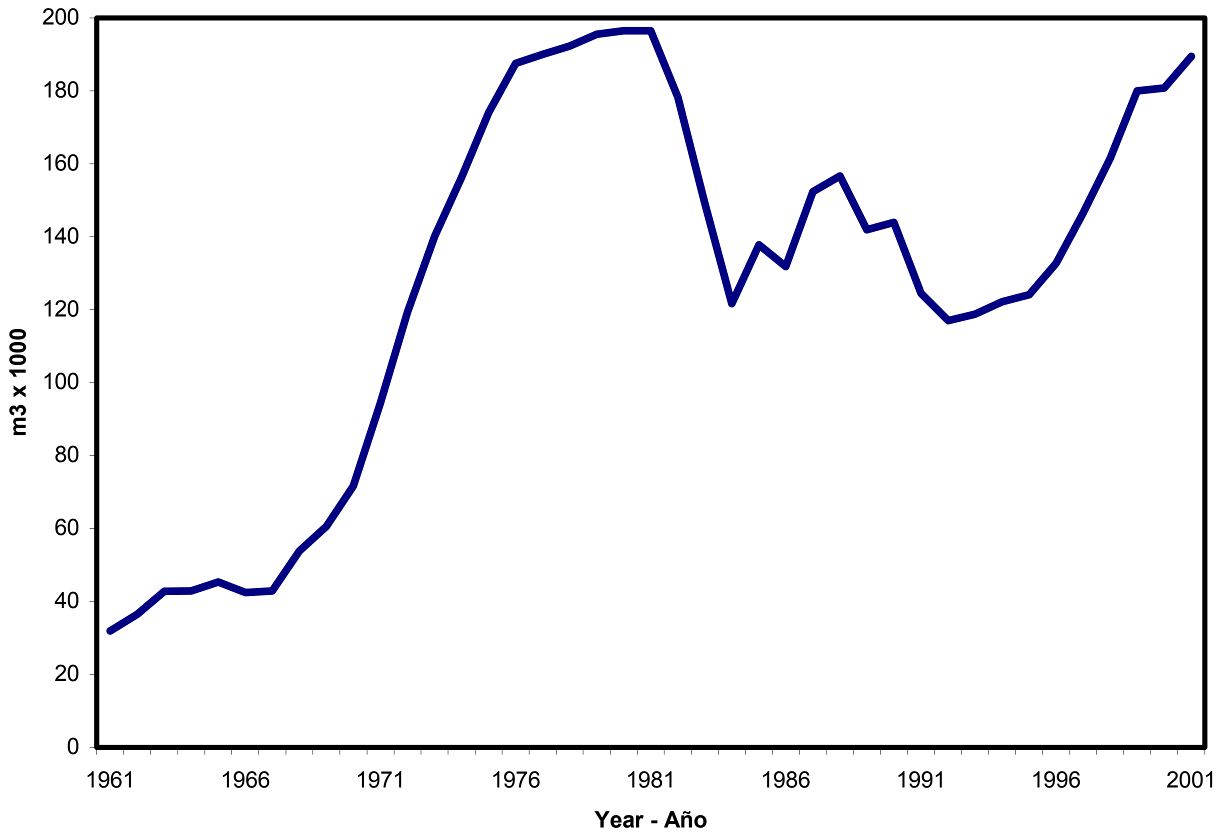

FIGURE 1. Purse-seine fleet capacity, in cubic meters, 1961-2001

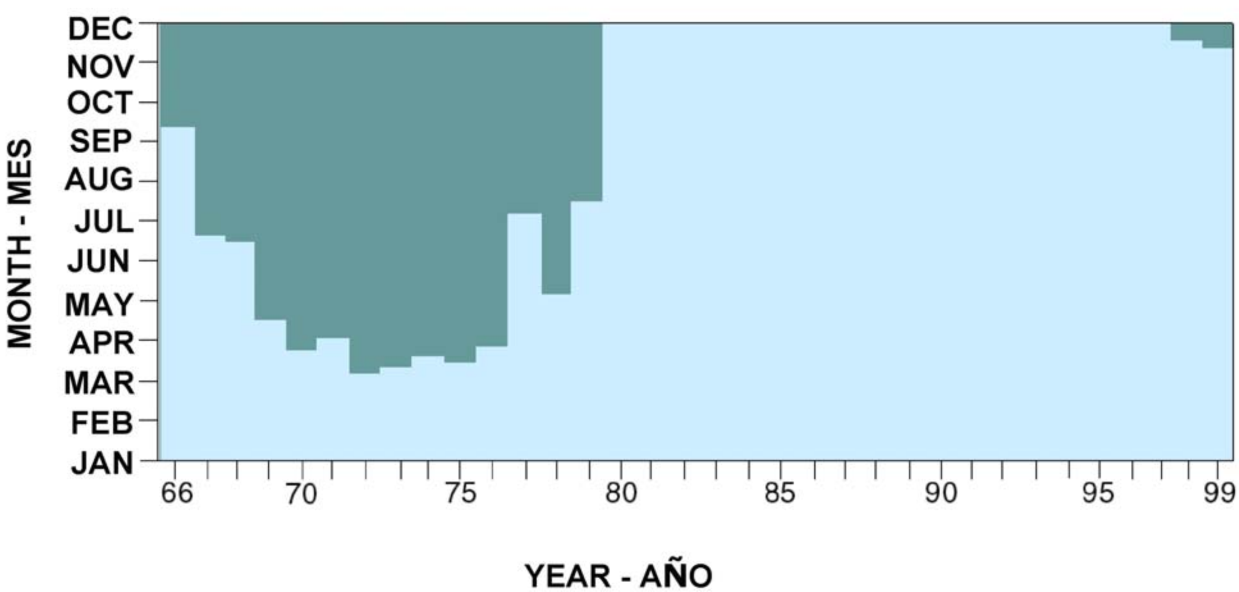

FIGURE 2. Closures of the purse-seine fishery for yellowfin tuna in the CYRA, 1965-1999.