Tunas Yield per recruit and MSY of longline fisheries, case of yellowfin stock in the Eastern pacific Ocean

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Summary

This paper discusses the conclusion of various IATTC stock assessment report on yellowfin that MSY of the longline fishery could be larger than 400000 t. in the EPO. Based on the analysis of fishery data and environmental data in the Pacific ocean and in the EPO, the paper reaches the conclusion that the real potential MSY of longliners on the EPO YFT stock is probably **very low**, for instance much lower than in the western Pacific ocean. This low potential MSY is simply due to the fact that this resource is not significantly available to longliners, even if their yield per recruit is high. This very low catchability of the EPO yellowfin stock to the past and present longline fisheries is probably explained by the low rates of oxygen observed in this area at the traditional fishing depth of longliners.

1- Introduction

In the Yellowfin tuna fisheries, there a paradox that has been often observed in most oceans, as on one side the longline fisheries are catching yellowfin (close to their optimal sizes (in term of yield per recruit), but on the other side, it is a fact that longline fleets were never able to obtain high levels of sustained catches (and by far much less than the real MSY of the various tuna stocks). This basic fact in the yellowfin longline fisheries has been observed even during periods of time when this gear was fishing alone, and surprisingly, without significant yield per recruit interaction with surface fisheries catching small fishes (Fonteneau and Pallares 1998).

The goal of this working paper will be to examine and to discuss this topic of the YFT stock yield per recruit and of the real MSY that can be obtained by longline fisheries in the EPO.

2- Fishing patterns and catch at size of PS and LL in the EPO.

Catch by gear:

The trend of yearly catches by gear in the EPO is shown by the following figure 1.

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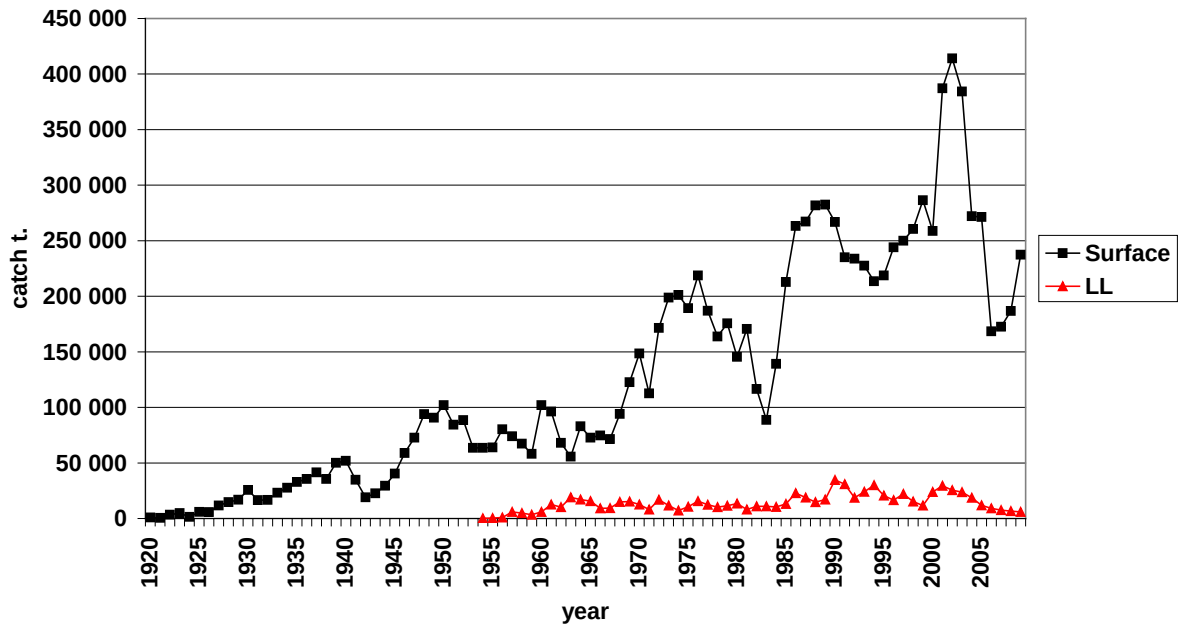

Figure 1: yearly catches of YFT in the EPO by surface gears and by longliners

This figure shows that surface fisheries have been always widely dominant in the EPO YFT fisheries since the beginning of the fisheries in the late 20ies. The maximum relative amount of YFT catches taken by longliners was observed during the sixties, but at a quite low average percentage of only 15% of the total YFT catches. This simple basic figure could already allow to conclude that the Eastern Pacific ocean is not the ideal fishing zone for longliners targeting YFT…..

YFT fishing zones by longliners in the Pacific ocean

The average catches of YFT in the EPO by longliners are shown figure 2.

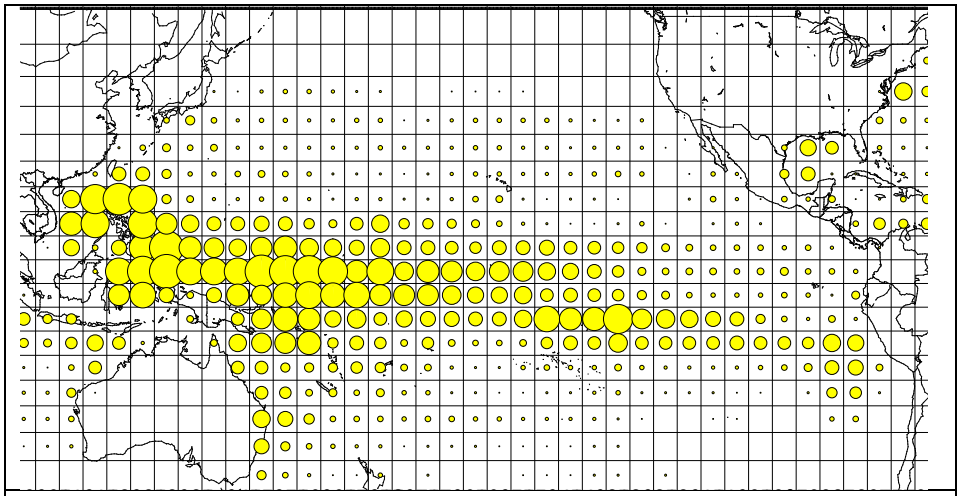

Figure 2: Catches of yellowfin by longliners in the Pacific ocean during the 1960-2005 period

This map shows that very low levels of LL catches have been observed in the core of the traditional fishing zone in the eastern basin of the EPO, when in the western equatorial Pacific the average catches of YFT taken by longliners tend to be much larger. Longliners have been actively targeting the western Pacific YFT, but never the Eastern Pacific stock.

Another interesting characteristic of the longline YFT fisheries in the EPO is that the LL CPUE have been always low or very low in the EPO, compared to the intertropical Western Pacific, an observation that is well shown by the average CPUE of Japanese longliners, see figure 3.

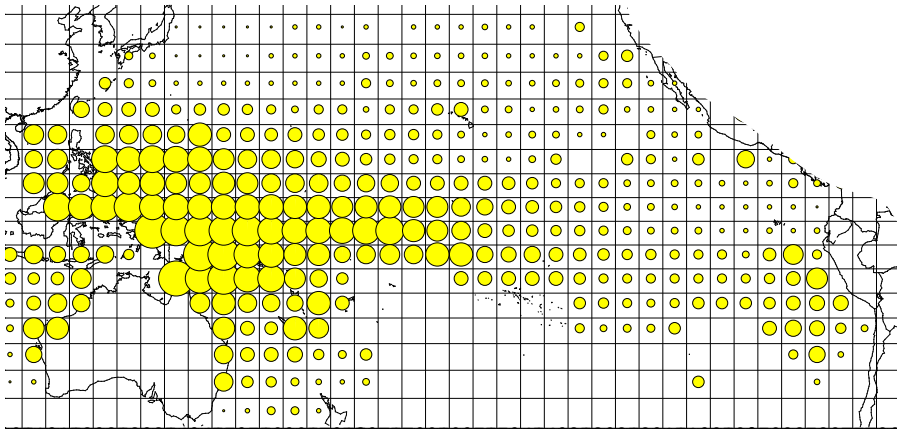

Figure 3: Average CPUEs of yellowfin of Japanese longliners in the Pacific ocean during the 1960-2005 period

These YFT CPUE tend to be very high in the Western and low in the Eastern Pacific. These major geographical differences in the YFT catches and CPUE are probably linked with environmental factors, these 2 basins of the Pacific ocean being widely different: the EPO showing a very shallow thermocline (the opposite in the West) and very shallow oxycline, see figure 4.

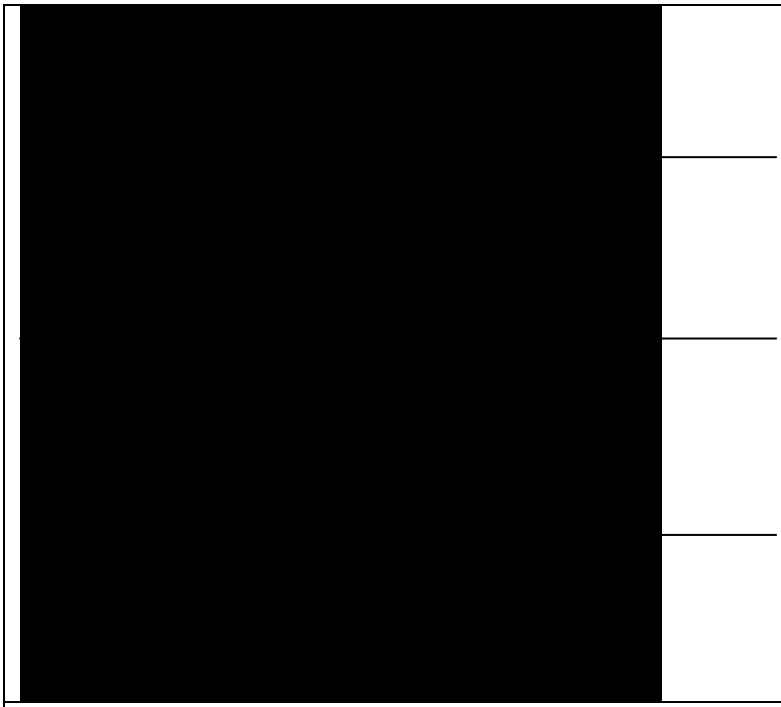

Figure 4: (taken from Prince et al 2010) Average levels of dissolved oxygen at 100 meters (a depth typical of the YFT longline fisheries) in the EPO (Data from Levitu atlas)

Such low levels of oxygen at the fishing depth of traditional longline are producing a compressed habitat: all the biomass of tunas and billfishes resources being “prisoners” in a compressed shallow habitat. Such habitat is not ideal for longline fisheries as most of them tend to fish in deep waters over 100 m. Such compressed habitat can be also found in the Eastern Atlantic (without significant YFT catches by longliners) and also in the North Western Indian Ocean, in the Arabian sea. It should be noted that YFT catches by longliners (fishing in shallow waters?) have been very successful in this

area since the early nineties, but this peculiar fishery remains an anomaly that has not been studied or explained by scientists.

Catch at size by gear

The average catch at size of yellowfin taken by purse seiners and by longliners in the EPO is shown by figure 5.

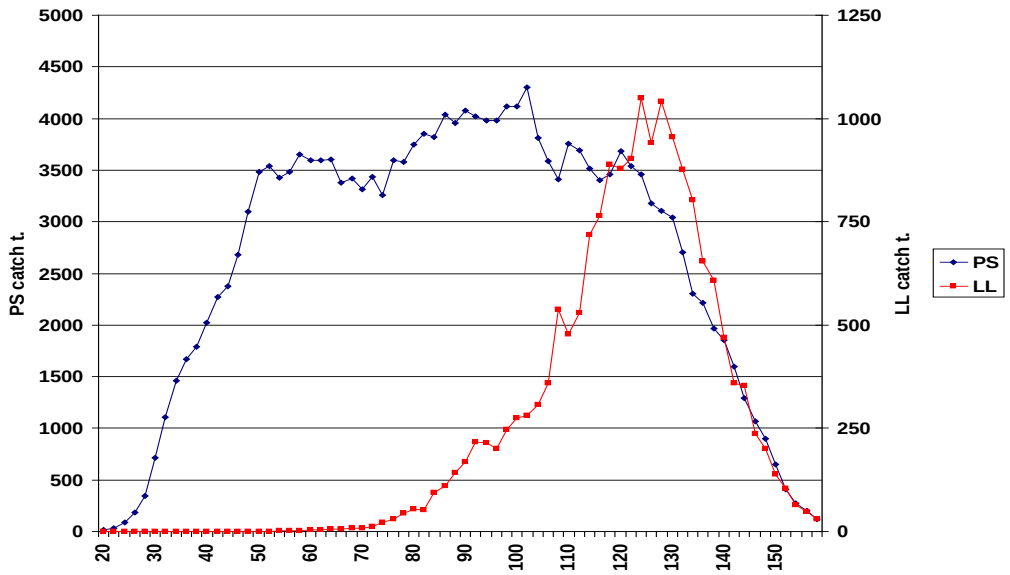

Figure 5: Average catch at size of yellowfin, in weight per 2 cm classes of fork length, taken by purse seine and by longline fisheries (IATTC data, period 1961-2006)

This figure shows that, as in all the other oceans worldwide, longliners are catching only the large fishes at sizes over 90 cm or mainly 1 meter, when purse seiners are catching a wide range of sizes between 30 cm to the same maximal size as longliners, at about 160 cm. It is quite striking to note that these PS catch at age in weight tend to be flat between the full recruitment in the PS fisheries at 50 cm and 130 cm.

Yield per recruit

The yield per recruit of the PS and LL fisheries have been routinely estimated by the IATTC staff for many years, and always leading to the conclusion that the yield per recruit of the longline fisheries is much better than for purse seine fisheries: for instance this year, a MSY of 407000 t. obtained by longliners when the MSY expected form the dolphin fishery was estimated at only 307000t. (when the catch at age of this fishery is also quite good, and the historical catches very high). The much better yield per recruit obtained by longliners is logical, as the combined modes of the purse seine fisheries are catching large quantities of YFT at small sizes, much lower than the "optimal" range of sizes that are producing the maximum yield per recruit. Consequently, the very high MSY of the longline fisheries estimated at levels over 400000 tons is simply based on this good yield per recruit of longliners.

3- Discussion upon the EPO YFT stock and longline fisheries

The basic yield per recruit calculations are interesting to do, but keeping in mind several limiting factors such as:

(1) the serious uncertainties in their results: as they depend of the natural mortality at age and of the growth pattern assumed. As an example the loss of yield per recruit due to the catches of very small tunas is widely dependent of the natural mortality assumed for these juvenile fishes, always an unknown parameter. Alternate Yield per recruit showing that the ideal Y/R would be obtained not by longliners but by the dolphin fisheries could for instance be easily obtained (at least this is our guess), when today the dolphin fishery has an estimated Yield per recuit 30% lower than longliners..

(2) yield per recruit results means that the fishes are fully recruited and fully available to the fishery, and this may not be the case for yellowfin caught in the EPO by longliners. This basic problem has been already often discussed by scientists, for instance already by Lenarz et al in 1975, but surprisingly it is very seldom discussed in its IATTC stock assessment reports.

It is important to understand the availability of YFT tuna to tuna fleets in general and to longliners in the Western and Eastern Pacific. A simple way to compare the YFT fisheries in the EPO and in the western Pacific is to compare the average YFT catches taken by the combined fisheries in the 50 best 5° squares, and to do the same comparison with the average catches taken by longliners. These results are shown figure 6a (combined fisheries) and 6b (longliners).

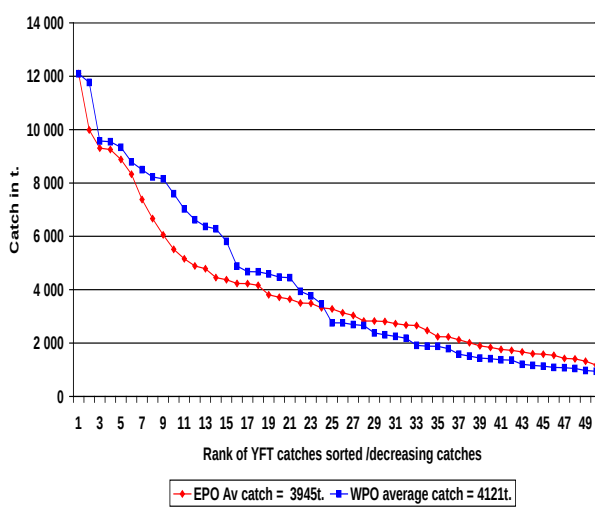

Figure 6a: Average catches of YFT taken by the combined fisheries, by 5° squares sorted by decreasing catches (only the 50 best 5° squares shown)

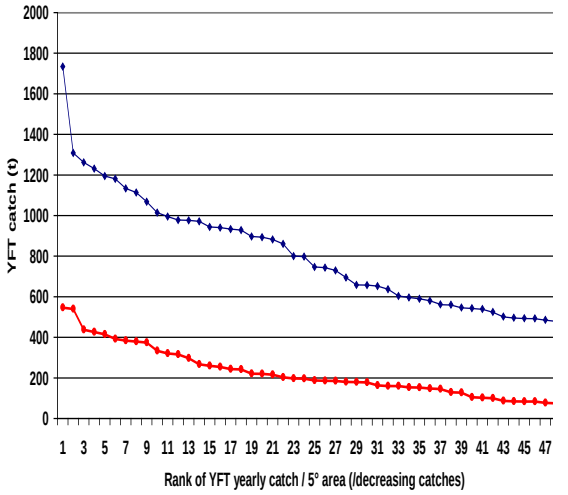

Figure 6b: Average catches of YFT taken by longliners, by 5° squares sorted by decreasing catches (only the 50 best 5° squares shown)

This figure shows well that the average catches of YFT by 5° squares in the 50 best areas was nearly identical for the combined gears in the Eastern and Western Pacific oceans: an average catch of 3900 t. in the EPO vs 4100 tons in the west. On the opposite, the average catches by longliners in the 50 best 5° squares areas was much higher in the Western than in the Eastern Pacific: 800 t vs 220t., a quantitative confirmation of the conclusion based on the fishing maps.

It should also be noted that the EPO is a quite small fishing zone compared to the WPO: in the EPO, only 150 5° Squares have been producing some YFT during the 1960-2005 period. As a consequence the theoretical 407.000t MSY that has been proposed by IATTC scientist for longliners in the EPO would have to be taken in these 150 squares, i.e. with an average « world record catch of 2800 tons » of YFT /5° square. Such average YFT catch would be 3.5 larger than the present average YFT catches by LL in the WCPO in the best 50 5° squares!! Such level of extremely high potential catches by longliners is of course totally unrealistic in the EPO were longliners have never been able to catch large amounts of YFT. There is no doubt that the compressed habitat observed in the EPO is not suitable for major YFT catches obtained by longliners: because of this major environmental constraint, longliners do show their typically high yield per recruit, but only a minor part of the population is available to this gear. As a consequence there is no doubt that the longline fleets would never be able to catch an MSY over 400.000 tons in the EPO.

After reviewing these fishery and environmental data, we do not support the conclusion by Maunder 2002 that "*fishing with longline would produce the greatest MSY….but longline effort would have to be increased by an unrealistic amount to produce the MSY*", our conclusion being that MSY potential catches in the EPO would be much lower than purse seine catches, because of the low availability of the YFT stock to longliners in the EPO.

4- Conclusion

Our conclusion, based on fishery and environmental data in the EPO, is that the real potential MSY that could be obtained by longliners on the EPO YFT stock is probably **very low**, simply because this resource is not significantly available to longliners. In such a basic context, the sustainable maximal catches by longline fleets are probably in a range of about 10 times lower than the theoretical MSY presently estimated by the IATTC staff, based on yield per recruit of LL. In such a context, it is quite/totally misleading to provide to the IATTC commissioners in the IATTC stock assessment reports these "miracle MSY" potentially obtained by longliners, over 400.000 tons, that have been estimated yearly in the IATTC reports. There is no doubt that these estimated MSY of longliners do not have any scientific basis: realistic estimates of MSY by longliners should never be based on estimated yield per recruit multiplied by numbers of recruits, but they should be conditioned by the availability of yellowfin tuna to the fishing gear, that is very low in the EPO due to its low rates of oxygen at the traditional fishing depth of longliners.

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