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On the major interest to do all yellowfin stock assessment analysis in the Eastern Pacific since 1950, or before.

By Alain Fonteneau & Javier Ariz

Summary

This paper examine the shifting base line syndrome faced by the yellowfin stock assessment done by the IATTC staff, as when its historical stock assessment were starting in 1934, all the present stock assessment start only in 1975. The paper concludes that future yellowfin stock assessment should be conducted starting since the beginning of the yellowfin fisheries, for instance in 1920. Such extended analysis should be based on an the results of ad hoc data mining program allowing to recover and to incorporate in the IATTC data base all these historical data. The assessment model should also be modified in order to fully use all these new data and the major changes in stock and fisheries (for instance in catchabilities, size selectivities and fishing zones). It is concluded that such extended analysis covering the early fishery should widely improve the modelling of present stock status and the validity of the estimated MSY.

1-Introduction

A general recommendation in all stock assessment of exploited fish stocks, is to run the analysis on the longest possible series and preferably since the beginning of the fisheries, as this method allows to better understand all the changes in the fish stock and fisheries, and also to estimate the famous "virgin stock" a key reference point in the management and conservation of all stocks. In such context, it is quite surprising for external scientists to see that all the stock assessments presently done on yellowfin by the IATTC are conducted only since 1975. Knowing that:

- the yellowfin stock has been fully studied by the IATTC scientists since the early 50ies (Schaefer 1957),
- that all the catch and effort and size data are fully available since 1950, and widely during the earlier years
- that this stock has been under strict management and quotas during the 1967-1979 period (with a nearly total closure during 6 month of all coastal areas),

it is hard to understand why these historical series pre 1975 should be abandoned from present stock assessment, when they have been fully used by the IATTC scientists in many of their past yellowfin stock assessments. We tend to consider that such *shifting baseline* in the analysis (Zeller et al 2005) should never be used in any stock assessment: when consistent historical data exist, they should always be used in the assessment, and never abandoned (or lost for external scientists). We shall examine and discuss in this informal working paper the major changes in the historical EPO yellowfin fisheries and the potential interest and difficulties to incorporate these data in the future yellowfin stock assessment.

2- 50 years of yellowfin stock assessments by the IATTC: a good example of shifting base line

There is no doubt that the IATTC has been the first Tuna Commission, as it has been created in 1950, i.e. well before the ICCAT created 17 years later. The IATTC has also been the first tuna Commission to do yearly stock assessment on its resources, for instance since the pioneer work by M. B. Schaefer in 1957 on global models done on the 1934-1955 catch and effort series, or some years after by Tomlinson using well structured VPAs based on the historical yellowfin catches at age (IATTC yearly reports). Based upon these systematic stock assessment of the yellowfin stock, this valuable resource has been under an active management by the IATTC Commission since 1967, all these analysis being also based on series of historical data since 1934.

However, it is rather strange that nowadays, all present stock assessment analysis are done using much shorter statistical series that are starting in 1975 (Maunder et Da Silva 2007). This is for us a typical case of the ***"Shifting baseline"*** syndrome that has been well analyzed by Zeller & al 2005. In such analysis, all the historical data tend to be abandoned from the analysis by scientists, considering *de facto* that these historical data are not important today for the understanding of today fisheries and stock status. We consider that this should never be the case, as these historical data are most often of great interest in the analysis, for instance to estimate historic stock biomass and natural mortality rates of unexploited stocks, especially in our case on the EPO yellowfin stock, as such unexploited stocks that has been fully followed by scientists during nearly a century are very rare. Such long term historical analysis can then be highly valuable for understanding changes in the yellowfin stocks over its entire fished period.

The IATTC tendency to forget the very long history of the yellowfin fishery (figure 1) in the EPO can easily be noticed, as all the basic catch and effort series used in the historical IATTC assessments, are never shown in the recent IATTC reports. Worse the basic file of yearly total catches by gear and species that is available in the IATTC WEB site, starts only in 1960, when all the other younger Tuna Commission initiate their data base in 1950. In parallel the IATTC detailed historical catch and effort data base by month and 1° square during the fifties (figure 2), cannot be obtained nowadays from the IATTC, when these interesting data have been published in various reports by the IATTC (figure 1). On the other side these historical data are clearly very interesting ones, for instance to quantify the geographical changes between historical and present fisheries. These changes are for instance of key importance to condition the MSY of the exploited stock (Die et al 1990): for most tuna stocks, it appears that due to the viscosity of most tuna stocks, the real MSY of the stock can be reached only when a large proportion of the distribution area is actively exploited by the fisheries. There is no doubt today that the coastal fisheries active during the sixties in the EPO would not allow to catch the present MSY of the yellowfin stock.

Another consequence of this shifting baseline in the stock assessment is that all the valuable information collected by the IATTC staff before 1975, catch and effort statistics, sizes caught, tagging and recoveries, that has been extremely useful in the past work of the IATTC and published in many scientific documents, are now de facto abandoned from the scientific memories. This loss of information is extremely negative, and especially the loss of the so valuable tag and recovery data that have been of key interest to study the yellowfin movement and their apparent mortality in the coastal area of the historical fisheries (Bayliff 1971).

3- An overview of the main historical changes in the yellowfin EPO fisheries

Major changes have been observed during the very long history of the EPO yellowfin fisheries: these historical fisheries have been very active in the EPO, using pole and line vessels, the clippers, since the early twenties, and this gear being dominant in the EPO fisheries until the early sixties. The fishing zones as well as the sizes caught by this gear have been well followed by the IATTC scientists and well described in various IATC papers (figure 2), showing a coastal fishery catching predominantly small yellowfin, but also some large yellowfin tunas.

It can also be noticed that the longline fisheries arrived in the EPO area during the 1954-56 period, and quickly reaching their full geographical coverage in 1965 (figure 6). It should also be keept in mind that this gear never caught large quantities of yellowfin in the EPO, only an average of about 16.000 t during the 1955-2005 period, i.e. much less than in the Western Pacific (an average yearly catch of 70.000 t during the same period) or in the Indian Ocean (60.000t). On the opposite, the bigeye catches taken by the same longliners tend to be very important in the area. It can also be noticed concerning the longline fisheries in the EPO, that major decline of the yellowfin CPUEs have been observed during their early period of activity in the area (figure 5), a decline that was clearly totally independent of stock size (during a period of low total catches) (Hamton et al 2005), but it remains striking that this major decline has been poorly explained by scientists (in the IATTC area of in the other oceans).

The purse seine fisheries became the dominant gear since the early sixties, this gear showing a more or less permanent geographical expansion of its fishing zones, and especially since the implementation of a seasonal coastal closure of the yellowfin purse seine fisheries since 1967. It should also be noted that this EPO yellowfin purse seine fishery has been under a strict yellowfin quota in the coastal CYRA zone during the period 1967-1979. This management was enforced yearly by the IATTC, based on the conclusion that the coastal yellowfin stock was then overfished, a conclusion that was a valid one, but only in the coastal area. This was typically a case of local depletion of a geographically overfished fraction of stock, when the whole EPO stock was far to be overfished. It can be concluded nowadays that at the real scale of the yellowfin stock in the EPO, the stock was not yet overfished and it was fully in the green area of a Kobe diagram, when the total yearly catches under 100.000 t. were much lower than any of the presently estimated MSY in the IATTC Convention area. We consider that this critical management period (1967-1978) and its closed fishing areas, should be better and fully integrated in the present and future assessment models.

It should also be noticed that a major change has been recently noticed in the purse seine yellowfin fishery, following the development during the nineties of the FAD associated fishery. When this fishery was targeting primarily skipjack tuna, it should be also noticed and kept in mind that the FAD associated catches in the offshore southern EPO are now very significant, these fishes being taken at a smaller size: about 40% of the yellowfin caught by purse seiners during the period 1990-2007 have been caught under FADs, and in a much wider area than before (figure 3c and 4).

A positive point in the analysis of the EPO yellowfin fisheries is that the size distribution and average weight of the yellowfin caught by the various fisheries has been very well followed by the IATTC staff, then allowing to use size data that are available since the early 50ies (possibly well before?). The overview of these average weight caught is also very interesting, as it shows that the average weight of yellowfin caught by the combined fisheries in the EPO has been very stable in the long run (figure 4), showing an average weight close to 10 kg during the entire period (and a low weight close to 6kg, but only during the 1978-

1983 period). It can be noticed that the same average weight has been showing much wider fluctuations in all the other areas (Atlantic, Indian and Western Pacific oceans), for instance in the western Pacific where the recent average weight of yellowfin caught appears to be under 2kg (SPC estimates).

4- A need to understand and to model all the changes in the fisheries

There is an increasing tendency by scientists and by RFO to use the recently developed Statistical models such as A-SCALA (Maunder) or SS2 (Methot) because they are able to incorporate in ideal statistical terms all the data available on the stocks and on the fisheries, but the present yellowfin stock assessment has always been done using A-SCALA, the IATTC home made age-structured model (Maunder & Da Silve 2008). This present model is based on the assumption that there is a single stock of yellowfin in the EPO. This hypothesis is probably a quite valid one as the mixing between Western and Eastern yellowfin appears to be low. But on the other side, these geographically unstratified models tend to face major difficulties to incorporate the observed major changes in the size of the fished zones over long periods of time (figure 5). Furthermore, the corresponding major changes in the catchability, in the size selectivity and in each of these increasing fished zones should also be estimated in the model.

We consider that if present models still face major difficulties to incorporate these changes in fisheries, a Stock Synthesis or a MF-CL model using a geographically stratified stock -for instance with 6 fractions of stocks as in the WCPFC area- would be necessary to fully incorporate these fundamental geographical changes in the fished stock. This capability of the assessment models to incorporate tuna movement patterns and their viscosity, should be fully recognized by the IATTC staff as a fundamental characteristics. The historical fishery data should never be abandoned from the assessment, simply because these historical fishing zones were too coastal!

Furthermore, the early major decline of longline CPUEs should also be fully incorporated in the stock assessment, and necessarily associated with a major decline in the yellowfin catchability to the longline gear (as in the Indian and Atlantic oceans). The present type of stock assessment analysis starting in 1975, and abandoning all the early pre 1975 period (that has been showing the major decline of longline CPUEs), offered a wide open field to the “infamous” Myers and Worm 2003 paper, as the biomass level and trend of the yellowfin stock was not estimated by the IATTC during this early period.

One of the scientific arguments by the IATTC staff favouring the present SA starting in 1975 is that this shifting baseline does not changes the diagnosis on the most recent stock status. We tend to consider that this conclusion may be widely false: for instance, we consider that the steepness parameter of the stock recruitment relationship, a key stone parameter in all the present tuna SA, is widely conditioned by the duration of the studied period. We also consider that if the SA analysis is unbiased, and if it can provide a 60 or 70 years series of yearly spawning stocks and recruitments, this stock recruitment relationship would be much stronger (as it is based on a much wider range of spawning stocks, fisheries and environmental conditions). And there in no doubt that this steepness parameter in the SR relationship widely condition:

(1) The present levels of estimated MSY,
(2) The present degree of stock overfishing,
(3) All the projections of future stock status?

It should also be recognized and accepted that this recommended longer stock assessment analysis may provide results that will be in contradiction with historical management recommendation done by the IATTC staff: it can for instance be envisaged nowadays that the early closure of the yellowfin coastal fishery, when the total yearly catches

were well under 100.000 tons, was not really necessary for the conservation of the EPO yellowfin stock considered as a whole (i.e. the biomass of yellowfin east of 150° East). Such potential changes in the assessment diagnosis should not be a reason to freeze or to abandon such stock assessment analysis covering a much wider period.

5- Conclusion

The conclusion of this working paper is quite simple and clear: there is now a major interest for the IATTC to run its future yellowfin stock assessment, not since 1975 as in the present analysis, but starting it in 1920 when the EPO yellowfin stock was then in a virgin status and doing this analysis using a full geographical stratification of this analysis.

All the basic data allowing to run this extended analysis should be quite easy to recover, as the total yearly catches by gear as well as the yearly fishing zones and the sizes caught should be quite easy to recover or to estimate by the IATTC staff, at least their order of magnitude. This recommended data mining programme should provide results that will be highly interesting:

- ✓ In countering the present 'shifting baseline' syndrome of the yellowfin stock assessment.
- ✓ In providing the early time period anchor points for meta-analyses and modelling.
- ✓ Allowing to incorporate in the present analysis all the valuable information collected by the IATTC staff before 1975: catch and effort statistics, sizes caught, tagging and recoveries, etc
- ✓ Improving the estimation of the unexploited stock parameter values of the EPO yellowfin stock.
- ✓ Improving the estimate of the Stock Recruiment relationship.

Various difficulties will of course be faced by such extended stock assessment analysis: this is not a simple task! The model should be able to fully incorporate the earlier set of lower quality data, and also to handle the major changes between the pre and post 1975 fisheries. Further work in the stock assessment model should then be recommended in order to handle the major changes in the fishing zones during this extended period (figure 5) and the major changes in gear efficiencies (excessive decline in the early LL CPUEs and widely increasing efficiency for most/all other fisheries at least during the last 30 years) and also their changes in size selectivities. A good stock assessment model for all tuna stocks should always handle the fundamental parameter of the increasing sizes of area fished (this is not really the case in the present IATTC model) as well as the permanent changes in fisheries global catchabilities and their size selectivities. The great potential flexibility of the SS2 model should allow to incorporate these basic tuna factors in the future IATTC stock assessments.

Recommendations

- A data mining programme should be developed by the IATTC staff in order to recover, and if necessary to computerize, all the historical data upon yellowfin, bigeye, albacore and skipjack tuna fisheries in the EPO (similar programme has been recently launched by the ICCAT)
- The present IATTC file giving the yearly catches by gear and species only since 1960 should be updated and placed in the IATTC WEB site: it should cover the entire period, at least since 1950 and preferably since 1920.
- All the historical catch and effort information upon monthly C/E by 1° squares of the surface fleets, already published by the IATTC or not, should be made available in the public domain at least since 1950
- Ad hoc “flexible” stock assessment models used by the IATTC should be developed allowing to incorporate these newly recovered historical data and their additional complexity (for instance Stock synthesis?).
- The Assessment model should be developed to incorporate a full scale area stratification of the fished stock (for instance using 6 fractions of stock as in the WCPFC MF-CL assessments)
- Future yellowfin stock assessment models should be tentatively conducted during the entire history of the fisheries, i. e. probably since 1920, in order to assess the changes in stock and fisheries status since the exploitation of the virgin stock.

Bibliography

Alverson F.K. 1960. Distribution of fishing effort and resulting tuna catches from the eastern tropical Pacific by quarters of the year, 1951-1958. Inter. Amer-Tropi. Trop. Comm.,Bull., Vol IV,N°6, pp321-446.

Bayliff W.H. 1971. Estimates of the rates of mortality of yellowfin tuna in the Eastern Pacific Ocean derived from tagging experiment. Inter. Amer-Tropi. Trop. Comm.,Bull., Vol 15,N°4, pp 381-436.

Die D.J., Restrepo V.R. and W.W. Fox, Jr. 1990. Equilibrium production models that incorporate fished area. Transaction of the American Fisheries Society. 119: 445-454, 1990, pp:445-454.

Hampton J., J. R. Sibert, P. Kleiber, M. Maunder and S. Harley. 2005 Decline of Pacific tuna populations exaggerated? NATURE, Vol 434, 28 April 2005.

Maunder M. A. Aires-Da-Silva, 2008, Status of yellowfin tuna in the eastern Pacific Ocean and outlook for the future. 9TH stock assessment review meeting, document IATTC SAR-9-07a, 70p.

Methot, R. D. 2005. Technical description of the Stock Synthesis II assessment program. NOAA Fisheries.

Myers, R. A., and Worm, B. 2003. Rapid worldwide depletion of predatory fish communities. Nature 423: 280–283.

Schaefer, M.B. 1957. A study of the dynamics of the fishery for yellowfin tuna in the eastern tropical Pacific Ocean. Inter-Amer. Trop. Tuna Comm. Bull. 2: 245-285.

Zeller D., R. Froese and D. Pauly 2005. On losing and recovering fisheries and marine science data. Marine Policy 29 (2005) 69–73.

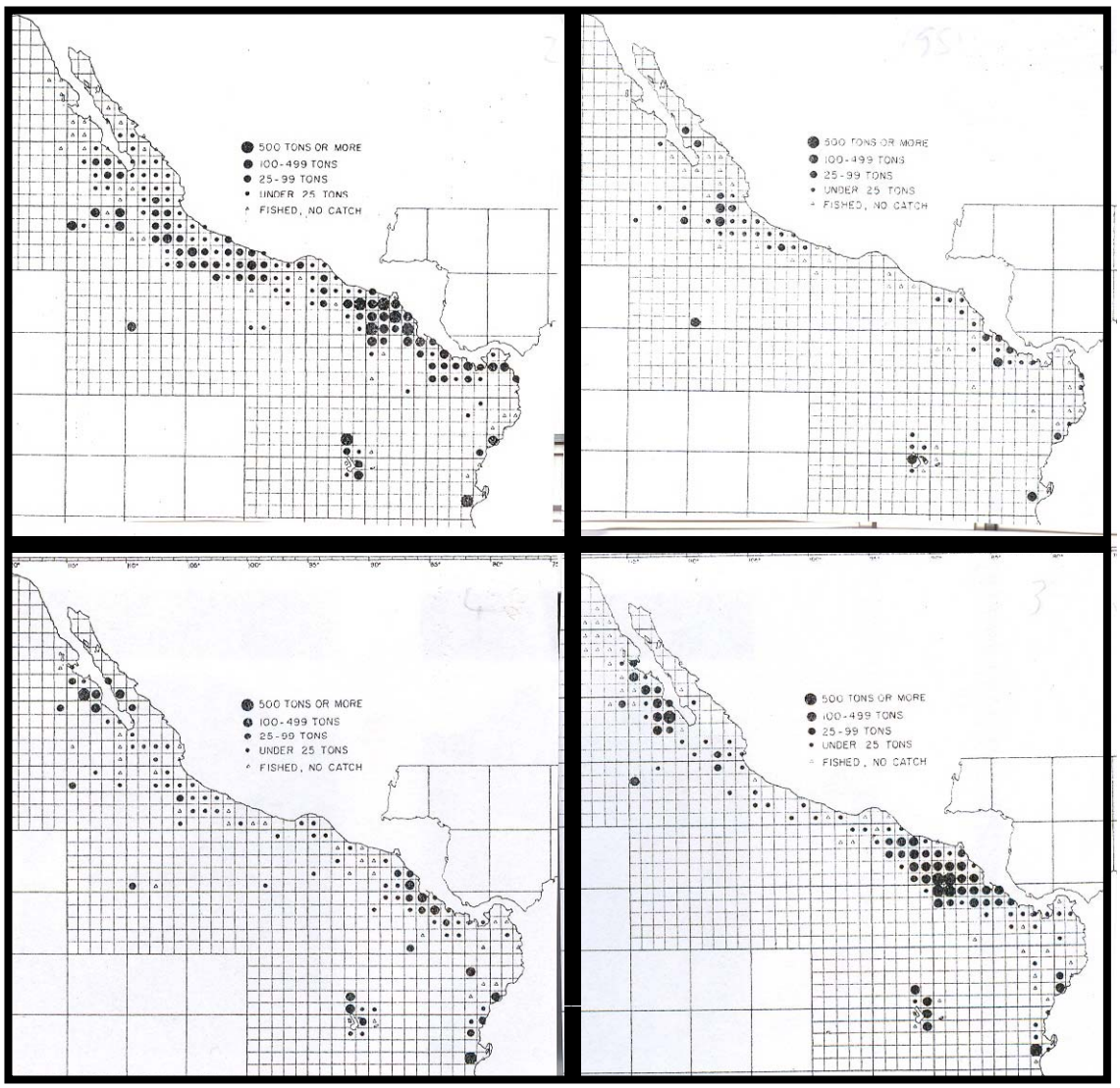
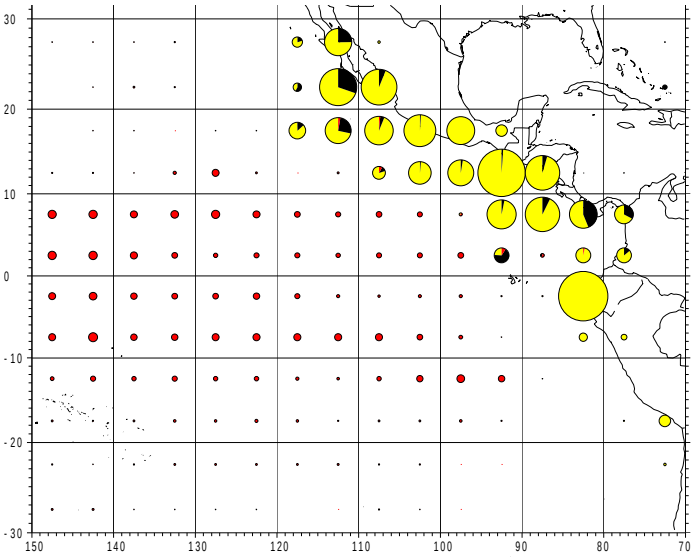
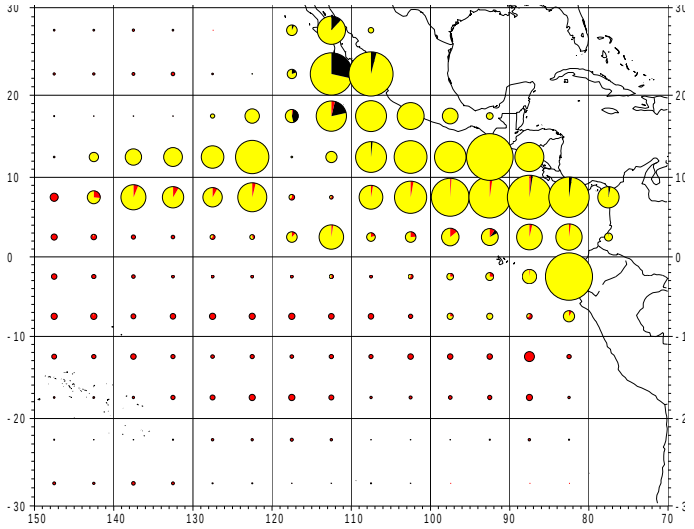


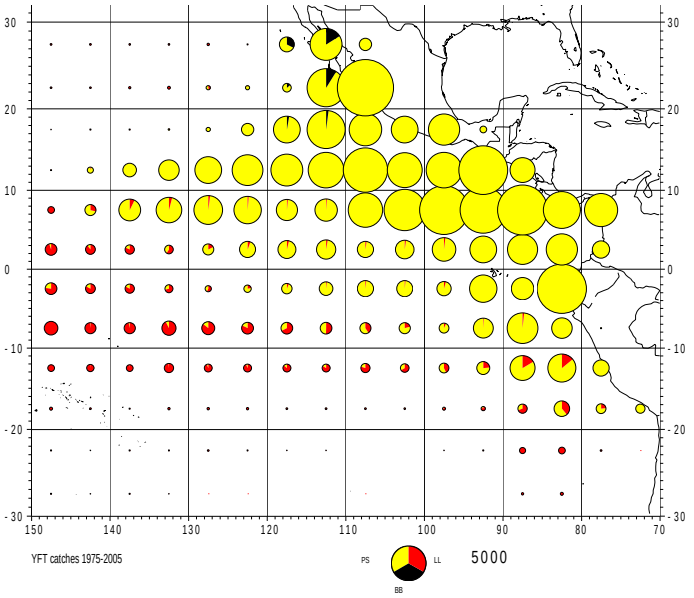
Figure 1: Historical quarterly fishing maps of yellowfin taken by pole and line vessels in the EPO (year 1951) (IATTC figures taken from Alverson 1960)



1959-1966



1967-1974



1975-2007

Figure 2: Yellowfin catrches by 5° squares taken by each by gear, by 5° squares, during 3 periods typical of the EPO YFT fisheries (present stock assessment covering only the 3rd period) (maps redone using IATTC data)

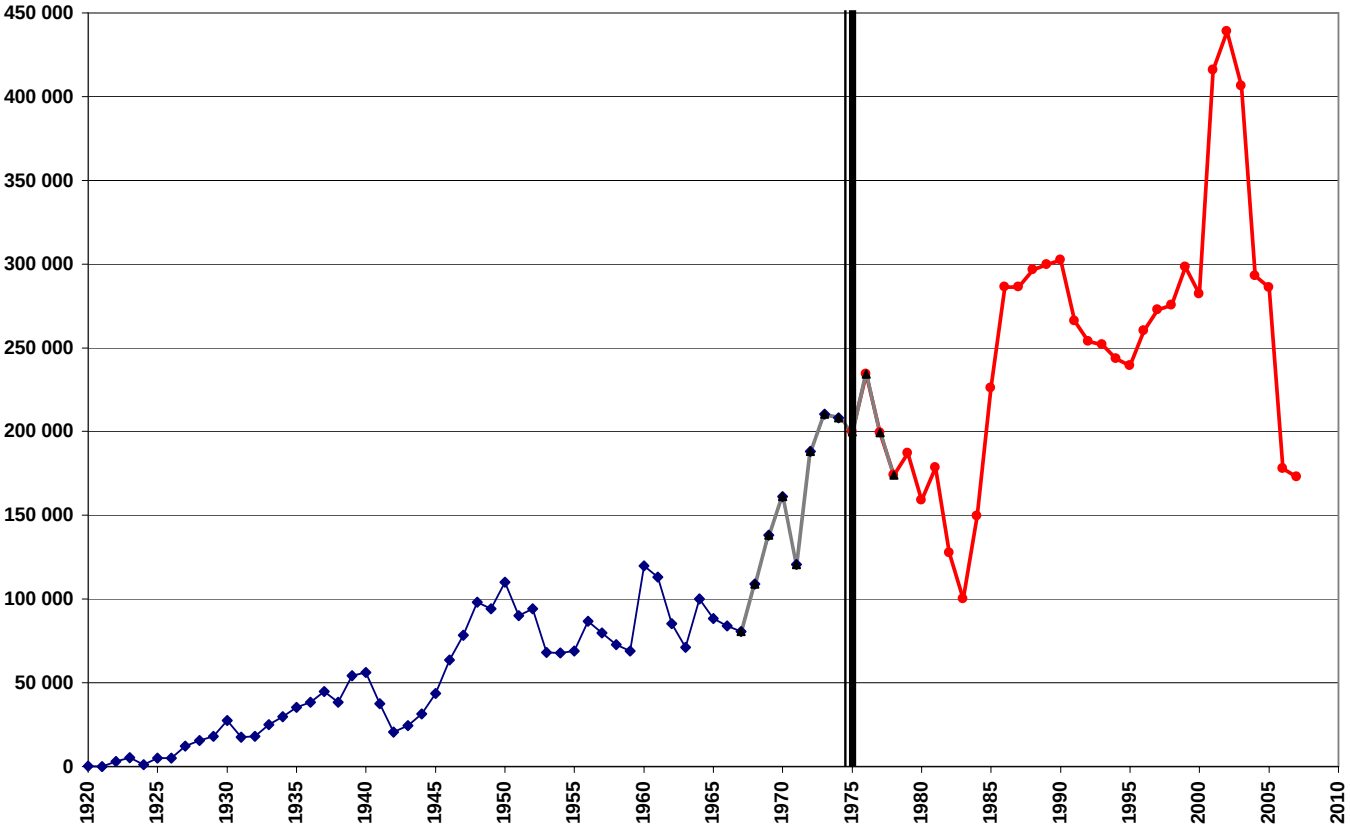


Figure 3: Yearly yellowfin catches during the 1920-2007 period in the EPO (rebuild from various IATTC reports)

NB: the period before 1975 is not used in present stock assessement;
the dark curve correspond to the 1967-1978 period during which there was extensive closures of the YFT purse seine fishery. Catches during the 1920-1959 period were taken from historical IATTC reports and from FAO.

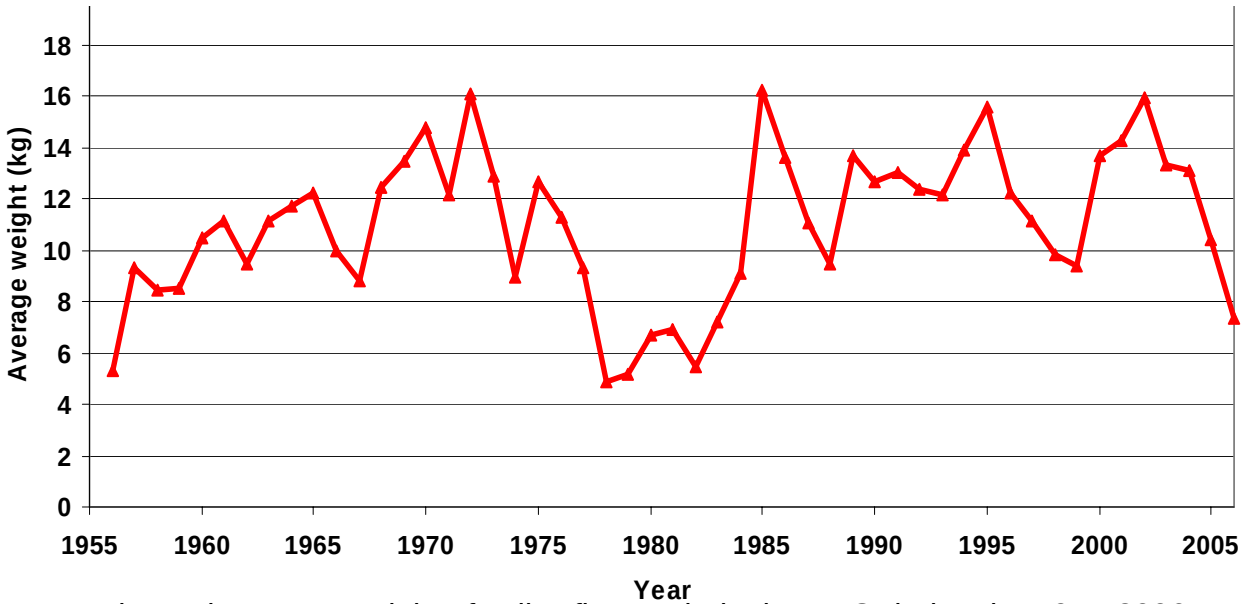


Figure 4: Estimated average weight of yellowfin caught in the EPO during the 1955-2006 period (IATTC data)

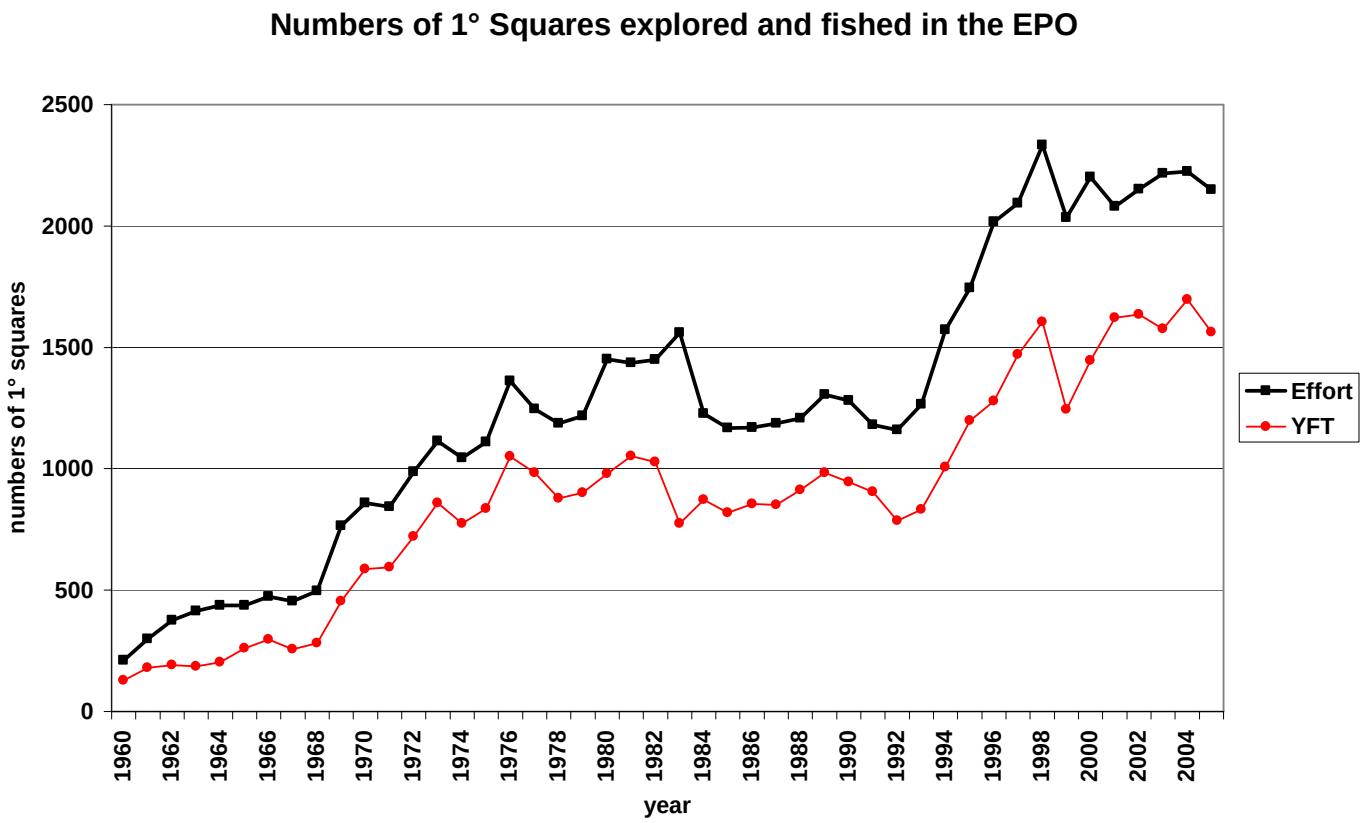


Figure 5: Numbers of 1° explored and with a yellowfin catch by purse seiners in the EPO

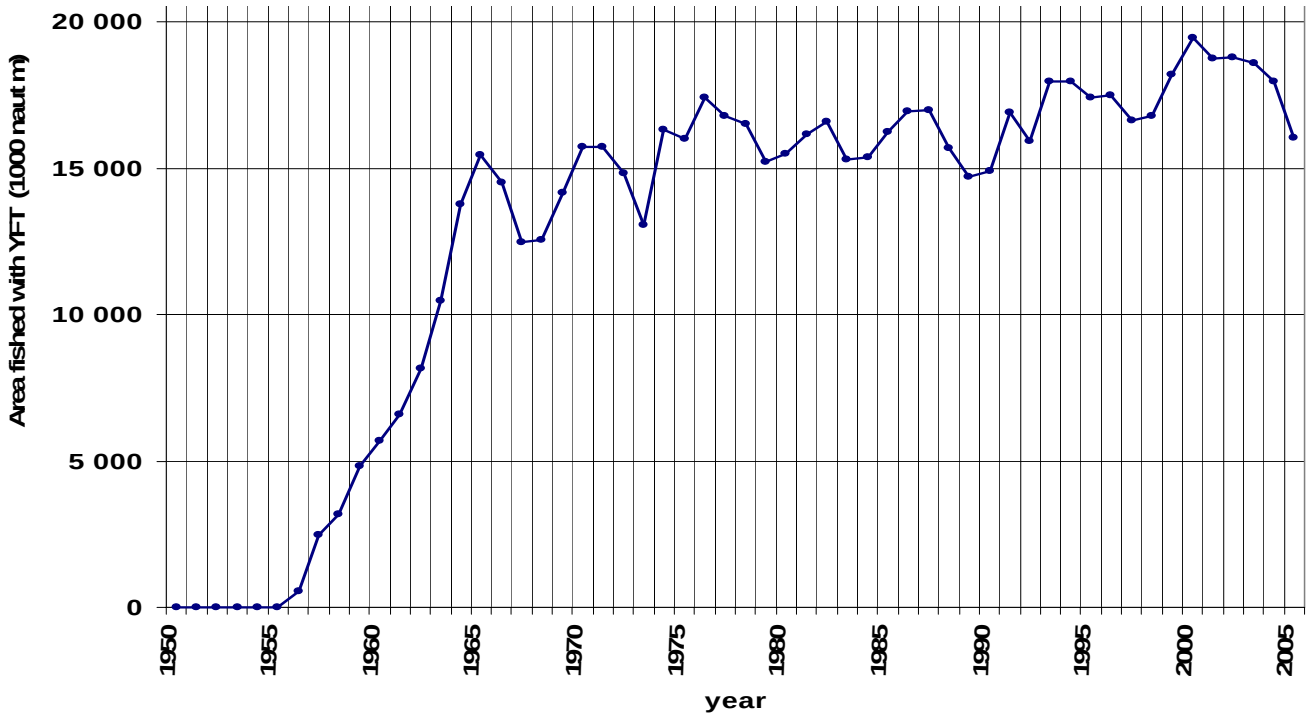


Figure 6: Size of the area fished yearly by longliners in the EPO (with a minimal yearly catch over 2t) , in 1000 nautical miles^2.

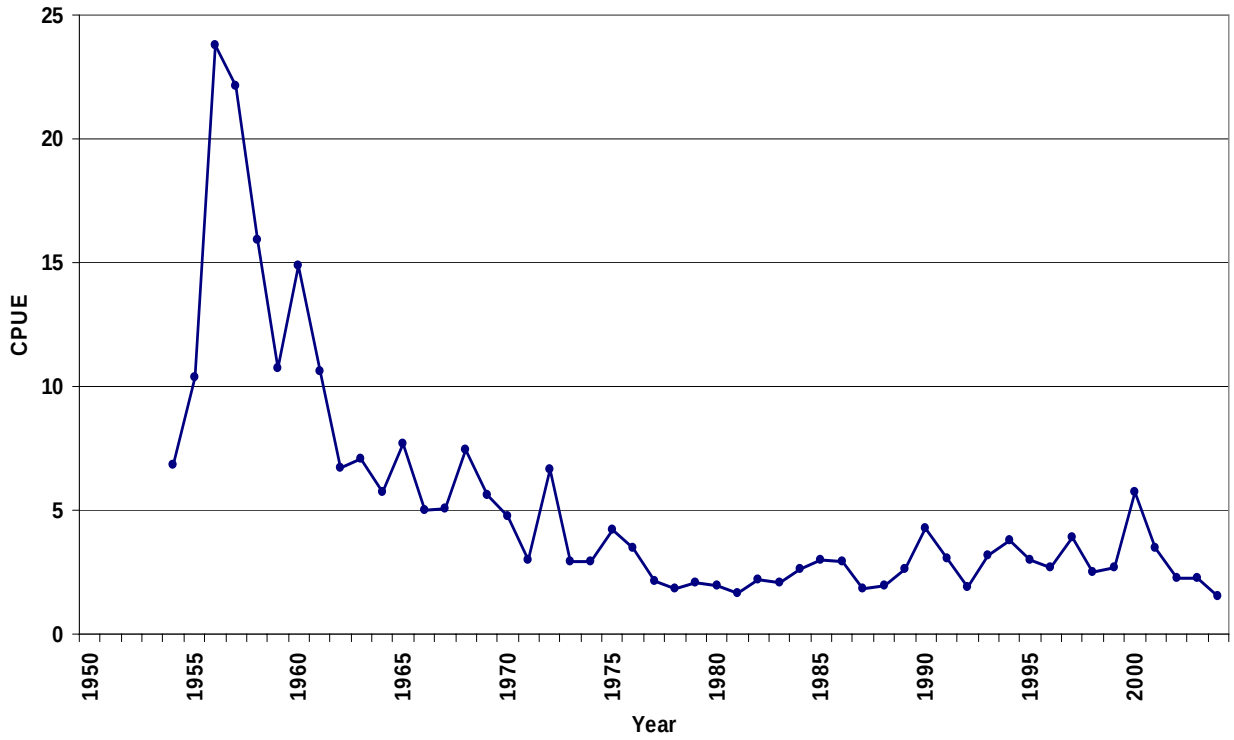


Figure 7: Nominal yellowfin CPUE of Japanese longliners in the EPO between 10°N-15°S (core area of the yellowfin fished by longliners in this area)