

WORKING GROUP TO REVIEW STOCK ASSESSMENTS

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Proposals targeting a better understanding of the IATTC stock assessment results

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1- Introduction

Statistical models that are increasingly used nowadays by various tuna RFO and by the IATTC, are clearly very interesting, but it appears, when reading the recent IATTC results, that the main results obtained by these complex models are often very difficult to follow.

This note will discuss this present lack of transparency in the present stock assessment reports, and it will make practical recommendations allowing to better understand the basic input data as well as the main results obtained from these models.

2- Global problem

A good report from a tuna stock assessment should be fully and easily understandable to any scientist: it should also contain a good summary of all the basic fishery data that are used directly or indirectly in the analysis, as well as an easily understandable presentation of its main results (all the details of the calculations, for instance by quarters areas and gears, being placed in an annex of the assessment document, not in the document itself). This recommendation is most often well followed in the IOTC and ICCAT reports, when in most IATTC reports, only the highly detailed results, but not their most interesting summarized tabulation, are given in the assessment documents.

Based on the experience of an ICCAT/IOTC scientist, this working paper will make and will discuss various proposals concerning the interest to show various basic indicators, as well as the various input and output data of the assessment model, that in the view of an external scientist, should necessarily be provided and well visible in all the IATTC stock assessment reports (independently of the model used in this assessment).

3- Main input data and results that should always be visible in all stock assessment reports

3-1-Useful basic indicators

From my point of view, a comprehensive tuna stock assessment report should clearly show on a routine basis a set of data or indicators: even when they are not explicitly used in the assessment, they are often of great potential importance to better understand, the fisheries themselves or the results of the assessment models. These figures should cover in the same ways all major gears active in the fisheries: purse seiners, longliners and others (if necessary). These indicators should also cover the entire period during which they could be available (in general the period 1950 to now, and possibly longer series), and not only the most recent years (1975 to now) during which the stock assessment model has been running. These longer

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series are essential to provide a basic information upon the history of stocks exploitation by the various fisheries.

As an example, my view is that the following information and figures should always be visible in such analysis (when available, an example of the present IATTC figure is provided in association with each of my proposed figures):

- 1) A good recent **fishing map by gear** (and by fishing mode) covering the entire studied ocean and showing the limit between stocks that is assumed in the assessment (see figure 1a, bigeye case, with its quite dubious frontier placed in the middle of a major fishing zone of adults). An historical map, for instance showing the fisheries during the historical period when the assessment model is starting, is also often useful to understand changes in fisheries during the period under study (figure 1b). The most recent map of catches should be used in conjunction with other data (for instance showing tag recoveries or selected environmental parameter) allowing to discuss the validity of the accepted stock assessment hypothesis (such discussion of the stock hypothesis used being necessarily a short but full part of the assessment report).
- 2) Yearly **size of exploited areas** (preferably for the main gears). Such figure (example of figure 2) shows if the fished zone has been increasing, stable or decreasing over time, an important parameter in the interpretation of the assessment results, for instance changes in the estimated MSY.
- 3) Yearly **age of the fishing fleets**: purse seiners and longliners. The average age of the fleet is an important factor in the interpretation and extrapolation of fishery trend. Such figure should be permanently available (figure 3).
- 4) Average **carrying capacity per vessel** of the main fleets: the average carrying capacity of the active fleet is also an important factor in the interpretation and extrapolation of fishery trends. Such figure should be permanently available (figure 4).
- 5) **Total carrying capacity** of the main fleets (a capacity weighted per its period of activity): the total carrying capacity developed by the fleet (weighted by its time of activity if the fishery was closed during the year) is also an important component (figure 5)
- 6) Trend of the **previously estimated yearly MSY**: the estimated MSY can vary each year following changes in the stocks, fisheries and assessment method. A figure showing the previously estimated MSY should be given in each assessment report (and if necessary, they should also be discussed in comparison with the most recent results) (figure 6)
- 7) Indicator of Environmental anomaly: the major environmental parameters that may be driving stock catchability or/and stock recruitment should always be visible in the report (and used when necessary in the discussion). (Figure 7)

3-2- Basic input data

- 1) **Catches by gear and /fishing modes** these yearly total catches by gear are a key stone parameter driving all stock assessments, and it should be fully visible, being part of the assessment report (figure 8).
- 2) **Total yearly nominal fishing efforts** by gear should be easily visible on a given figure done on a yearly basis for the whole fishing zone (figure 9)
- 3) Natural mortality at age: an important figure always good in IATTC reports
- 4) Total **average weight of the catches** and by gear (estimated from the extrapolated catch at size matrix) is an important parameter that should always be fully visible in reports, see figure 10, taken from Indian Ocean bigeye fisheries, showing the yearly average weights taken on the bigeye stock by each major gear and for the combined fisheries. On the other side the detailed information by gear and areas presently shown

in the IATTC reports does not help the reader to catch the global trends in average weights caught.

- 5) Changes in **catch at size** taken yearly by each major gear, possibly by 10 cm intervals fisheries (see figure 11, taken from Indian Ocean bigeye fisheries). The detailed information on the sizes taken by gear and areas presently shown in the IATTC reports does not help the reader to catch the global changes in the quantities taken by each gear). Another basic average figure showing the average size distribution of catches taken by each gear (or fishing modes: FAD, dolphin and free schools) during recent years is also a highly valuable piece of information for the readers of the stock assessment reports (see figure 12).
- 6) **Basic selected CPUE**: nominal and standardized. Well selected nominal CPUE, for instance by gear and fishing mode in the core areas of each activity (see figure 13), will be later very informative and interesting to follow, in addition to the assessment results. These areas could be selected on an ad hoc basis, and not necessarily using the areas used for the stock assessments.

3-3- Results of the assessment model

- 1) **Yearly estimated Fishing mortality**: the average total fishing mortality should be fully visible as well as the average fishing mortality exerted by each gear (in a given range of ages) (figure 14). The detailed information on the fishing mortality exerted by each gear on the local population of the small areas used in the model (presently shown in the IATTC reports) does not help the reader to catch the global changes in the fishing mortality exerted by each gear.
- 2) Relationship between **yearly catches and yearly estimated fishing mortalities**. A production model-like figure showing the relationship between the estimated fishing mortality and yearly total catches is always very informative (for both scientists and managers) (figure 15). This figure should also show the position of the estimated MSY in terms of catches and fishing mortality.
- 3) Yearly trend of estimated adult and juvenile **biomass**. A figure that is OK in all the IATTC reports (yearly and quarterly curves being very similar or identical).
- 4) **Yearly variability of estimated recruitment**: the average yearly estimated recruitments should be fully visible, when the quarterly values given in present IATTC reports are of minor interest for the reader (simply because population sizes, catches and stock dynamics are better understood at a yearly scale) (figure 16).
- 5) **Chronological plot** graph of the recruitment and spawning biomass levels: the basic traditional plot of recruitments versus spawning stock sizes should be given **always on a yearly basis**, and showing time and years in a sequential way (figure 17). This time dynamics is essential in the understanding of events, success of recruitment as a function of stock size.

4- Conclusion

This working document is proposing a wide range of possible changes in the presentation of future IATTC stock assessment reports. Most of these changes are only minor ones and they can be could be easily done (for instance simply adding or averaging the quarterly values by areas to build yearly totals by gear), when other may be more complex. This may be the case for the estimated average weights by gear, a data that was fully and immediately available when the IATTC scientists were doing VPA on the catch at size/age tables. These extrapolated catch at size tables are not immediately available in the present data handling done by the IATTC and its statistical models, but these basic estimates of average weights as well as the total numbers caught by size by each gear remain of major importance in the understanding of stocks and fisheries trends. Knowing that the IATTC has good series of total catches and good sizes sampling by time and area strata during very long periods, this work of extrapolation and substitution should not be too difficult to do with modern computers and modern software.

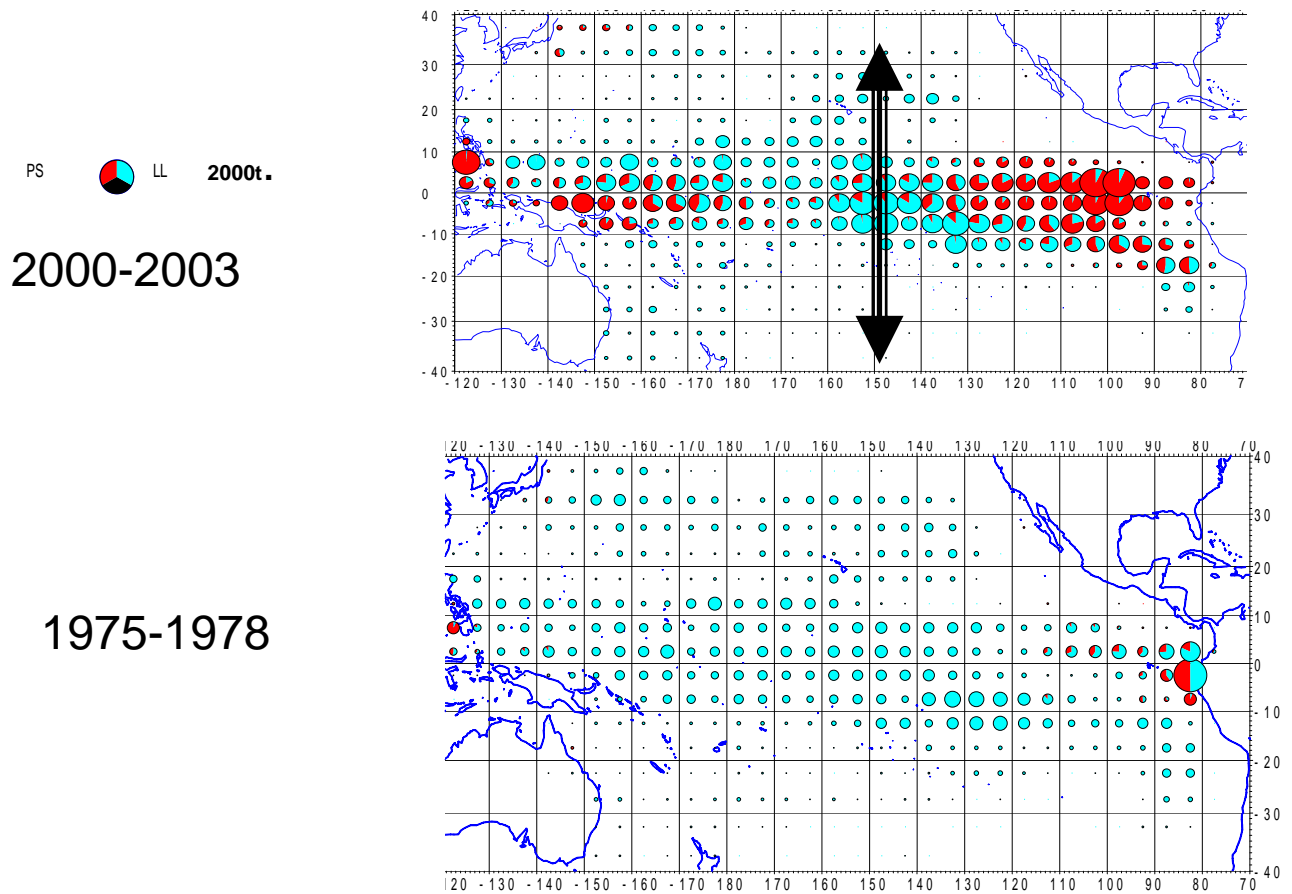


Figure 1: Maps of the average catch of bigeye taken by gear in the Pacific ocean during the 2 periods 1975-1978 (beginning of the assessemnt) and 2000 -2003, and western limit of the stock presently used in the assessment

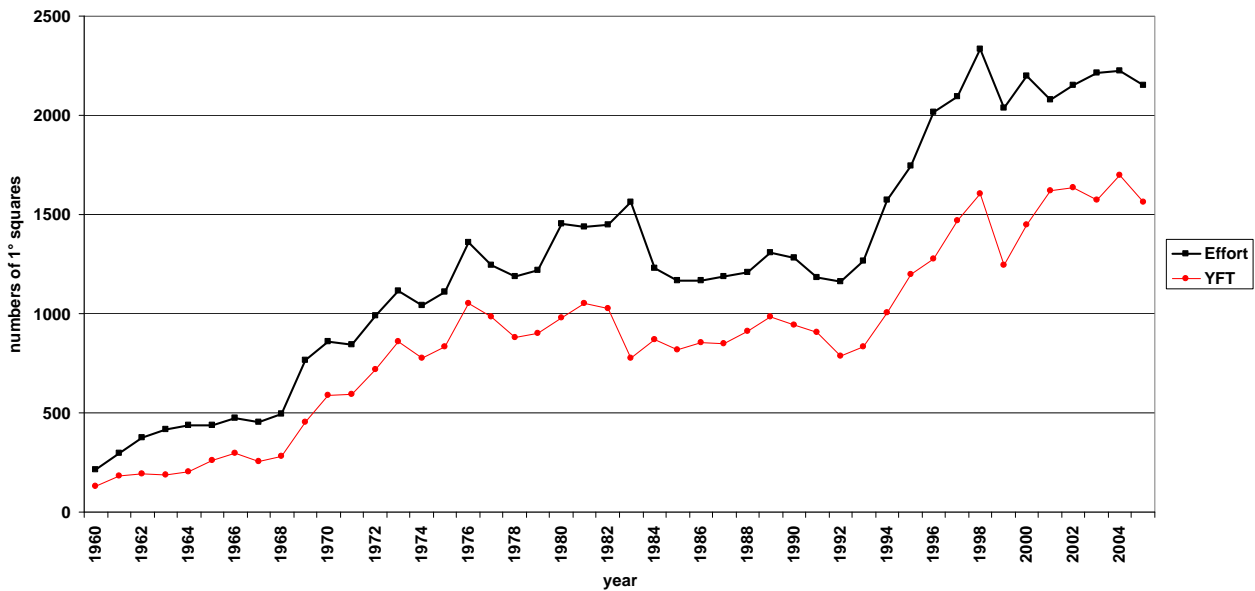


Figure 2: Yearly size of exploited areas fished and with a yellowfin catch by the purse seine fleet (expressed in numbers of 1° squares)

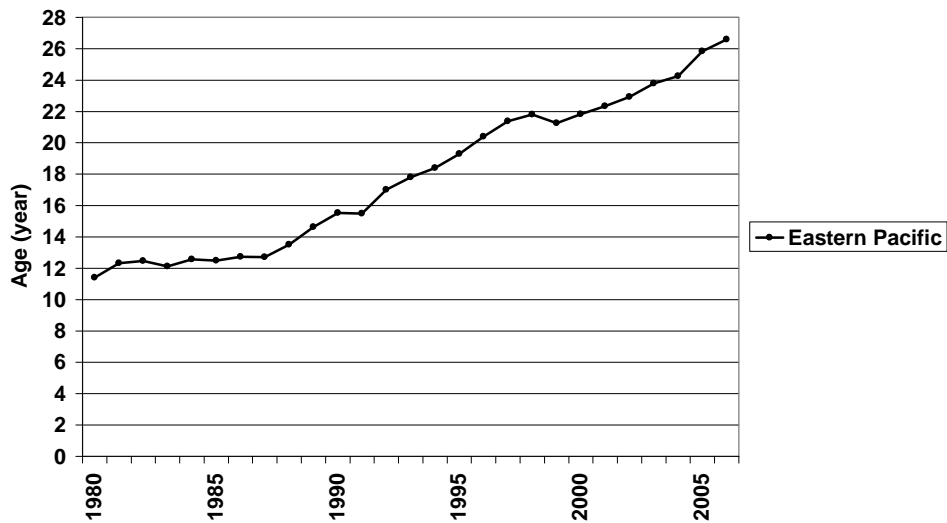


Figure 3: Average age of the vessels of the main fleets; example of the purse seine fleet in the Eastern Pacific Ocean

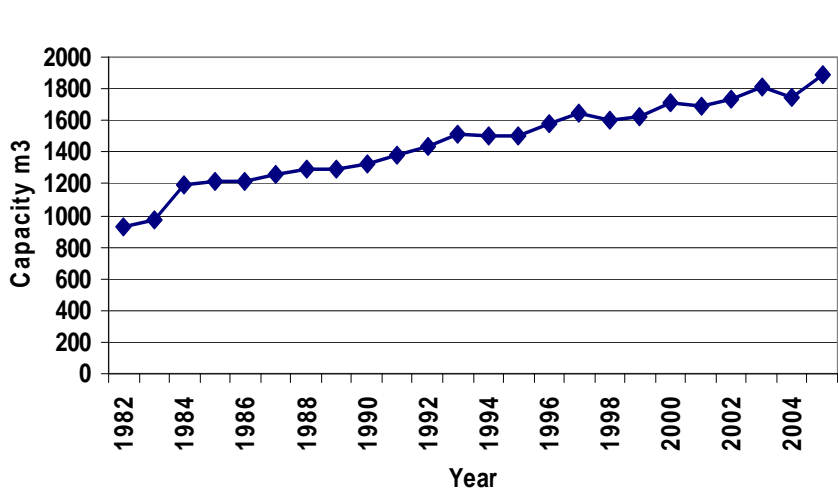


Figure 4: Average carrying capacity of the main fleets; example of the purse seine fleet in the Indian Ocean

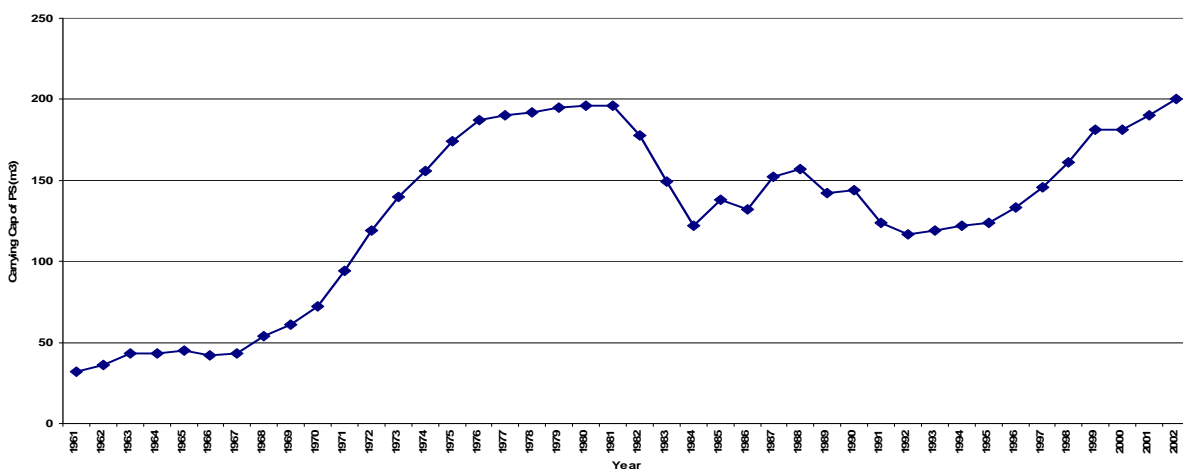


Figure 5: Total carrying capacity of the main fleets; example of the purse seine fleet in the EPO (a capacity weighted by times of activity of the fleet)

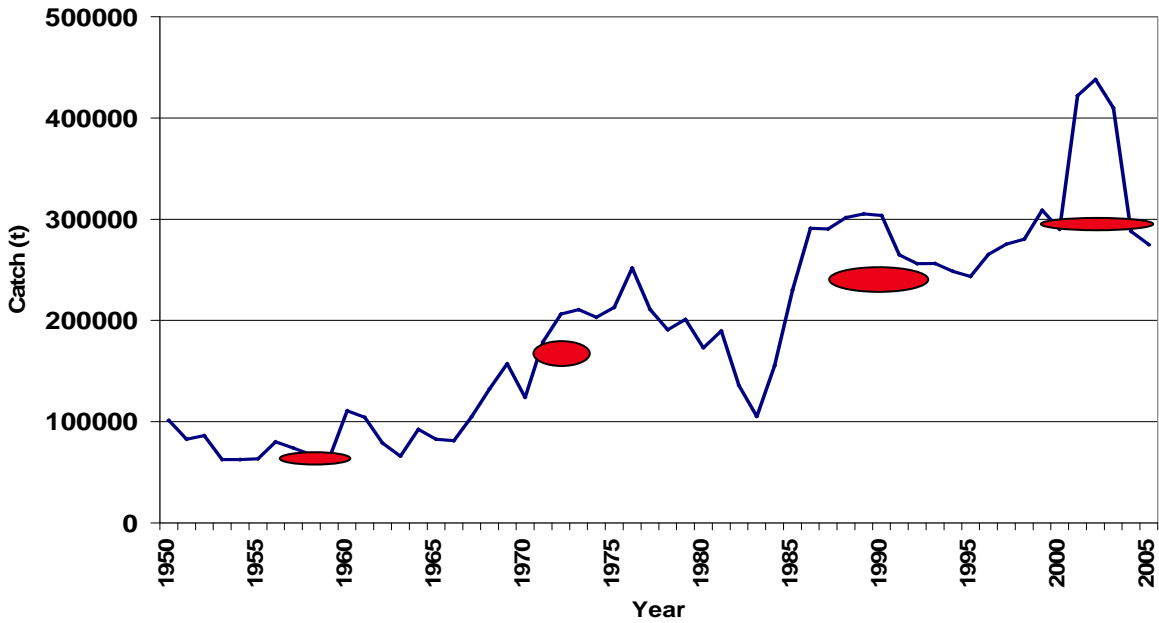


Figure 6: Range of yellowfin MSY estimated in the Eastern Pacific oceanas a function of the year; (Yearly total catches being also plotted in the same figure)

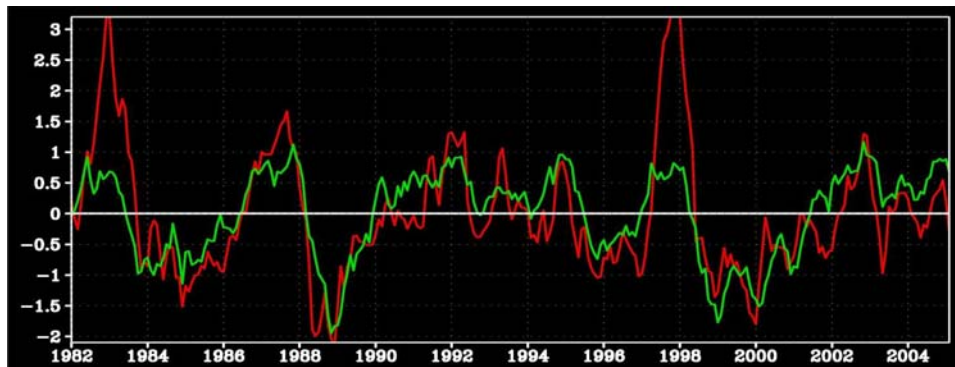


Figure 7: Selected indicator showing the yearly environmental anomalies (El Niño) in the area

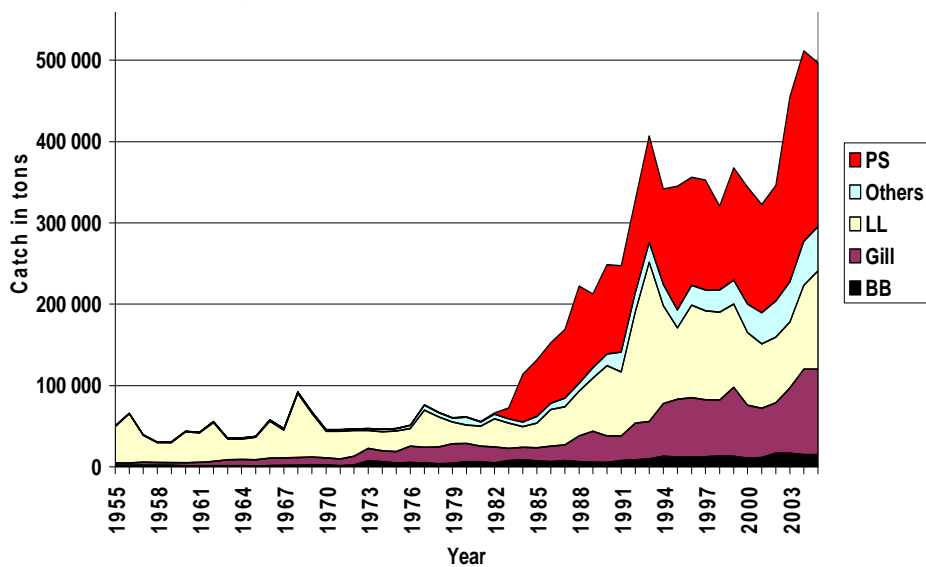
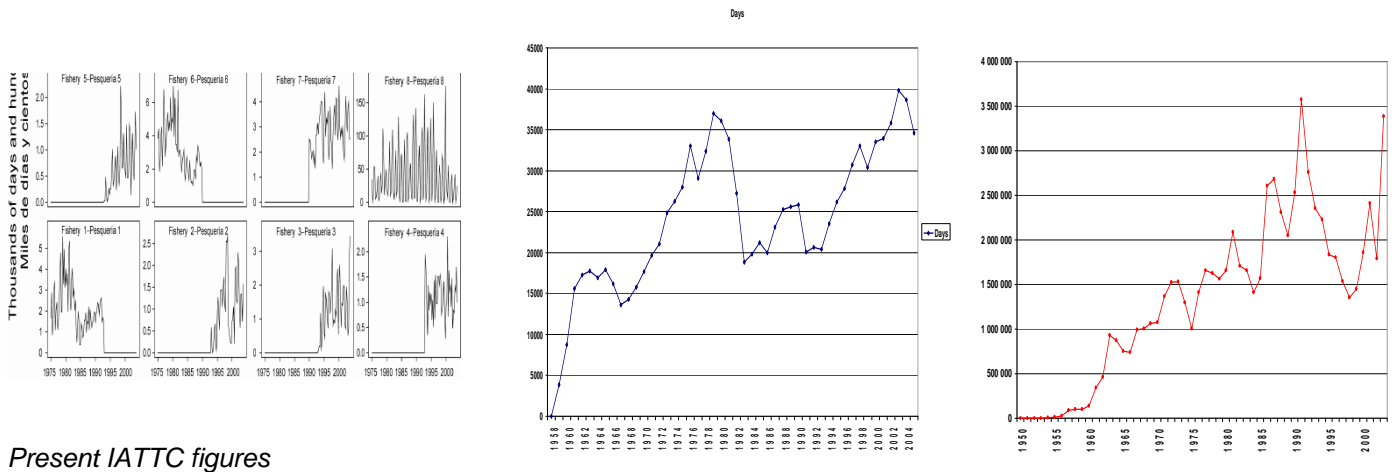


Figure 8: Yearly catches by gear taken on the species (example of Indian Ocean YFT), a figure necessarily starting since 1950



Present IATTC figures

Figure 9: Nominal fishing efforts exerted by purse seiners and by longliners in the Eastern Pacific (IATTC typical figures on the left and proposed figures on the right)

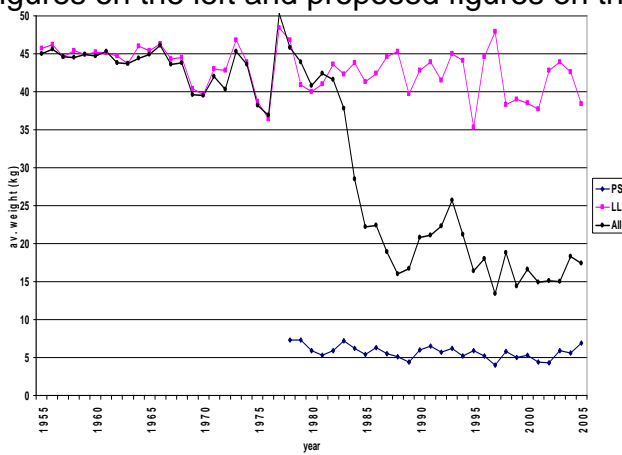


Figure 10: Total average weight taken by gear during each year, and combined average weight taken by the entire fisheries (example of Indian Ocean bigeye fisheries)

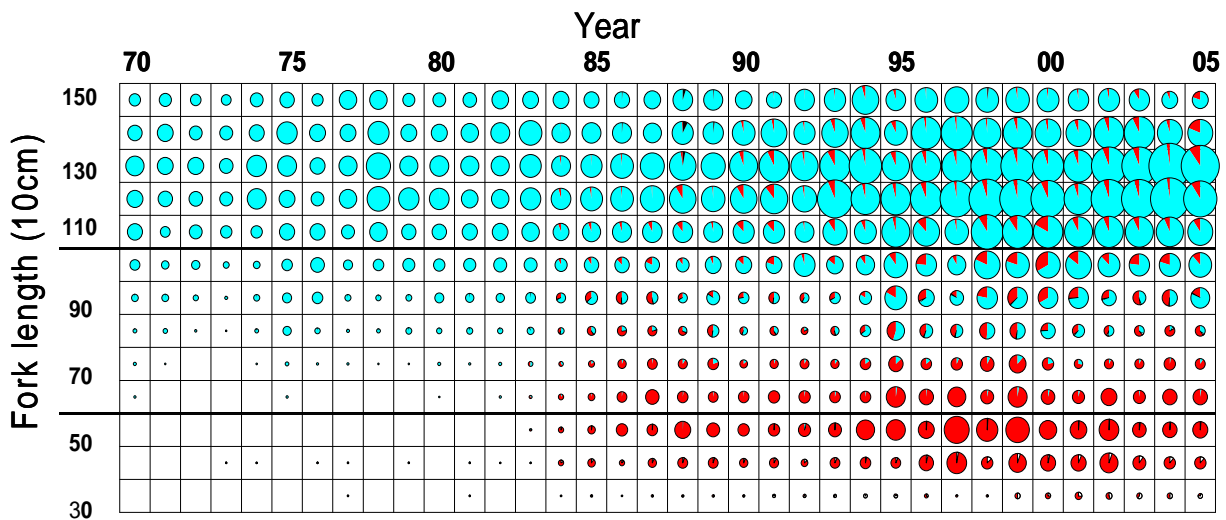


Figure 11: Total weight of bigeye caught by gear during each year by 10 cm size classes (example of Indian Ocean bigeye fisheries; each circle has an area proportional to the catch, the colour showing the gear: blue for longliners and red for purs seiners)

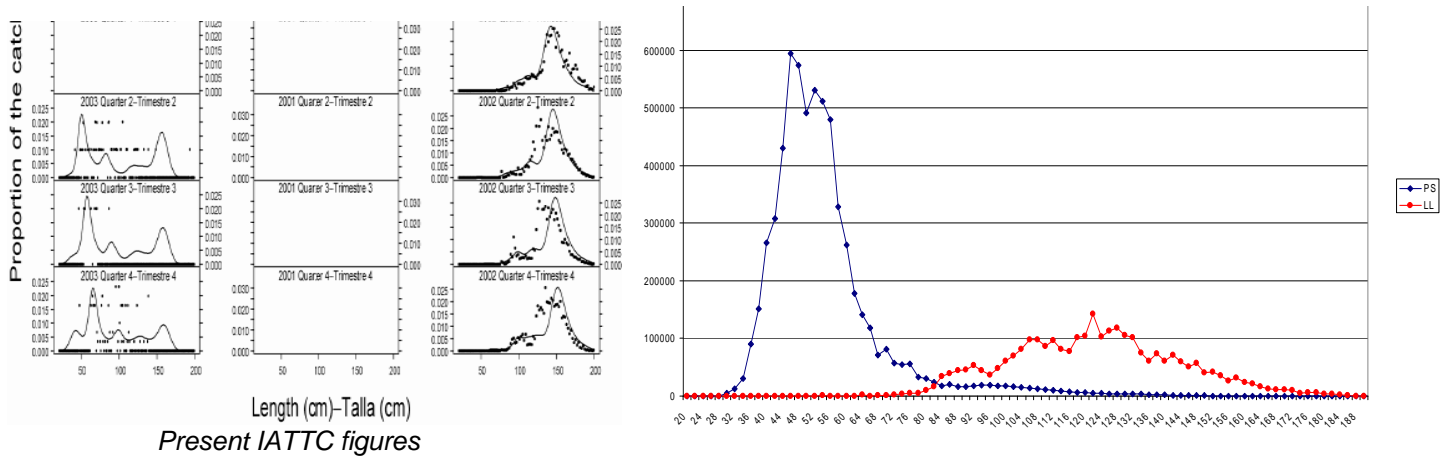


Figure 12: Average size distribution of catches taken by the mean gears (or fishing modes: FAD, dolphin and free schools) during recent years. (Indian Ocean bigeye) (IATTC typical figures on the left and proposed figure on the right)

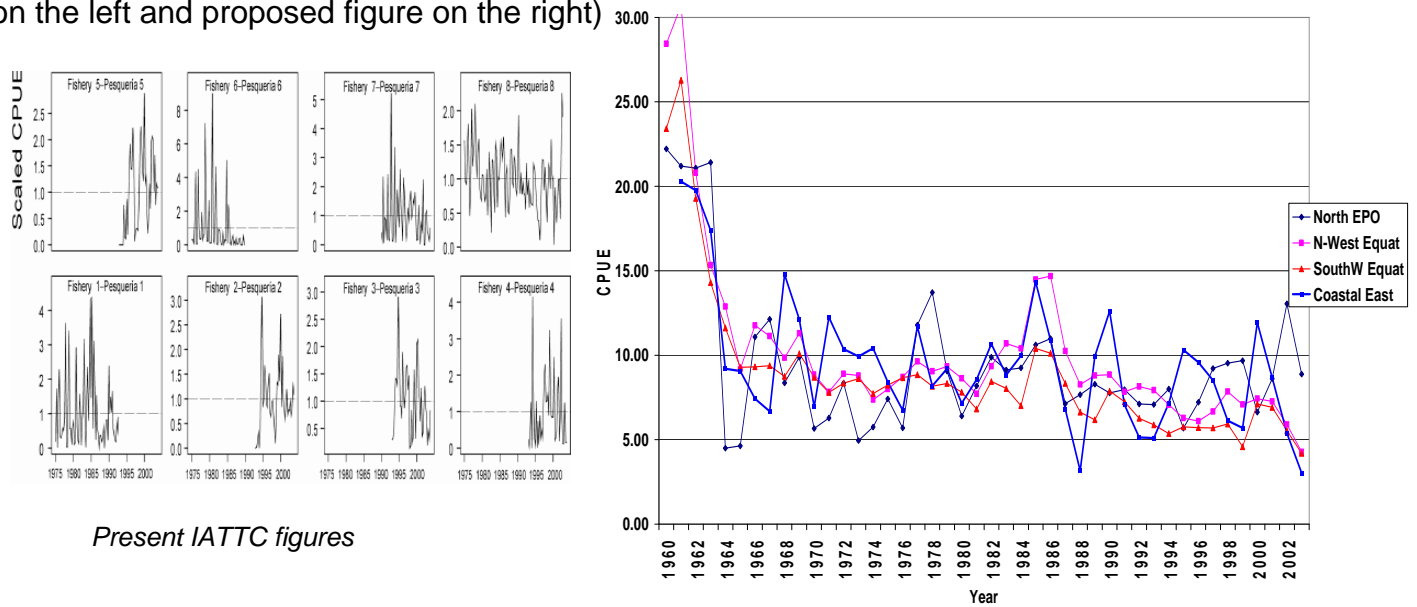


Figure 13: Nominal CPUE (catch/effort) of selected gears in 4 selected areas (the core zones of each gear or/and fishing modes when they are targeting the species) (IATTC typical figures on the left and proposed figure on the right)

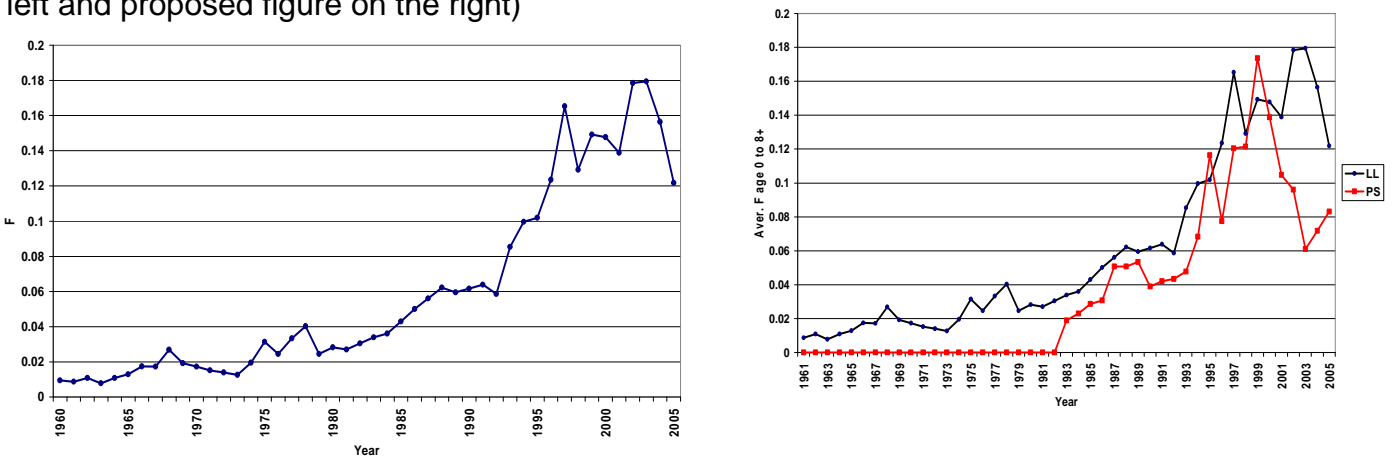


Figure 14: Assessment results: estimates of total yearly fishing mortality suffered by the stock and estimates of F exerted at selected ages by the main gears (exemple of Indian Ocean bigeye)

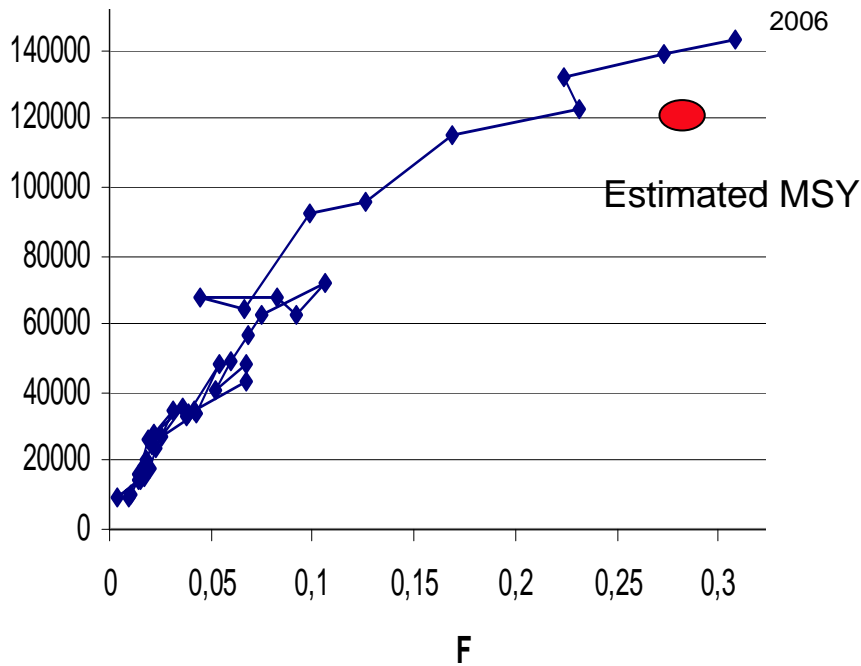
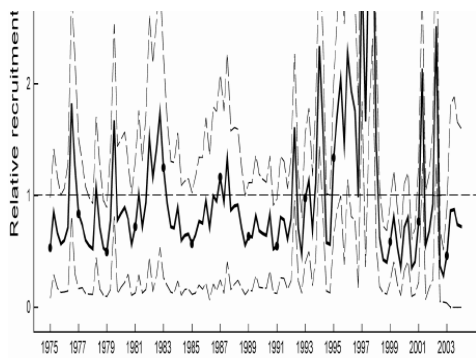


Figure 15: Assessment results, plot of total yearly catches versus the estimated total fishing mortality, a production like model providing a synthesis overview of changes in catches and exploitation rate suffered by the stock.



Present IATTC figures

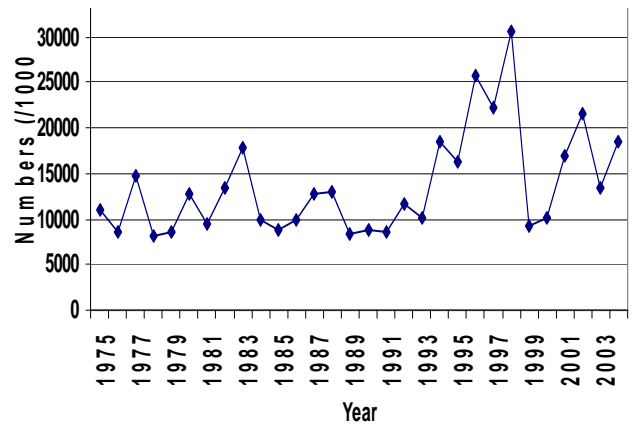
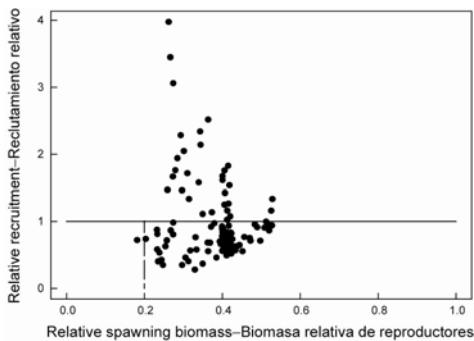


Figure 16: Assessment results, yearly variability of estimated recruitment (EPO BET stock) (IATTC typical figures on the left and proposed figure on the right)



Present IATTC figures

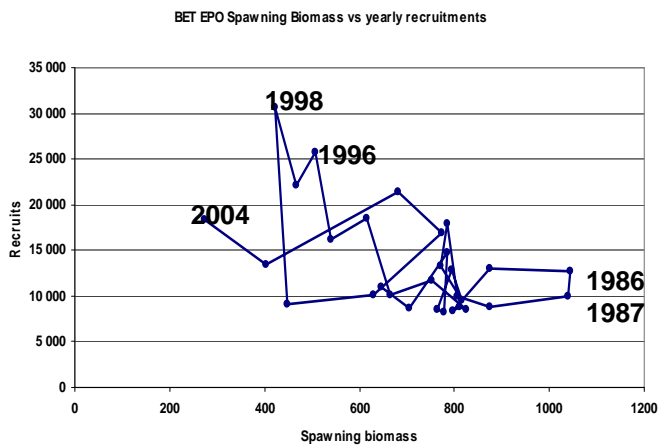
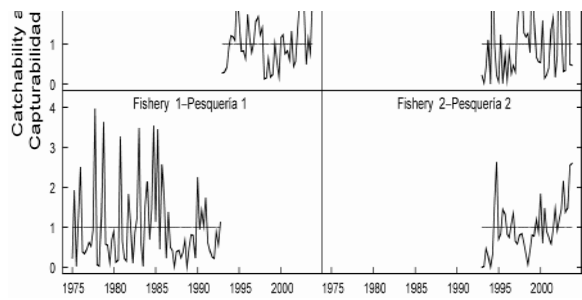


Figure 17: Assessment results, chronological plot of recruitment and spawning biomass levels, EPO BET (IATTC typical figures on the left and proposed figure on the right)



Present IATTC figures

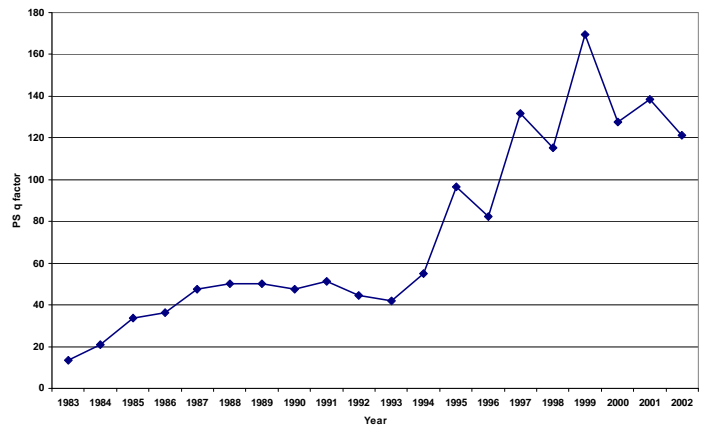


Figure 14: Assessment results: estimates of total yearly catchability of the main gears (exemple of PS catchability coefficient on Indian Ocean bigeye) (IATTC typical figures on the left and proposed figure on the right)