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Potential indicators of fishing efforts targeting yellowfin and bigeye tuna exerted by Japanese and Taiwanese longliners in the Indian Ocean,

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Summary

This working paper estimate the fishing effort of Japanese and of China Taipei longliners that have been targeting yellowfin or bigeye in the Indian Ocean at the basic level of the 5° and month strata. The changes in the monthly and yearly sizes of targeted fishing zones are also estimated as well as the CPUEs in these targeted strata. This paper shows major differences and changes in the targeted efforts exerted by the 2 fleets. It is concluded that such basic fishery indicators may be of indirect use in the stock assessment of bigeye and yellowfin.

1) Introduction

This paper is targeting to conduct a proper and simple identification of the fishing effort exerted by longliners in the Indian Ocean as a function of the species that was estimated to be the main target species, targeting to estimate the yellowfin and bigeye efforts, at the level of the basic 5 degrees and month strata, i.e. at the level of the basic IOTC fishing strata. The idea of this simple indicator of "targeted effort" comes from the examination of monthly/5° areas fishing maps by fleet, that are dominated in weight by a given species in most 5° squares. The same type of monthly fishing maps, also shows that in some cases the dominant species was dominant for all flags (for instance in the gyre dominated by albacore) or different in the equatorial areas, for instance catches in the same square being dominated by yellowfin, or bigeye or swordfish, depending of the gear handling. In each of these cases, the target species can easily be identified, simply because of its dominant quantity, and without any detailed knowledge of the details in the gear handling. The same calculations can be done for each of the main fleets of longliners active in the Indian Ocean, for instance for the 2 major fleets of Japan and China Taipei. These indicators of targeted efforts also allow to estimated the sizes of the fishing areas targeted for yellowfin and for bigeye, the areas where targeted efforts have been exerted, as well as the corresponding CPUEs in these targeted strata.

2) Method

The analysis of catch and effort data at the scale of the 5°-month strata immediately allows to identify when one species was dominant in weight, and in this case the effort corresponding to this dominant species can be classified as being a targeted effort. For Japanese longliners, the catch in number was first converted to catch in weight caught of Japanese longliners by 5° and month strata. Catch in weight of China Taipei longliners provide the basic data of this indicator without conversion. When the catch of a species in the strata is larger than 50% in weight, then the fishing effort is cumulated in the monthly and yearly fishing efforts targeting this species. The total yearly catches of the selected species in these selected strata are also cumulated. The same calculation of targeted effort will be done at the level of the entire Indian Ocean (IOTC area) and also in the core equatorial areas where yellowfin and bigeye, the two species targeted by this study.

3) Results

3-1- Levels and trend in effort targeting yellowfin and bigeye

The analysis of the species composition observed for both fleets of longliners in the Indian Ocean shows that a great majority of their fishing efforts have been producing a majority of a given species: an average of 84% of Japanese fishing efforts being targeted for the Japanese fleet (1952-2009) and an average of 82% of fishing efforts being targeted for the Taiwanese fleet (1967-2009). In the remaining 5°-month squares (16 and 18% of their total effort), none of the 12 species caught was dominant in weight.

Yearly proportion of these targeted efforts exerted at the level of the Indian Ocean are shown by the following figure 1a (Japan) and 1b (China Taipei).

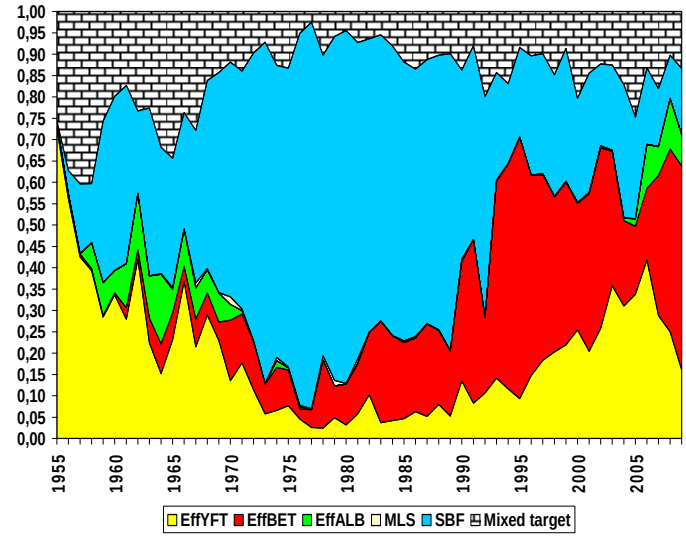

Figure 1a: Yearly effort in % exerted by Japanese longliners in the entire Indian Ocean as a function of the target species

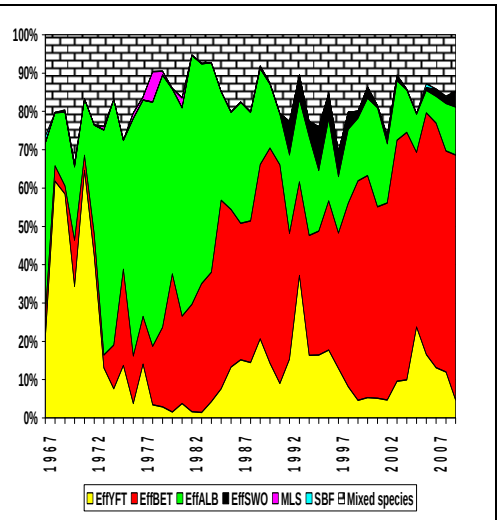

Figure 1b: Yearly fishing effort in %, exerted by Taipei China longliners in the entire Indian Ocean as a function of the target species

As the goal of this paper is to review the fishing efforts targeting bigeye and yellowfin, the fishing maps showing all the 5° squares where targeted efforts have been exerted on yellowfin and on bigeye by each of the 2 fleets have also been done, only the 5° squares were each of the 2 species have been targeted at least during 5 month in the studied period have been kept. These targeted areas are shown on figure 2 (yellowfin) and on figure 3 (bigeye).

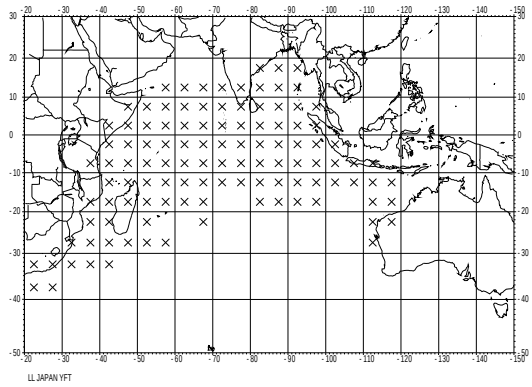

Figure 2a: Fishing zones where yellowfin has been targeted by Japanese longliners during the 1952-2009 period and during at least 5 month

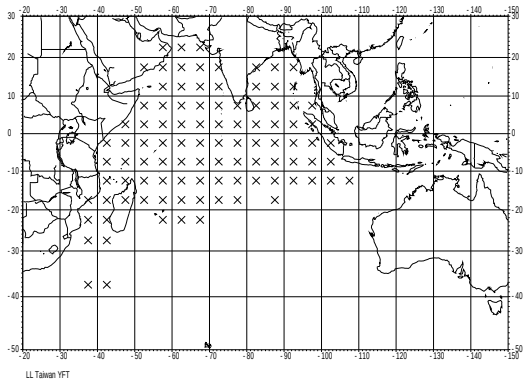

Figure 2b: Fishing zones where yellowfin has been targeted by China Taipei longliners during the 1967-2009 period and during at least 5 month

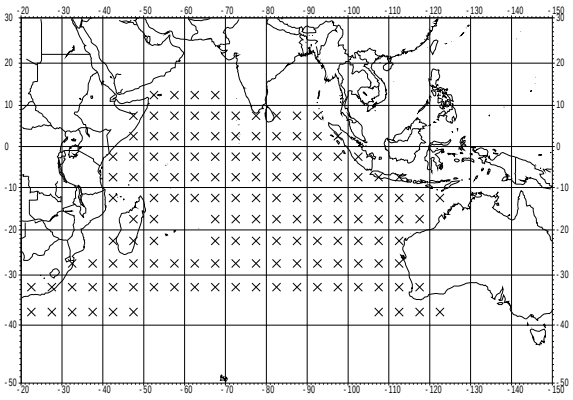

Figure 3 a: Fishing zones where bigeye has been targeted by Japanese longliners during the 1952-2009 period and during at least 5 month

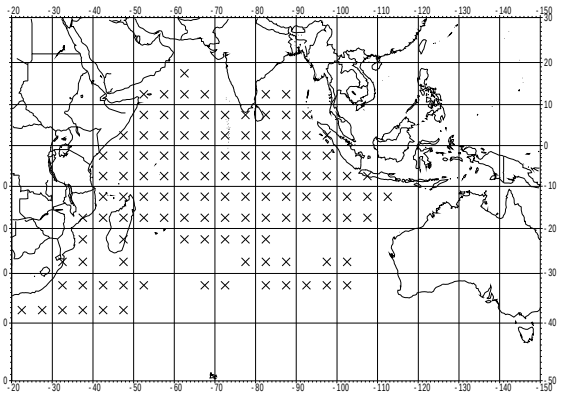

Figure 3b; Fishing zones where bigeye has been targeted by China Taipei longliners during the 1967-2009 period and during at least 5 month

These figure 2 and 3 allow to conclude that the intertropical areas, for instance between 15°N and 15°S, have been the main fishing zones where both species, yellowfin and bigeye, have been targeted during the studied period by both fleets (when other areas, such as the Arabian sea have been actively targeted by longliners, but only those from China Taipei and only for yellowfin). This equatorial area will then be selected as a core area homogeneous fishing area fished in common by the 2 fleets; the observed changes of target species by the 2 fleets will then be analyzed in this core fishing area.

The first step is to estimate the observed changes in the targeted fishing effort exerted on the various tuna species in this core fishing area for Japanese (figure 4a) and China Taipei (figure 4b) longliners.

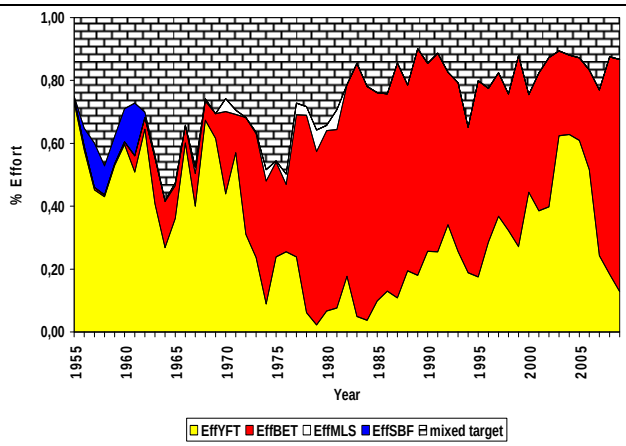

Figure 4a: Yearly effort in % exerted by Japanese longliners in the core equatorial area of the Indian Ocean, 15°N-15°S, as a function of the target species

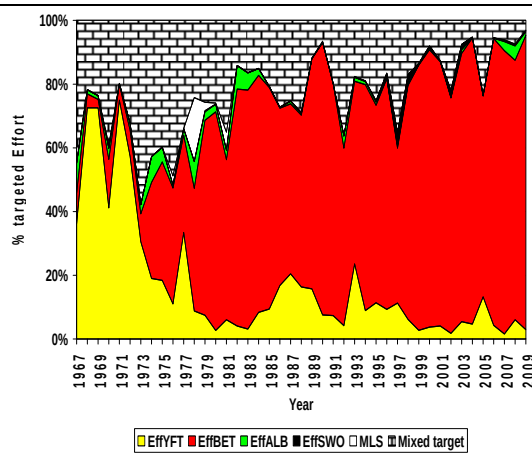

Figure 4b: Yearly effort in % exerted by China Taipei longliners in the core equatorial area of the Indian Ocean, 15°N-15°S, as a function of the target species

These targeted efforts of the 2 fleets exerted in this core equatorial area have been clearly targeting the 2 tropical species, yellowfin and bigeye, but at a variable degree as a function of the period and the fleet. This figure shows that:

- The untargeted fishing effort, i.e. without a species dominant in weight, has been decreasing during the period for both fleets, being at less than 20% during recent years.
- For Japanese longliners, figure 5a, yellowfin has been increasingly targeted during the 1980-2005 period, showing its maximum over 60% during the 2003-2005 period. This yellowfin effort has been reaching an average level over 60% of total equatorial effort during the 2003-2005 period, showing later a major decline, as only 18% and 13% of the 2008 and 2009 effort has been targeting yellowfin. On the opposite, fishing effort targeting bigeye were permanently declining during the 1980-2005 period, when this targeted effort on bigeye has been rapidly increasingly during recent years (since 2005) and reaching 70% of total equatorial effort in 2008 & 2009.
- For China Taipei longliners, figure 5b, yellowfin has been targeted at a low and stable rate during the last 30 years (1978-2009 period), at an average of only 8%. During this period, the targeted effort on bigeye has been widely dominant (at an average of 71%) and slowly increasing during recent years, reaching 90% in 2009 (data still provisional).

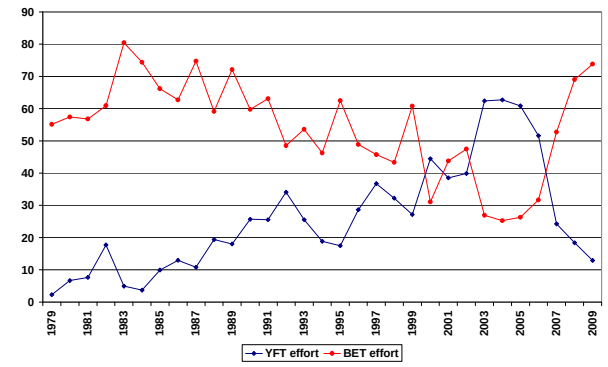

Figure 5a: Percentage of fishing effort exerted by Japanese longliners targeting yellowfin or bigeye in the 15°N-15°S area

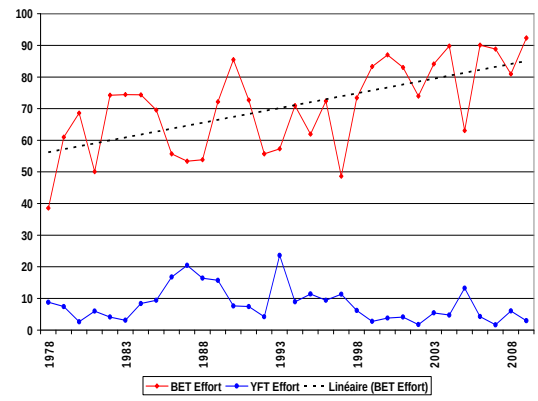

Figure 5b: Percentage of fishing effort exerted by China Taipei longliners targeting yellowfin or bigeye in the 15°N-15°S area

3-2- Size of the targeted areas

The changes in the size of the targeted fishing areas are also interesting to analyze, this parameter being studied at the level of the entire Indian Ocean

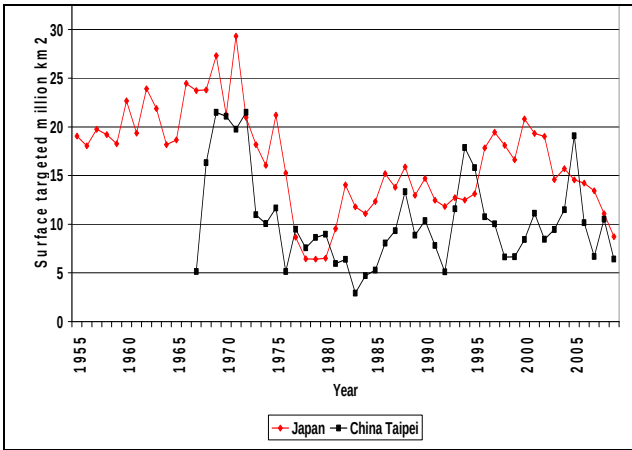

Figure 6a: Size of the yearly fishing areas targeted for yellowfin by Japanese and China Taipei longliners (in million square km^2)

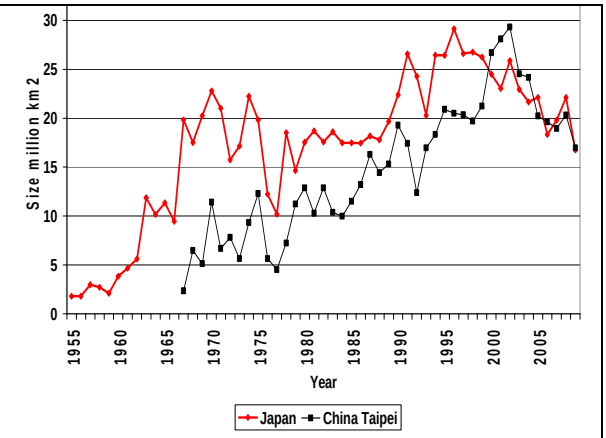

Figure 6a: Size of the yearly fishing areas targeted for bigeye by Japanese and China Taipei longliners (in million square km^2)

- The fishing areas targeted yearly for yellowfin by Japanese and China Taipei vessels have been quite stable since the early eighties, at an average level of 14.1 million km^2 for Japan and a smaller area of 9.3 million km^2 for China Taipei. A marked decline in the size of targeted area was observed for Japan during the last 3 years.
- The fishing areas targeted yearly for bigeye by Japanese and China Taipei vessels have been permanently increasing during the studied period. The average size of the area targeted by Japan during the 1970-2009 period was always larger than for China Taipei longliners (20.6 vs 15.7 million km^2).. A marked decline in the size of area targeted for bigeye was observed for Japan and China Taipei during the last 8 years.

It is also interesting to compare the average size of the fishing areas targeted monthly by longliners with the total size of the targeted areas fished yearly. This ratio has been calculated for both species and both fleets (figure 7).

For yellowfin it appears that this ratio was very similar for both fleets during the 1970 1995 period and at an average level of 18%: this ratio corresponds to a great seasonality of the yellowfin fishery: the fishing areas targeted yearly are more than 5 times larger that the average areas targeted monthly. During recent year, since 1995, an increase of this ratio can be noticed, but mainly for Japanese longliners (monthly/yearly area= 29%).

For bigeye it appears that this ratio has been very similar for both fleets since 1970, when this ratio has been permanently increasing, reaching 50% during recent years, i.e. fishing areas targeted yearly that are only 2 times larger than the average monthly areas.

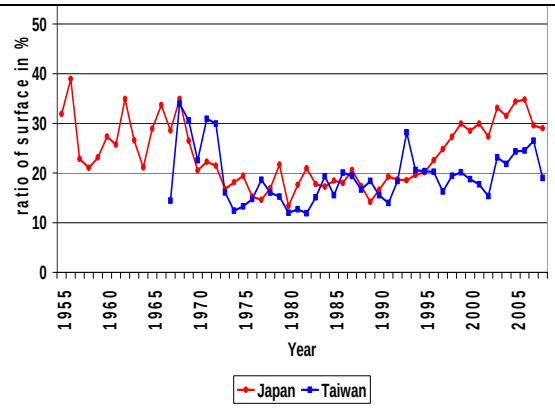

Figure 7a: Ratio of the size of the fishing areas targeted for yellowfin by Japanese and by China Taipei longliners: monthly vs yearly sizes, expressed in term of %

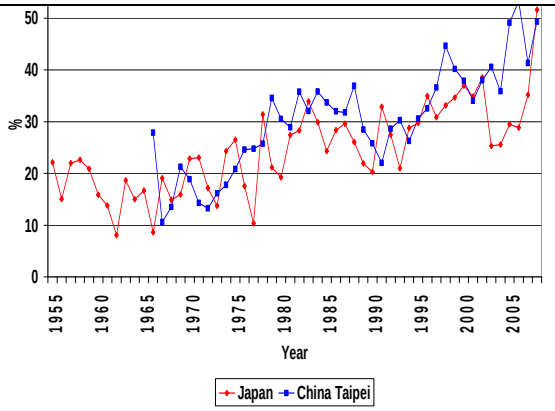

Figure 7b: Ratio of the size of the fishing areas targeted for bigeye by Japanese and by China Taipei longliners: monthly vs yearly sizes, expressed in term of %

3-3 CPUEs in the targeted strata and in the core equatorial areas:

These CPUEs cannot be considered as being representative of stock biomass, but they constitute a special type of indicator show one kind of best CPUE observed in the best fishing areas where/when the studied species was dominant in the 5° & month strata. These CPUEs have been calculated in the core equatorial areas, as the average CPUEs of all the 5°-month strata that have been targeted each year by each fleet. These CPUEs are shown figure 8 for both fleets and both species.

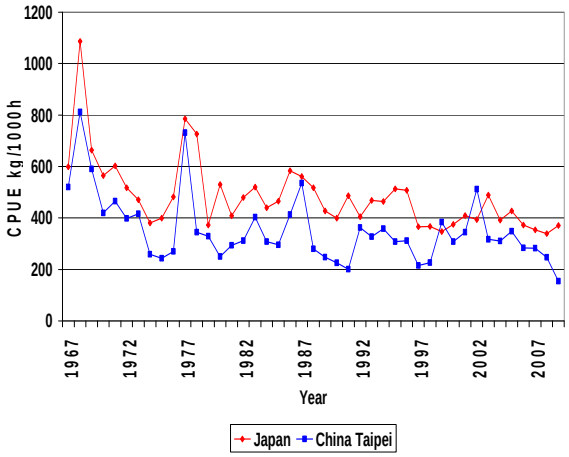

Figure 8a: Average CPUE of all month & 5° strata targeted for yellowfin, for Japanese and China Taipei longliners. in the fishing areas targeted for this species

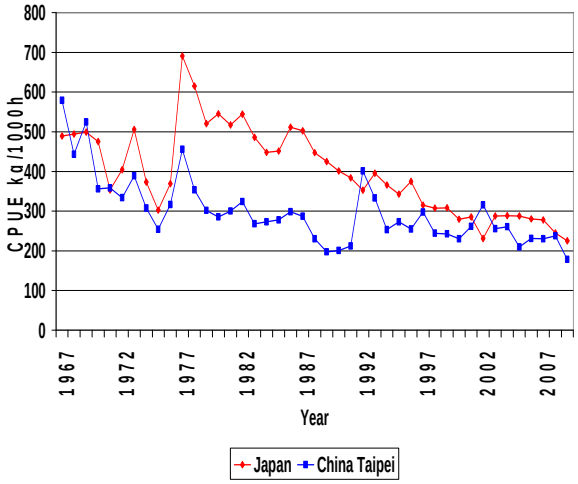

Figure 8b: Average CPUE of all month & 5° strata targeted for bigeye, for Japanese and China Taipei longliners. in the fishing areas targeted for this species

These average nominal CPUEs targeting yellowfin are always higher for Japanese than for China Taipei longliners, but showing similar flat trends for both fleets during recent years. These average CPUEs in the 5°-month strata targeted for yellowfin or for bigeye can also be compared to the average nominal CPUEs calculated in the core equatorial areas, 15°N-15°S, as a simple average CPUEs in all 5° squares fished monthly, independently of the species caught or targeted. These nominal CPUEs are shown figure 9a (yellowfin) and 9b (bigeye).

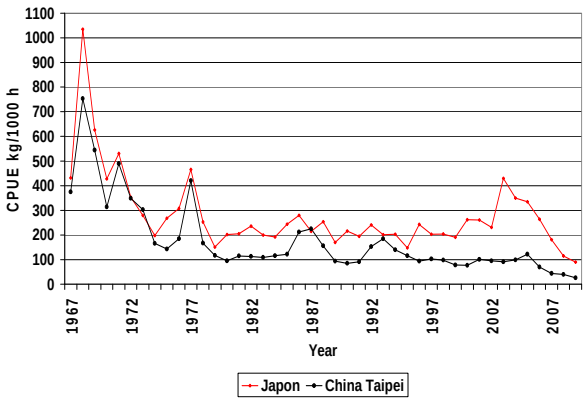

Figure 9a: Average CPUE of yellowfin, Japanese and China Taipei longliners in the 15°N-15°S core fishing areas of both fleets.

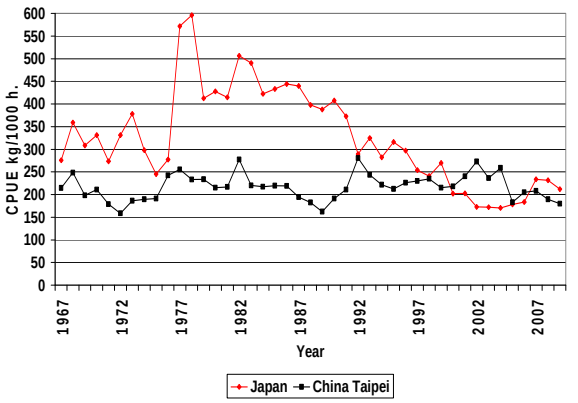

Figure 9a: Average CPUE of bigeye, Japanese and China Taipei longliners in the 15°N-15°S core fishing areas of both fleets.

These nominal CPUEs are always much higher for yellowfin than for bigeye, and most often higher for Japanese vessels than for China Taipei longliners. When both fleets have been obtaining quite similar and stable bigeye CPUEs during the last 20 years, the same nominal yellowfin CPUE are showing a major decline since 2005, recent years (2008 and 2009) being at their lowest historical levels.

As a final comment, it appears that the 2 types of yellowfin CPUEs are showing opposite trends: the nominal CPUEs in the core yellowfin area showing a major decline for

both fleets, when the yellowfin CPUEs in the targeted strata tend to be quite stable (Japan) or moderately declining (China Taipei), the last year 2009 being the lowest in the series.

4- Discussion and conclusion

The indicators proposed in the present paper, and their associated indicators of size of area targeted or CPUEs, are very simple ones as they are simply based on the existence of a species dominant in weight in each 5°-month strata. There is no doubt that the basic criterion used in this indicator, 50% of total catches in the strata, could be improved using the value of the catches, as a small catch of very high value may sometimes be the real target of the fleet, for instance in the southern bluefin strata. Unfortunately this economical parameter is difficult to obtain or to estimate, and it cannot be used today with the available data. On the other side, the simple criterion of a dominant weight is probably already quite indicative of the major levels and changes in the targeted species. Such indicator may for instance help to question the validity of the recent changes observed in the recent GLM CPUEs of Japanese longliners: it is striking to observe that a major (and unexplained?) decline in the GLM CPUEs was estimated between the early eighties and nineties, when all the nominal YFT CPUEs tend to be quite flat, or even increasing.

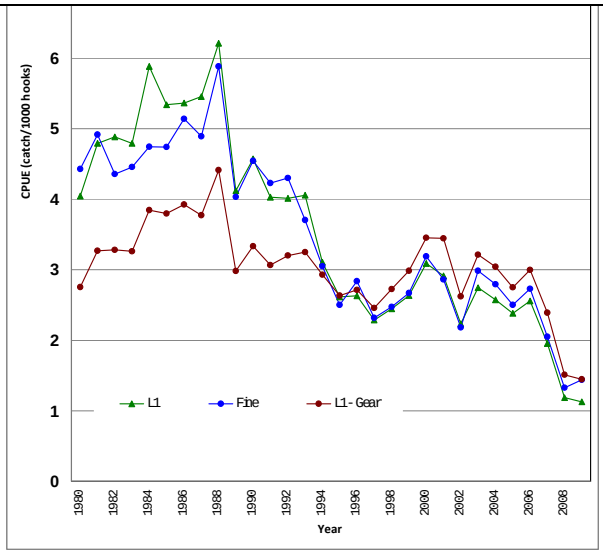

Figure 10a: typical GLM YFT CPUEs estimated in 2010 by Japanese scientists

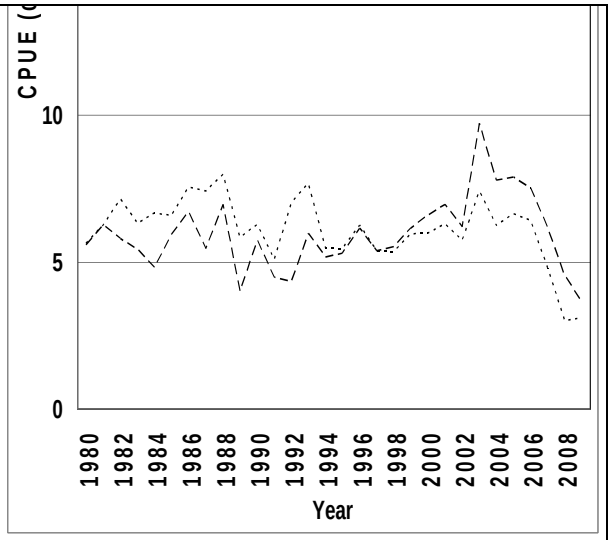

Figure 10b: Typical nominal YFT CPUEs estimated in 2010 by Japanese scientists

On the other side the indicator of yellowfin targeted efforts shows that there was a major increase of targeted yellowfin effort exerted by the fleet between the early eighties and the late nineties, see figure 11. Comparing figure 10 and 11 it becomes very hard to understand why the relative biomass of the adult stock was so low during the late nineties, when the nominal CPUe was stable and the targeted fishing effort was very high. Such divergency may be realistic, but it should at least be fully understood and explained by scientists, because this early decline of the YFT CPUEs during the early nineties plays a significant role in the stock assessment, as this trend in the GLM CPUEs are introducing a pessimistic component, increasing yellowfin effort and catches, on an already severely depleted theoretical biomass)

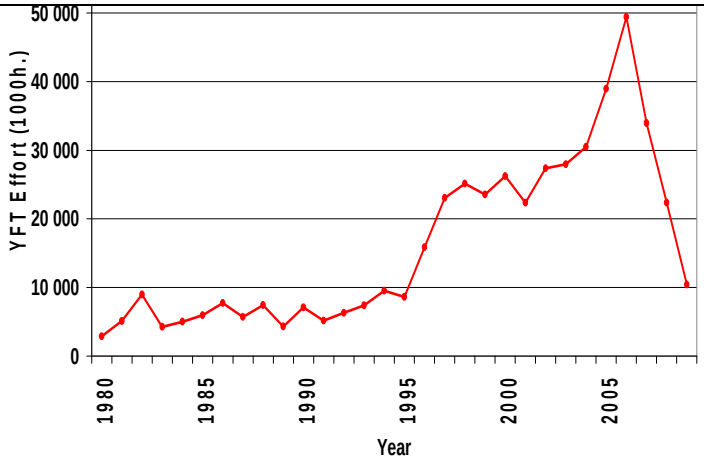

Figure 11: Fishing effort targeting yellowfin tuna exerted by Japanese longliners in the Indian Ocean

The present results already shows major differences and changes over time in the targeting between Japanese and China Taipei longliners, as well as between yellowfin and bigeye. These indicators cannot be of direct use in the stock assessment modelling, but they are very simple to estimate and they may offer a different and informative view upon the variability and trends of the longliners activities and of their targeting.