ESTIMATED SEX RATIO OF LARGE YELLOWFIN TAKEN BY PURSE SEINERS IN THE INDIAN OCEAN; COMPARISON WITH OTHER OCEANS

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SUMMARY

This document analyses and compares the sex ratio at size and sizes distribution of yellowfin tuna taken in the Indian Ocean by purse seiners since 1982. The same data were obtained from the Eastern Atlantic and Eastern Pacific and compared with the Indian Ocean data set. Similarities and differences between oceans are compared and discussed. The conclusion is that in the Indian Ocean the sex ratio of the purse seine catches is well equilibrated 50% males and 50% females, when males are always dominant in the Atlantic landings (about 60%)

INTRODUCTION

It has been observed in other oceans, that catches of large yellowfin are most often widely dominated by males (Capisano 1991, Fonteneau 1992, Schaeffer 1998). This phenomenon has also been observed to some extent in the Indian Ocean sex ratio (Timochina et al 1992). Such differential sex ratio can be explained by a combination of a differential growth (female being smaller than males; this differential growth by sex was shown in the Eastern Pacific by Wild 1986.) and/or of differential natural mortality, females suffering a larger natural mortality in relation with spawning. The biological reasons (growth, natural mortality, catchability, etc) explaining such differential sex ratio at sizes are still a matter of scientific debate, but this discussion is outside the goals of this paper. In term of stock assessment and modeling of stock exploitation, this differential sex ratio at size may have serious implications when large fraction of the catches are dominated by males, as observed in the Atlantic ocean. In such a case, the analytical assessment should preferably be done independently for each of the two sexes. This type of age structured analysis by sex has for instance been conducted by the ICCAT for swordfish in the Atlantic. The A-SCALA model used by the IATTC (Maunder 2001) is working on the hypothesis of a higher M of spawning females.

DATA

Sex ratio data

The data available on sex ratio of yellowfin taken by purse seiners were collected at the cannery by the ORSTOM and SFA research teams in Victoria during the late eighties and early nineties. Part of this data base has already been described and analyzed Karpinski and Hallier 1988. Other sex ratio data were obtained from the IRD data base (Atlantic) and the IATTC (Eastern Pacific)

Sizes of yellowfin tunas landed by purse seiners

Size data of yellowfin landed in the Indian Ocean by purse seiners are taken from the IOTC data base. These size data (shown on figure 2) were collected by field technicians in various landing ports since the beginning of the purse seine fishery, primarily on EU purse seiners. These size data used were the new size data recently submitted by Spanish and French scientists to the IOTC. It can reasonably be assumed that these sizes are fully representative of the purse seine catches because (1) the sampled fleet is dominant in the purse seine fishery and (2) this sampling routine has been conducted very significantly during the period, very large numbers of yellowfin have been routinely measured each year in the fishery. It should also be noticed that most of these large yellowfin taken by purse seiners are fished in free swimming schools, often during the spawning season (e.g. from December to March) in reproductive status, and very few under FADs.

Similar size data were also obtained from other oceans, namely the Atlantic and Indian oceans. These yearly size distributions of total yellowfin catches were kindly provided to us by the ICCAT and the IATTC (same figure 2).

CATCHES AT SIZE BY SEX

The average sex ratio at size was estimated on a sample of 1792 yellowfin larger than 80 cm landed by purse seiners in Victoria, Seychelles during the period 1983 to 1995. The areas where large yellowfin are taken is well shown by the geographical distribution of free swimming schools, because these large fishes are widely dominant in weight in this fishing mode. These samples were primarily on fishes taken around Seychelles Islands, which is the main fishing zone for large yellowfin (see the map of average fishing location of large yellowfin figure 3). It was assumed that this sex ratio at sex was constant and permanently representative of the sex ratio at size during the entire period 1983-2001 (e.g. assuming a stability of sex ratio at size during the entire period). In this set of working hypothesis, the yearly catches by sex of large yellowfin taken by purse seiners were estimated multiplying the catch at size by the average sex ratio. On the average of the 1984-2001 period, landing of large yellowfin by purse seiners were estimated to be constituted of 51 % of males and of 49% of females. Even if these percentages are mainly indicative because of the method and limited data used, they show probably an equilibrium of catches by sex in the Indian Ocean yellowfin landings.

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COMPARISON WITH OTHER OCEANS

Data of yellowfin sex ratio by size obtained on purse seine catches taken in various oceans were compared: Indian Ocean, Atlantic and Eastern Pacific (Capisano 1991, Fonteneau 1992, Schaeffer 1998, Timochina 1992). The average pattern of sex ratio by sizes observed in each of these areas are shown by figure 1. It can be noticed that the same sex ratio pattern, males being dominant at larger sizes, appears to be dominant world wide. However, it should also be noticed that the size at which males start to be dominant in the catches appear to be quite different in each ocean:

- 134 cm in the Eastern Pacific Ocean,
- 146 cm in the Eastern Atlantic Ocean,
- 154 cm in the Indian Ocean,

It can also be noted that very large yellowfin (for instance larger than 160 cm) are predominantly males (between 70 and 100%) in similar proportion, in the three oceans (these observations being indicative and at least valid for the limited samples of sex ratio by size which are presently available).

Combining the average weight of large yellowfin landed by size by purse seiners in each ocean and these average sex ratio at size, we can reach the conclusion that the proportion of males and females appears to be quite different between ocean, with a larger proportion of males in the Eastern Atlantic landing: an average 61% of total catches in weight being males. A small dominance of females is observed in the Atlantic at intermediate sizes, but not in others oceans. This apparent dominance of females at intermediate sizes (between 125 and 140 cm) found in the Atlantic is not apparent in the Indian Ocean samples.

DISCUSSION AND CONCLUSION

These preliminary results are still provisional and tentative ones, primarily due to the lack of sufficient data upon sex at size taken on purse seiners during recent years. This type of comparative analysis should also cover catches by longliners as these fishes are always taken at large sizes, but this work would require a more consistent data base concerning sex ratio at size and sizes. Changes of sex ratio at size is an important parameter which may be directly in relation with differential growth, and/or natural and fishing mortalities by sex. Such data should be, as much as possible, collected routinely in the canneries (as catches by sex at size may vary as a function of the exploitation rates of stocks). In some cases such as the Atlantic yellowfin, the age specific catch at age analysis would probably be an improvement over than the present analysis which is conducted on combined sexes. In the Indian Ocean, the present conclusion appears to be that this differential sex ratio at sea could be neglected without major bias. However this conclusion is based on a relatively small sample and on data collected during the early fishery, e.g. with lower exploitation rates of the stocks and different fishing patterns. An intensive sampling of sex at size should be recommended and conducted during at least one year in the Victoria cannery. It should be well accepted that this parameter may play an important role in a realistic modeling and analysis of tuna stocks. Comparative analysis done world wide between the various yellowfin tuna stocks should also be encouraged, as this type of comparison may provide valuable output allowing a better understanding of differential sex ratios at size and a better modeling of this basic characteristic of may tuna stocks. Further cooperation in this field between the various tuna commission is recommended in this domain; this increased cooperation should allow (1) an exchange of sex ratio data between interested scientists, (2) an increased and well planned collection of sex ratio data taken on large yellowfin (for instance greater than 1 meter) and (3) a join cooperative analysis and comparative interpretation of these interesting data.

AKNOWLEDGMENT

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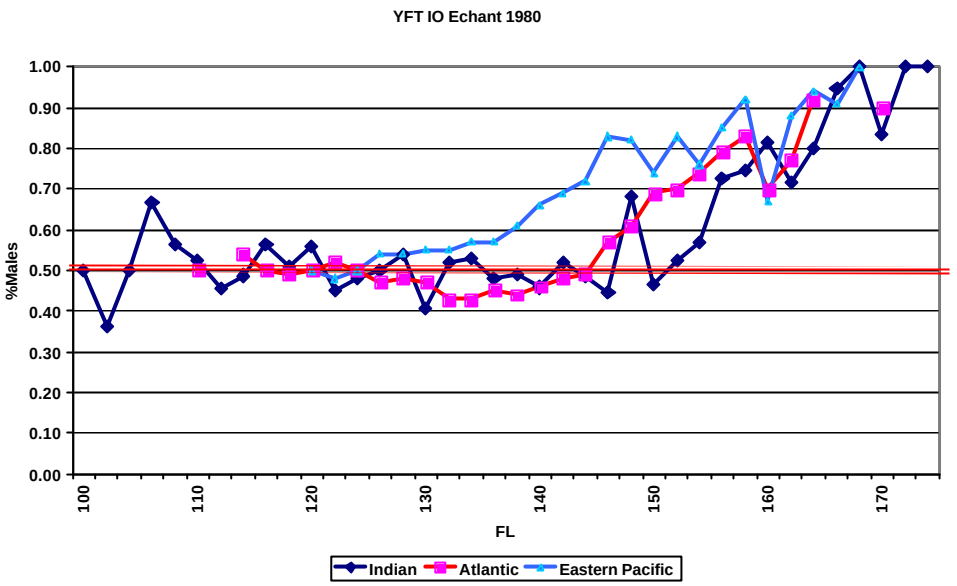

Figure 1: Average sex ratio at size observed on purse seiners in various fisheries and oceans

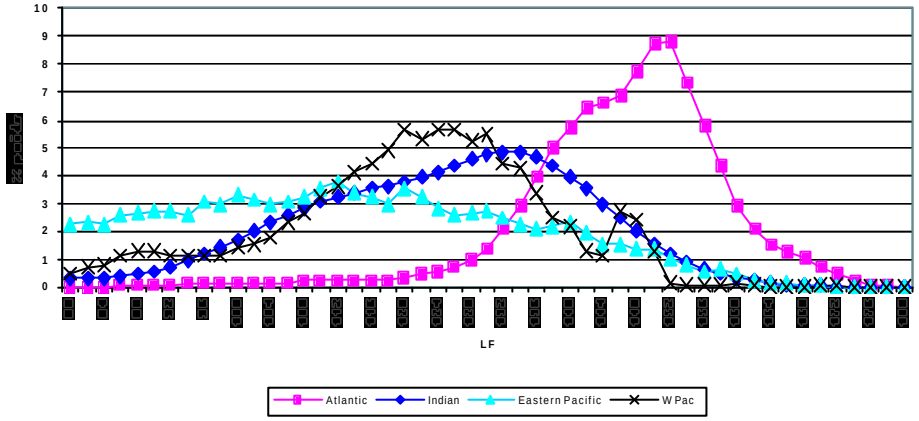

Figure 2: Average size distribution of yellowfin tunas, in weight by 2 cm intervals, for fishes taken during recent years by purse seiners in various oceans (Indian Ocean and Eastern Pacific: 1992-2001, West Pacific: 1997-2001, Atlantic: 1991-1999) (Eastern Pacific data were kindly provided by the IATTC, and Western Pacific data by the SPC°

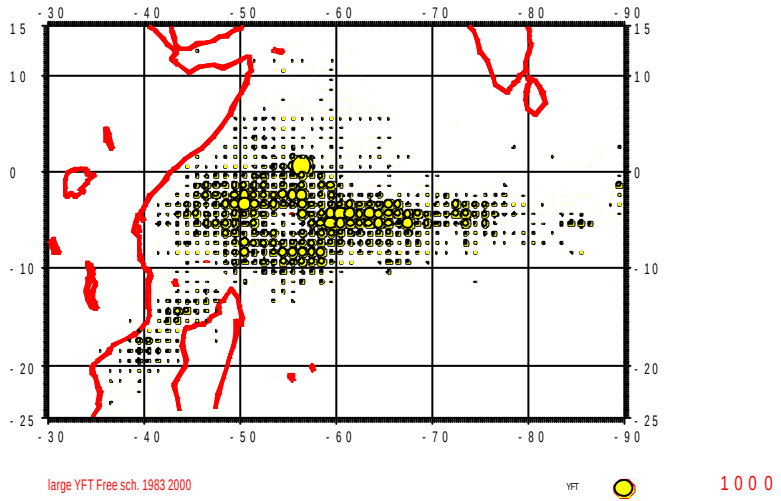

Figure 3 Average fishing zone of yellowfin tuna taken on free schools during the period 1983-2001 (predominantly of large sizes)