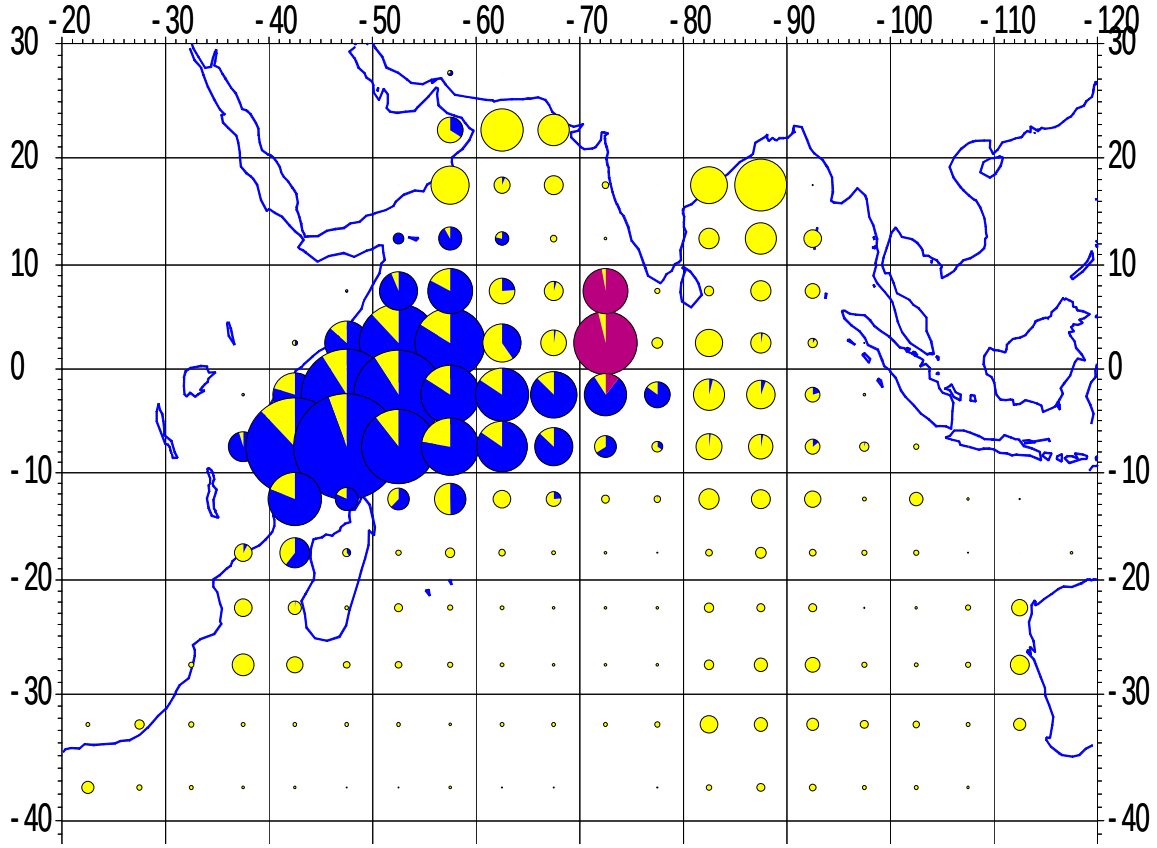
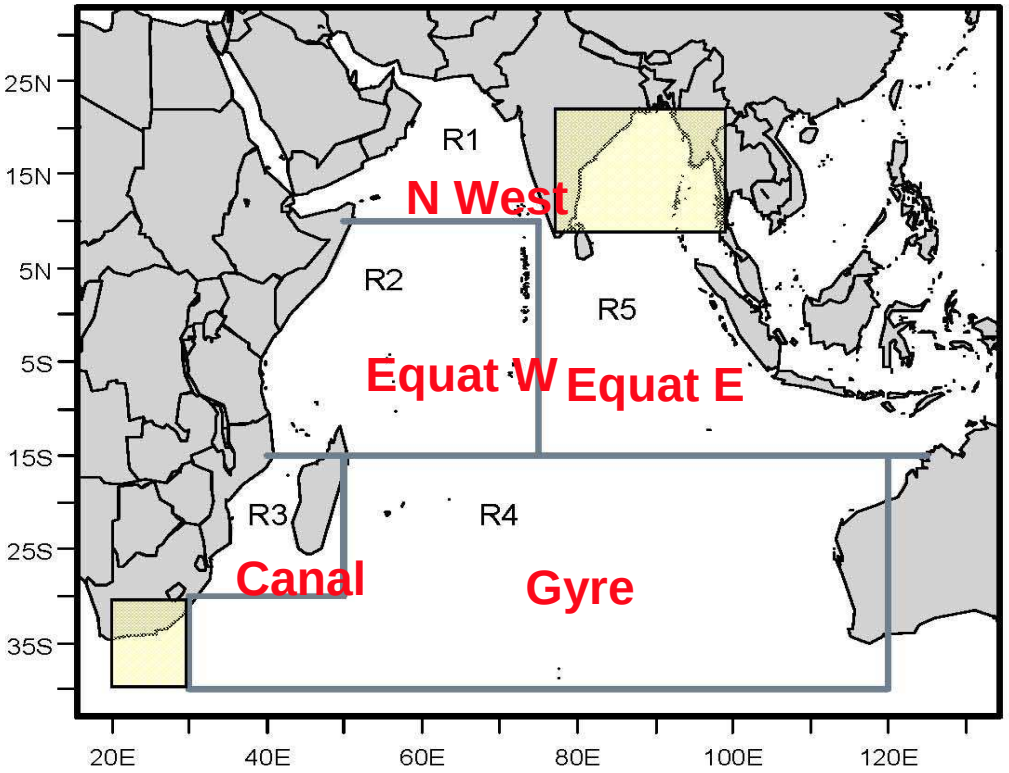
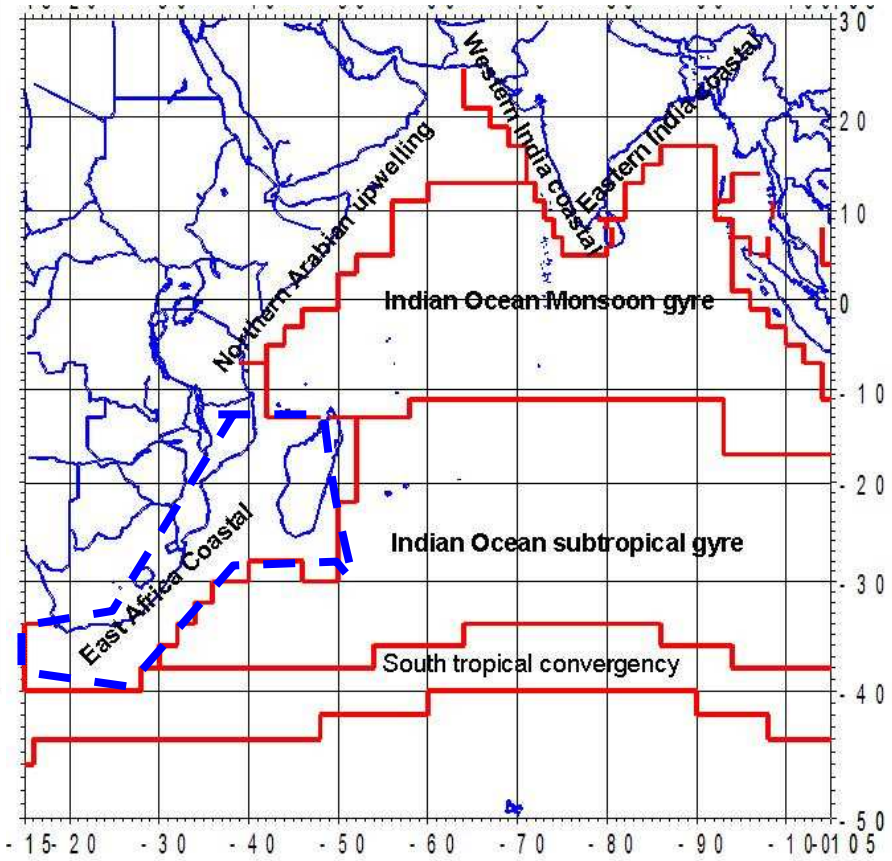
An overview of the YFT Indian Ocean MF-CL assessment: data, hypothesis and results



YFT catch / gear 2001-2005

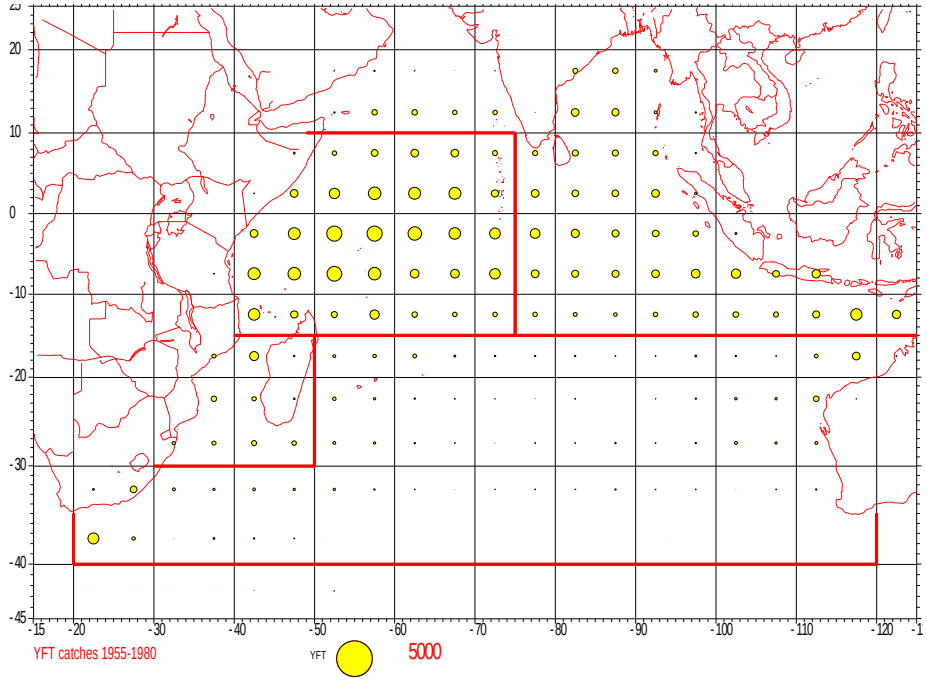




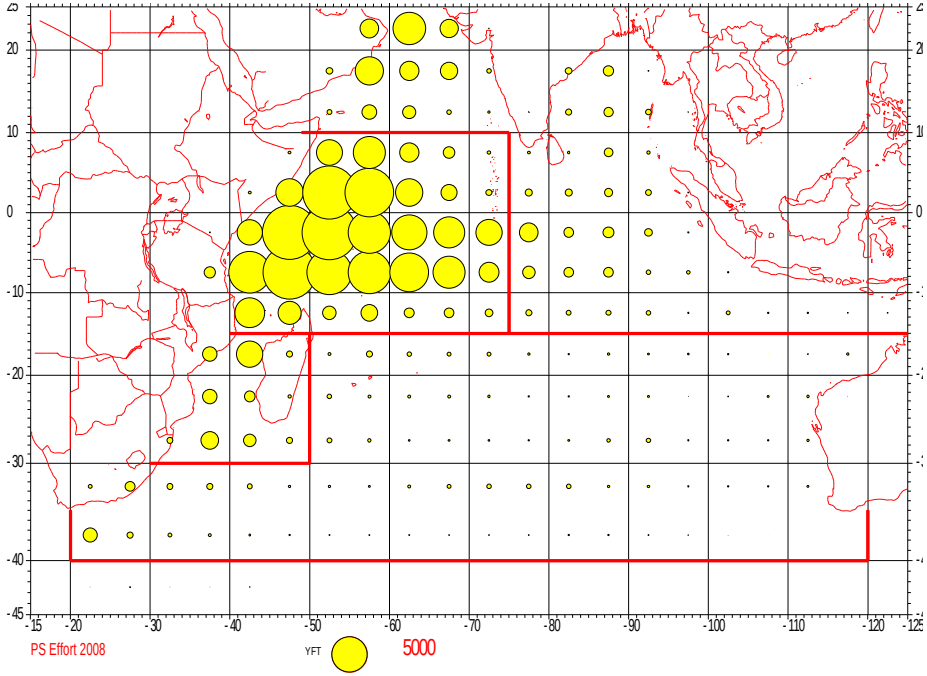
2008 assessment areas:

- ***Not ideal ones,***
- ***Nobody is perfect,***
- ***But quite reasonable ones, and quite consistent with tunas and billfishes species composition, and with Longhurst 1998 environmental areas***

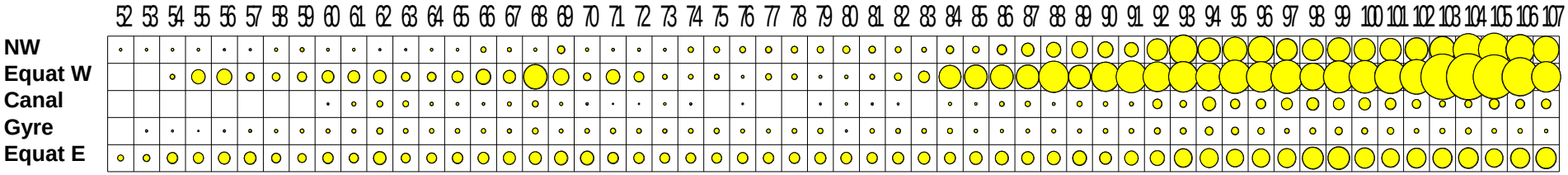
But a detail: …SAF area being connected to EAF area, not to the gyre…



YFT identified catches 1955-1980



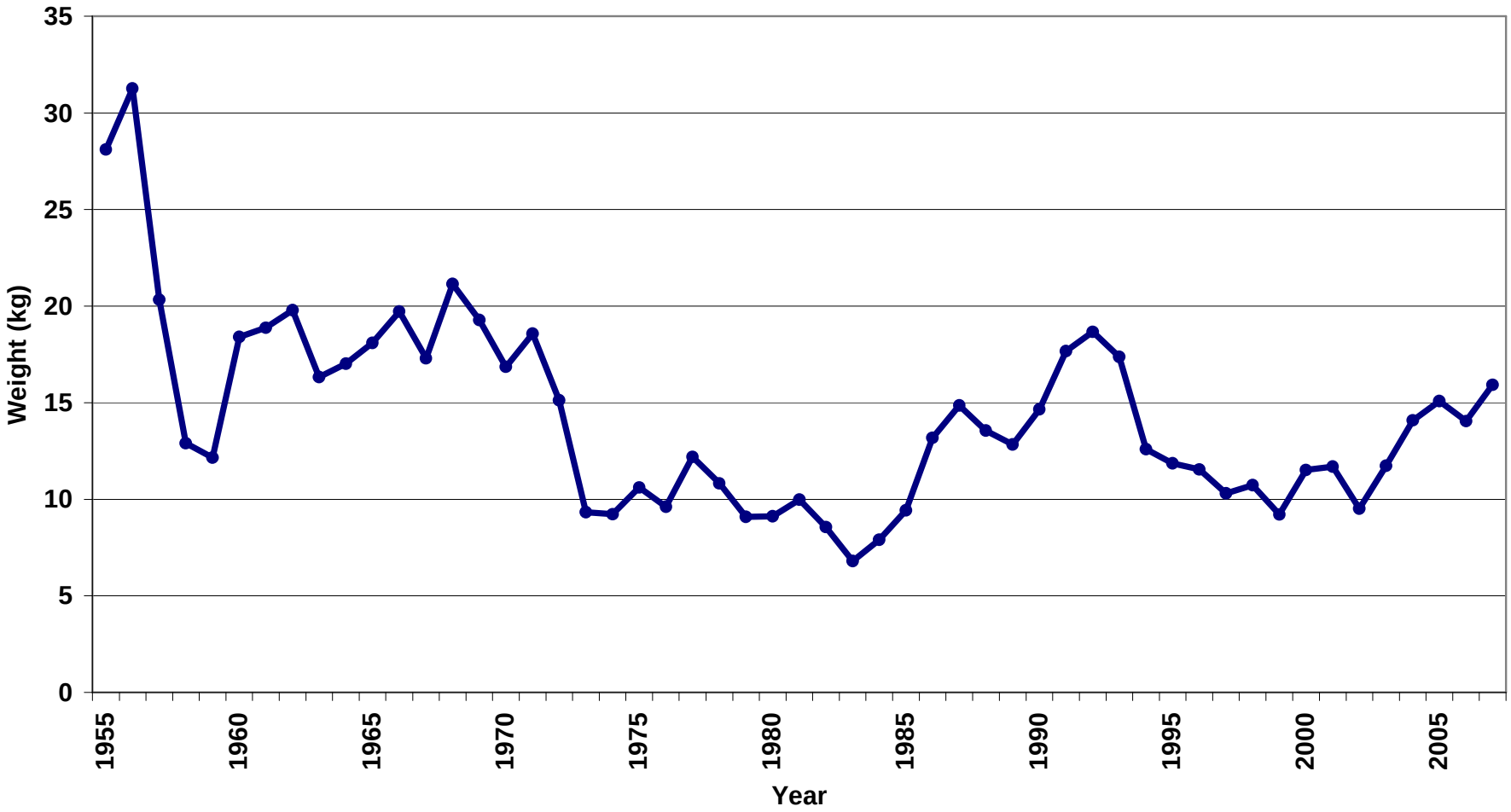
YFT identified catches 1990-2006



Total Yellowfin catches in the 5 SA areas

Catches medals/area:

(1) Gold: Eq West
(2) Silver: NW
(3) Bronze: Eq East

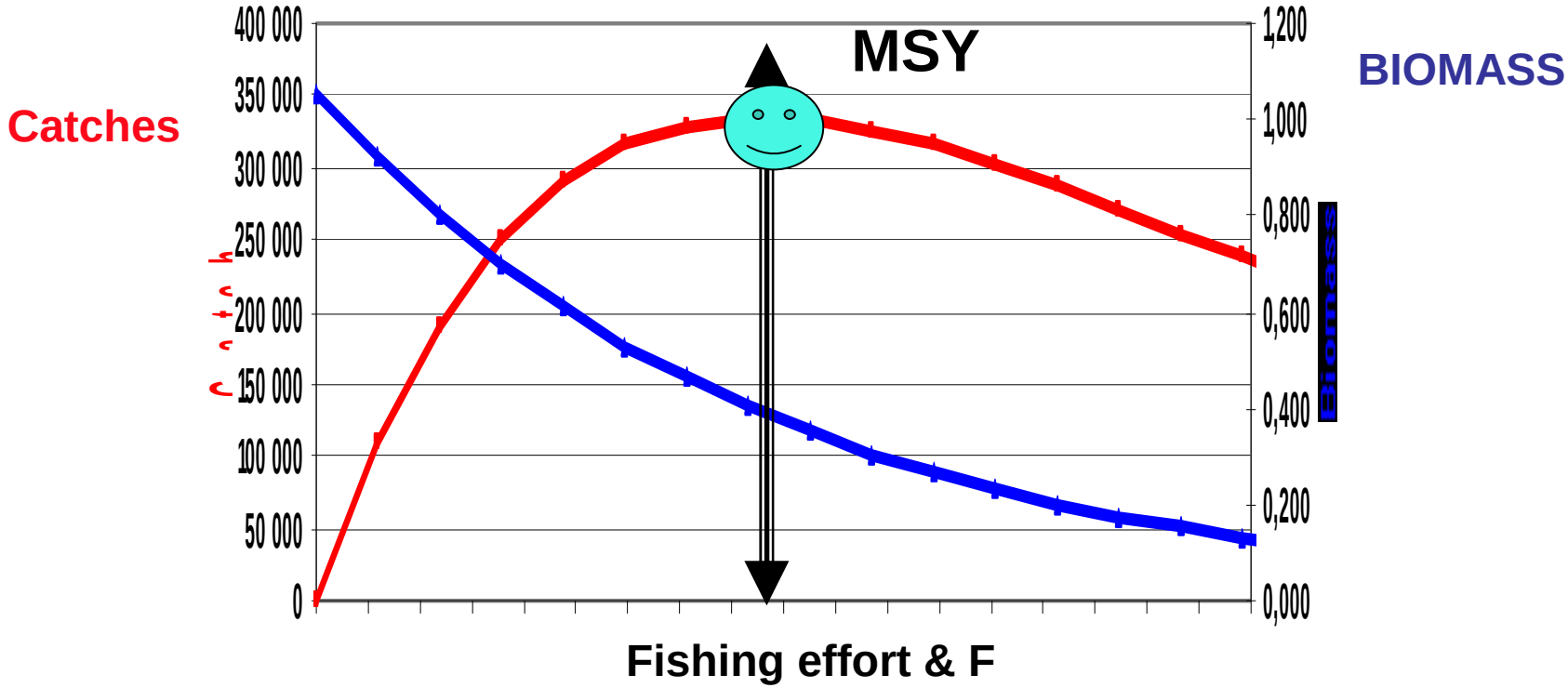


The average weight of YFT caught by combined fisheries has been quite stable during the entire period 1950-2007, then probably without major fluctuation in the yield per recruit of this stock

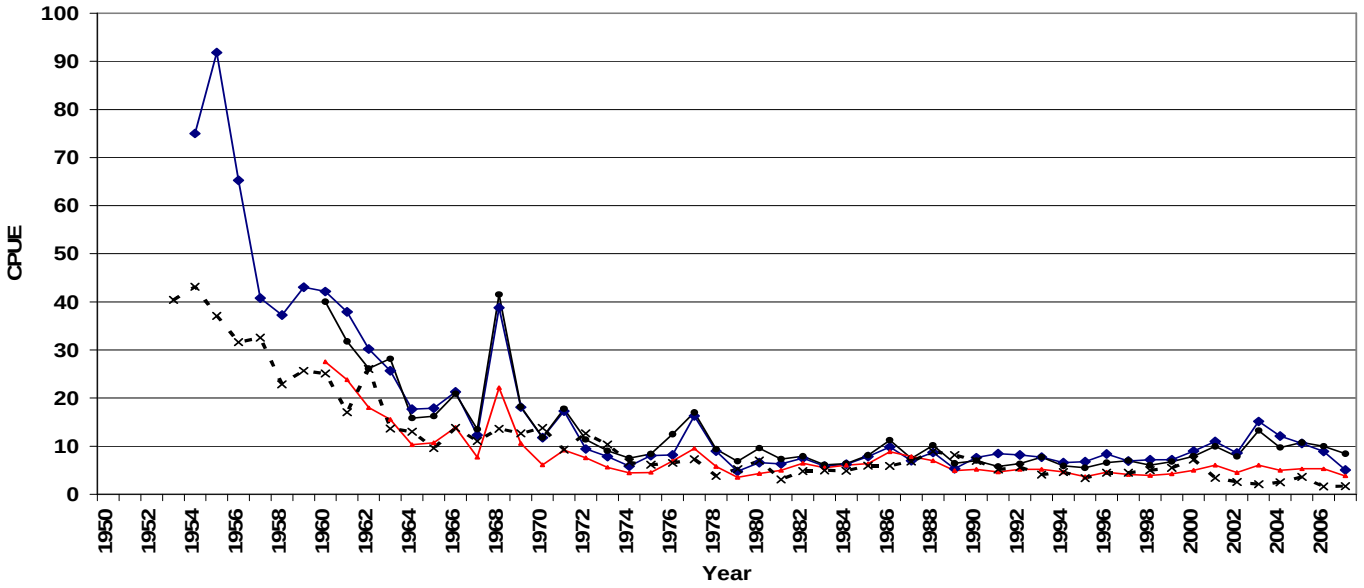
And recent average weights taken at about 15 kg that are quite >0 in term of Yield per Recruit

Back to school of fisheries

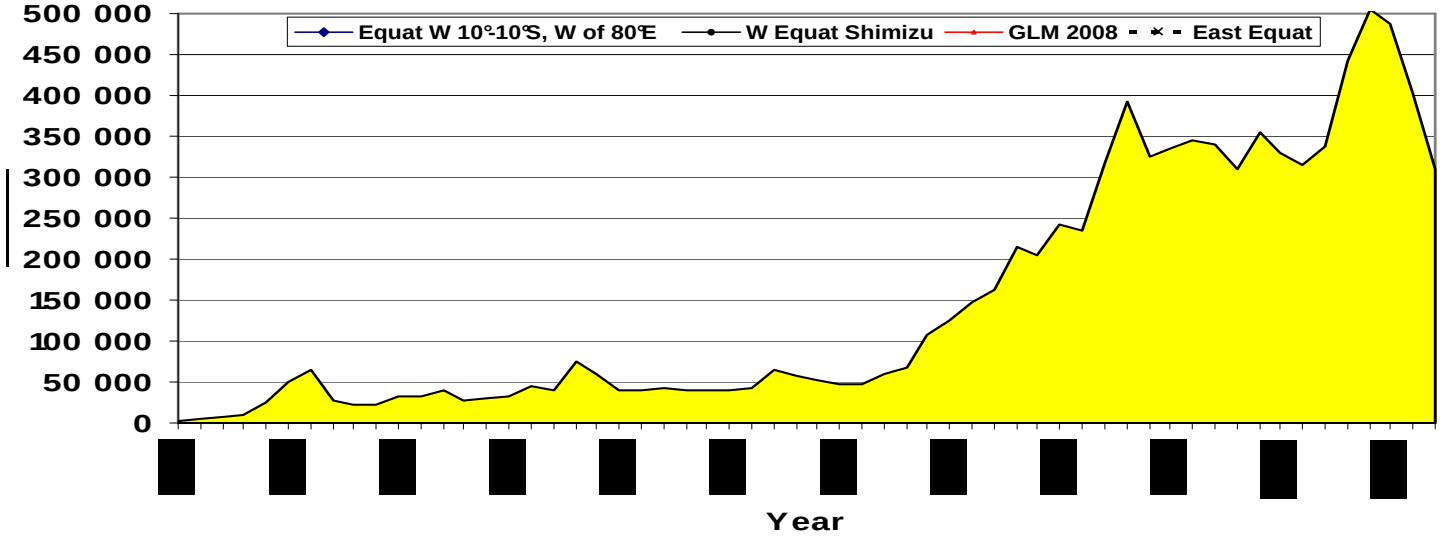
and to the basic Rules of Stock Overfishing



- **Tuna stocks tend to show a poor Stock/Recruitment relationship**
- **Fishing effort/mortality tend to show + or - permanently increasing trends**
- **Stock tend to show corresponding declines of their Biomasses**
- **Adult biomass tend to show more decline than the biomass of juvenile**
- **In this decline, MSY is reached at a level of about 1/3 of virgin stock**



LL CPUE

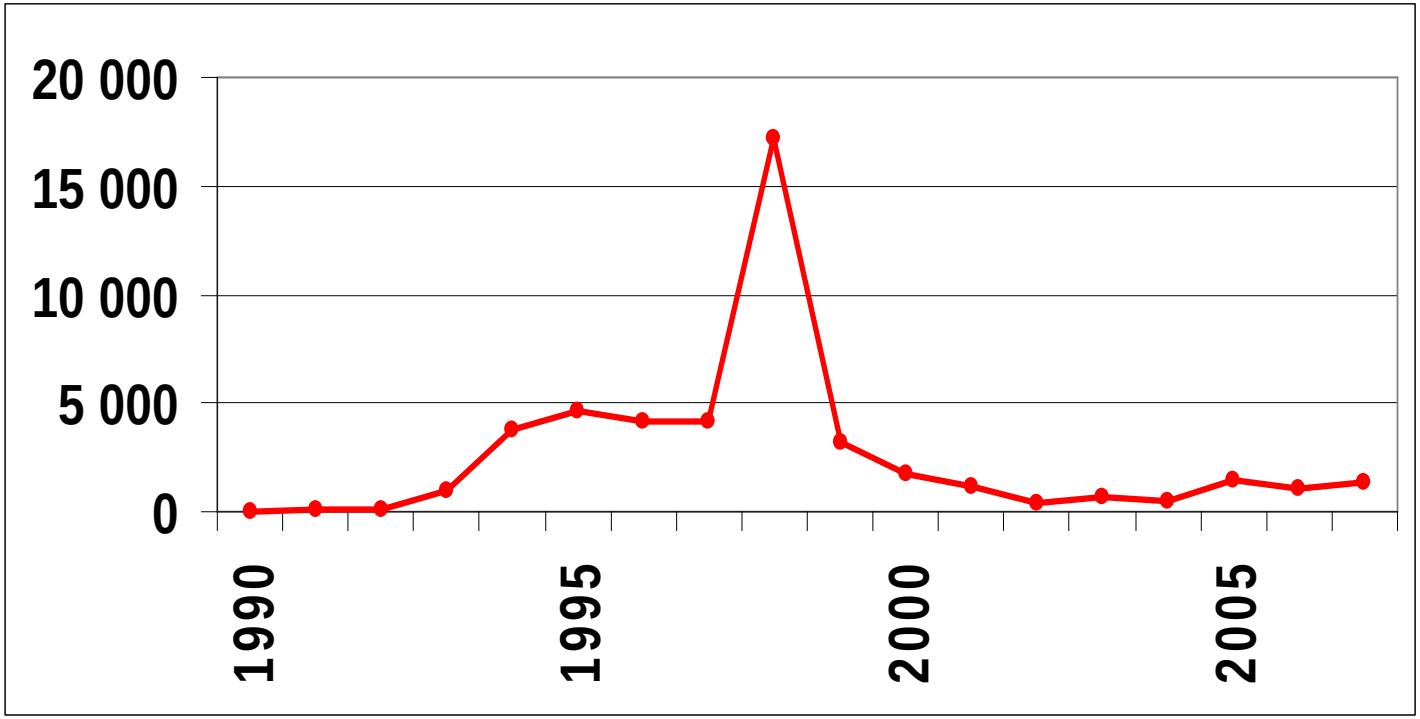


Total yearly YFT catches

But here a very different & difficult stock assessment based on LL CPUE data:

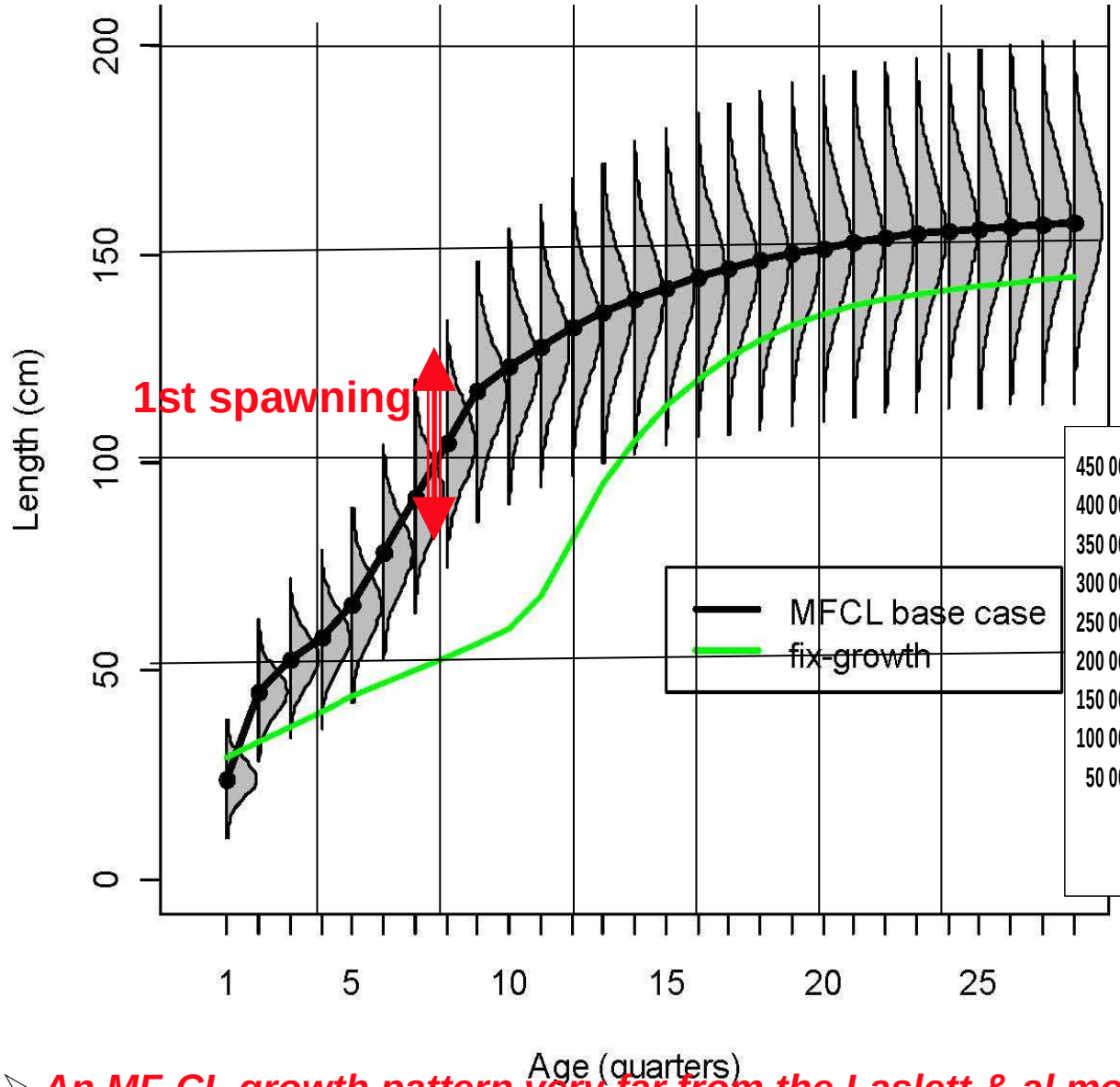
- ***Showing a major & early 10 folds LL CPUE decline, surprisingly during a period of low and stable catches***
- ***Followed since 1984 by a stable/increasing LL CPUE during a period of major increase of total catches***

PS catches in the Eastern Indian Ocean

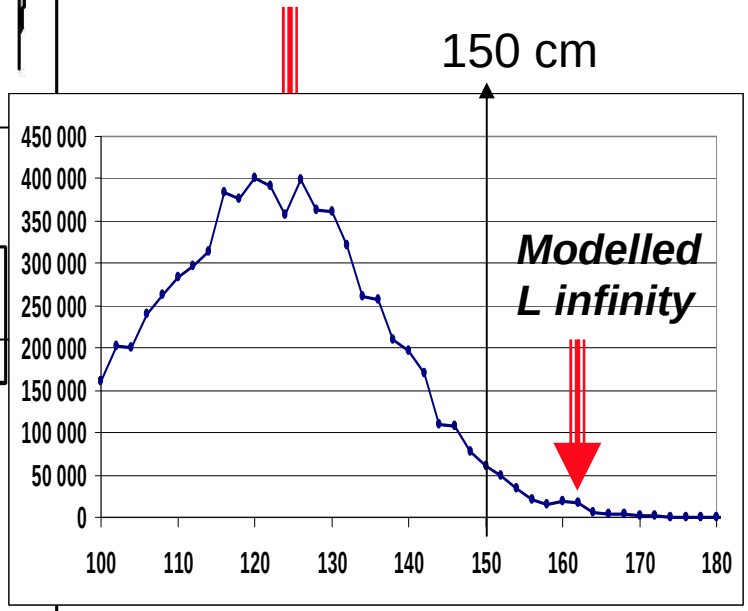


Low but significant YFT catches taken by PS in the Eastern Indian Ocean and with some tag recoveries?

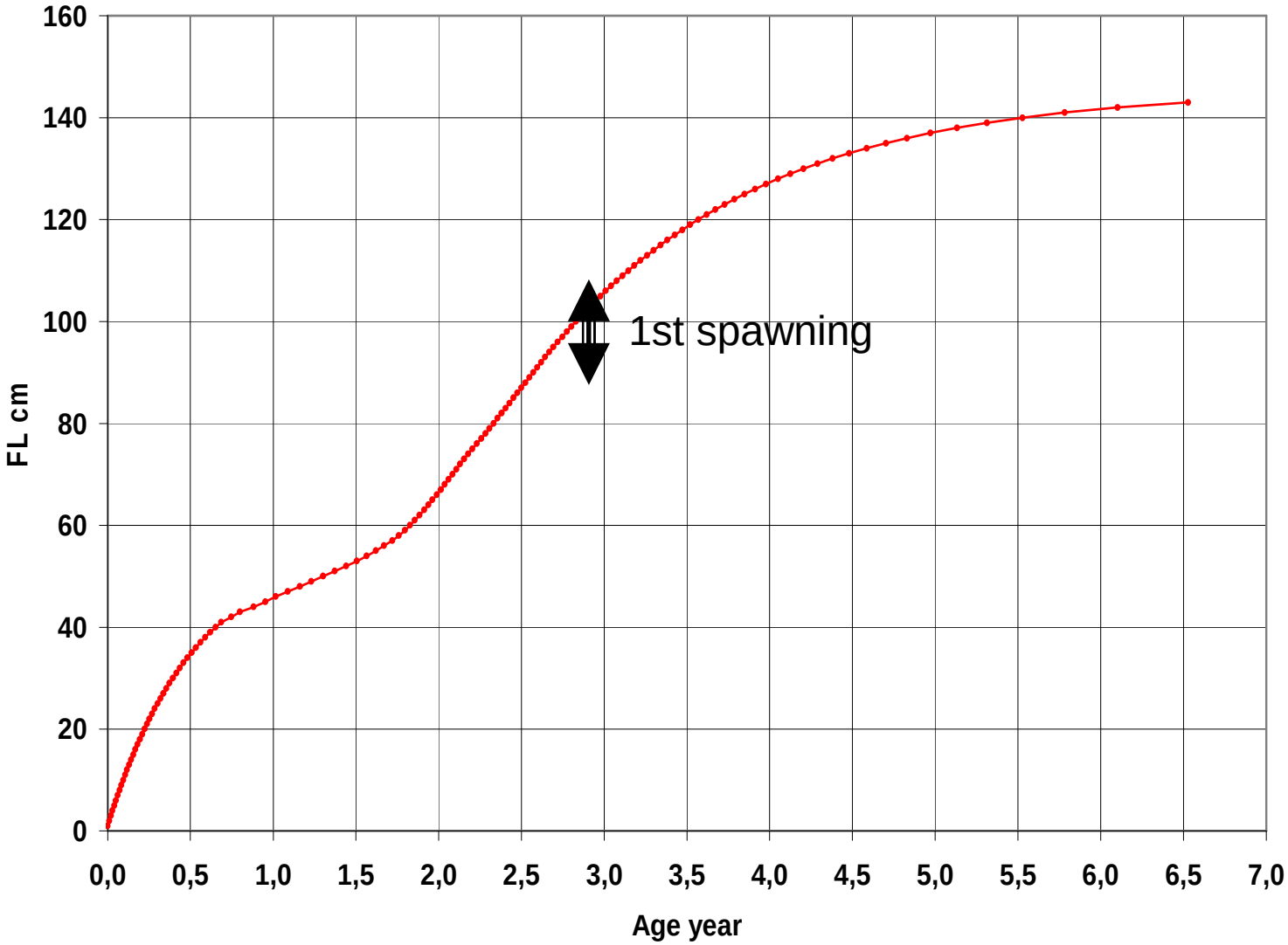
There is no reason to mix these catches in the Western IO as they can condition the E-W YFT movements!



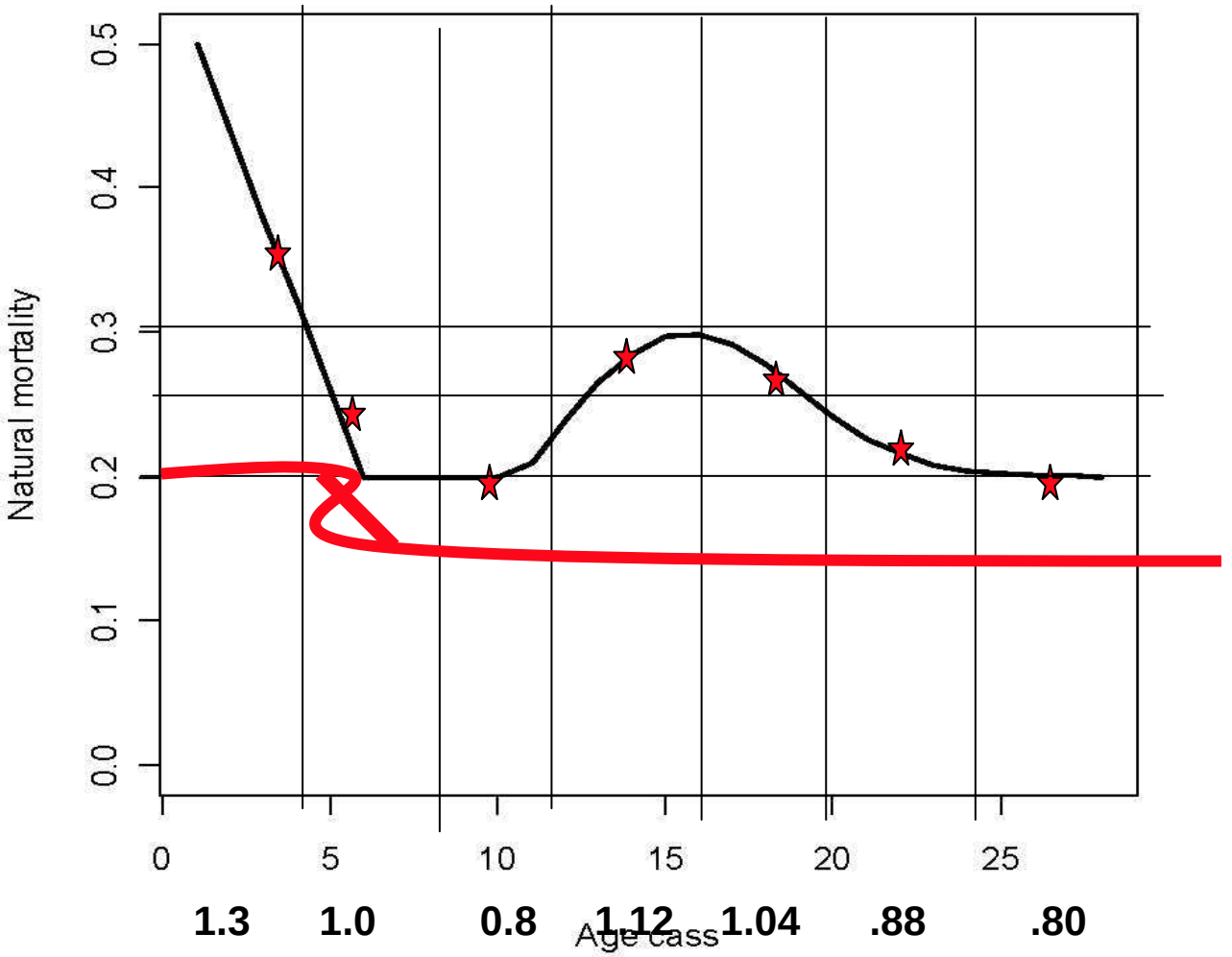
Recent catch at size of IO adult YFT: YFT >160 cm rarely caught



- ***An MF-CL growth pattern very far from the Laslett & al modelled growth***
- ***A reasonable growth pattern, but possibly too fast at young ages: a spawning size at 1 meter reached after only 2 years, appears to be fairly unrealistic and hardly supported by tagging data: Fonteneau and al growth indicating a 1 year duration between 46 and 67 cm***
- ***An L infinity that appears to be quite high: very very few YFT > this L infinity…***



A more realistic? growth pattern proposed by Fonteneau: A similar 3 stanza pattern, but fishes reaching a 1m size at nearly 3 years (1st spawning), not at 2 years, and a lower L infinity fixed at 1,46cm (5% of large YFT being larger than 1,46m)

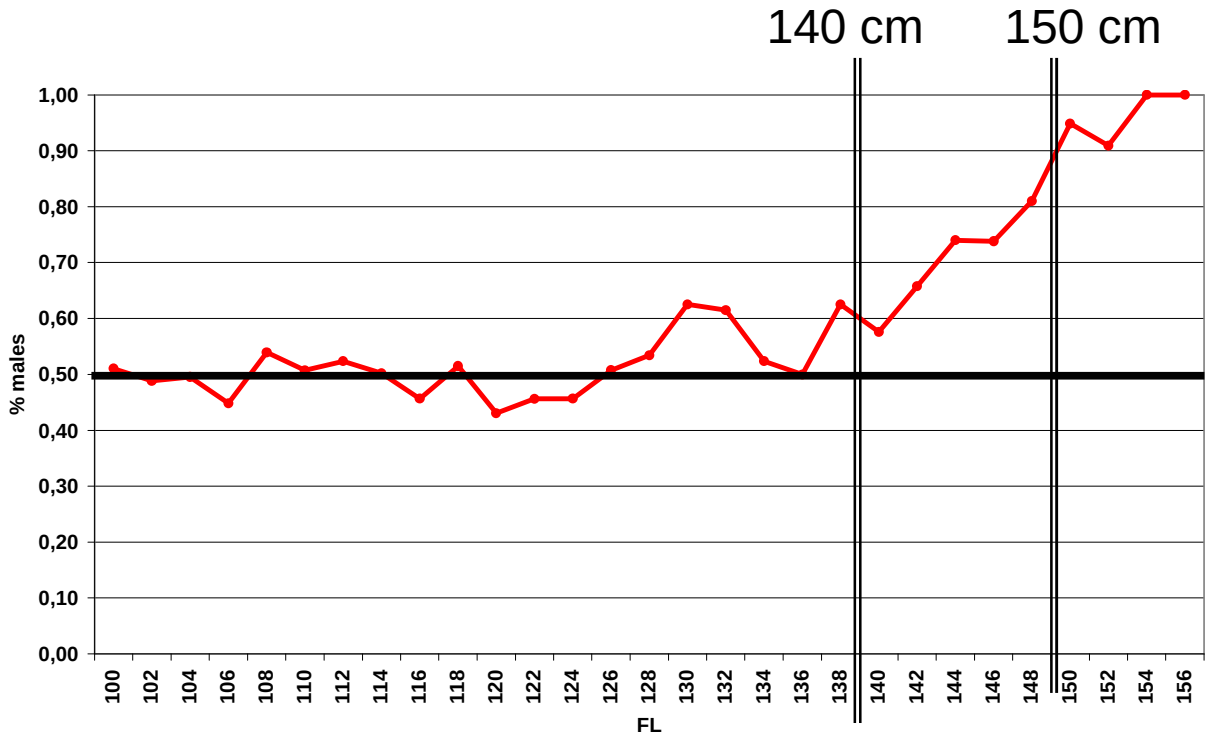


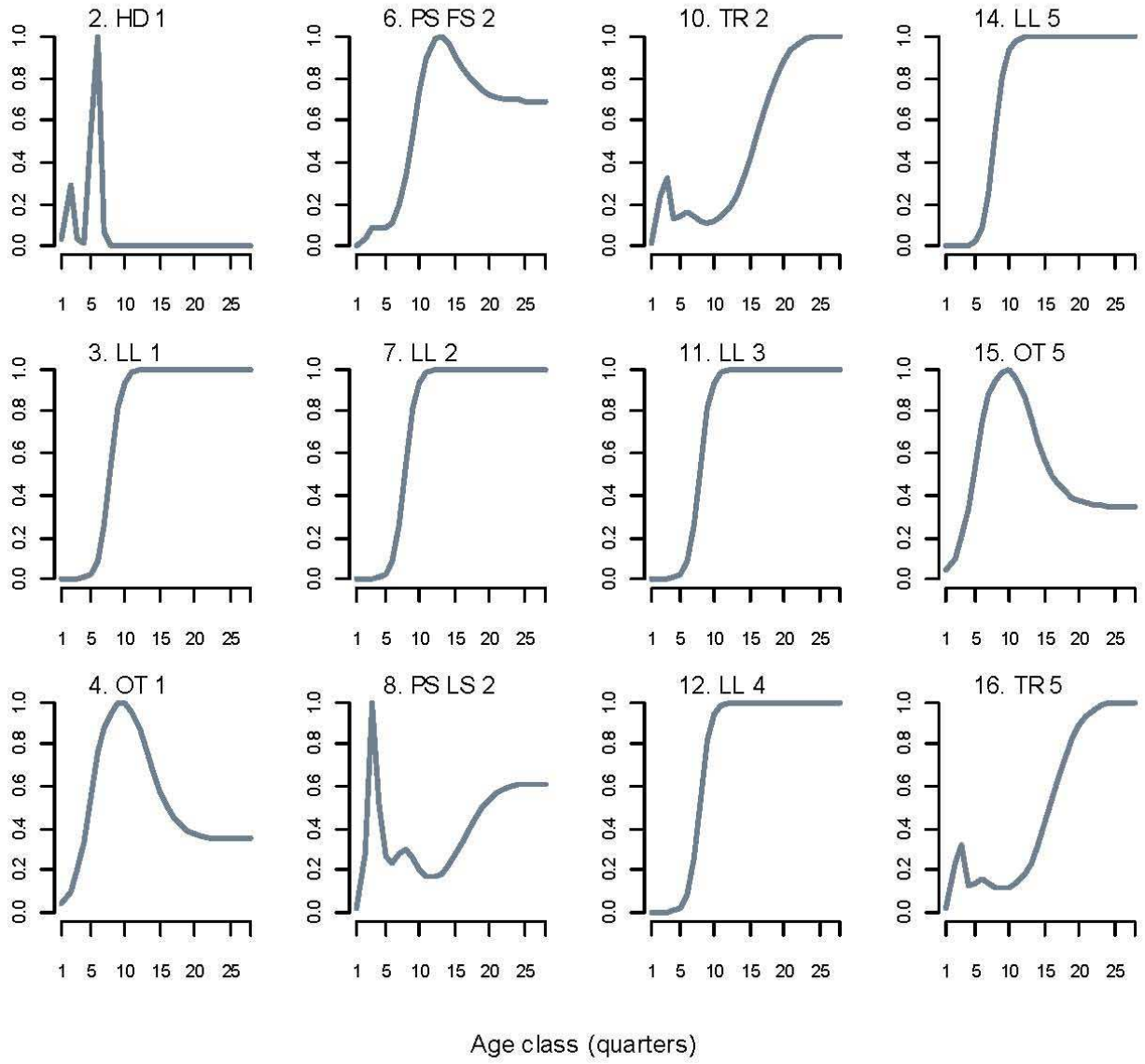
Previous M (ICCAT based)

- ***A reasonable level and pattern of Natural mortality at age,***
- ***But at a much higher level than previously assumed by IOTC WG= 1.0***
- ***NB : this high yearly M rates are much higher than the apparent Z, total mortality, apparent in the adult Catch at age table estimated by Fonteneau growth (showing a yearly apparent Z at about 1.0 in recent years)***

But still a pending question: why the YFT observed sex ratio at size?

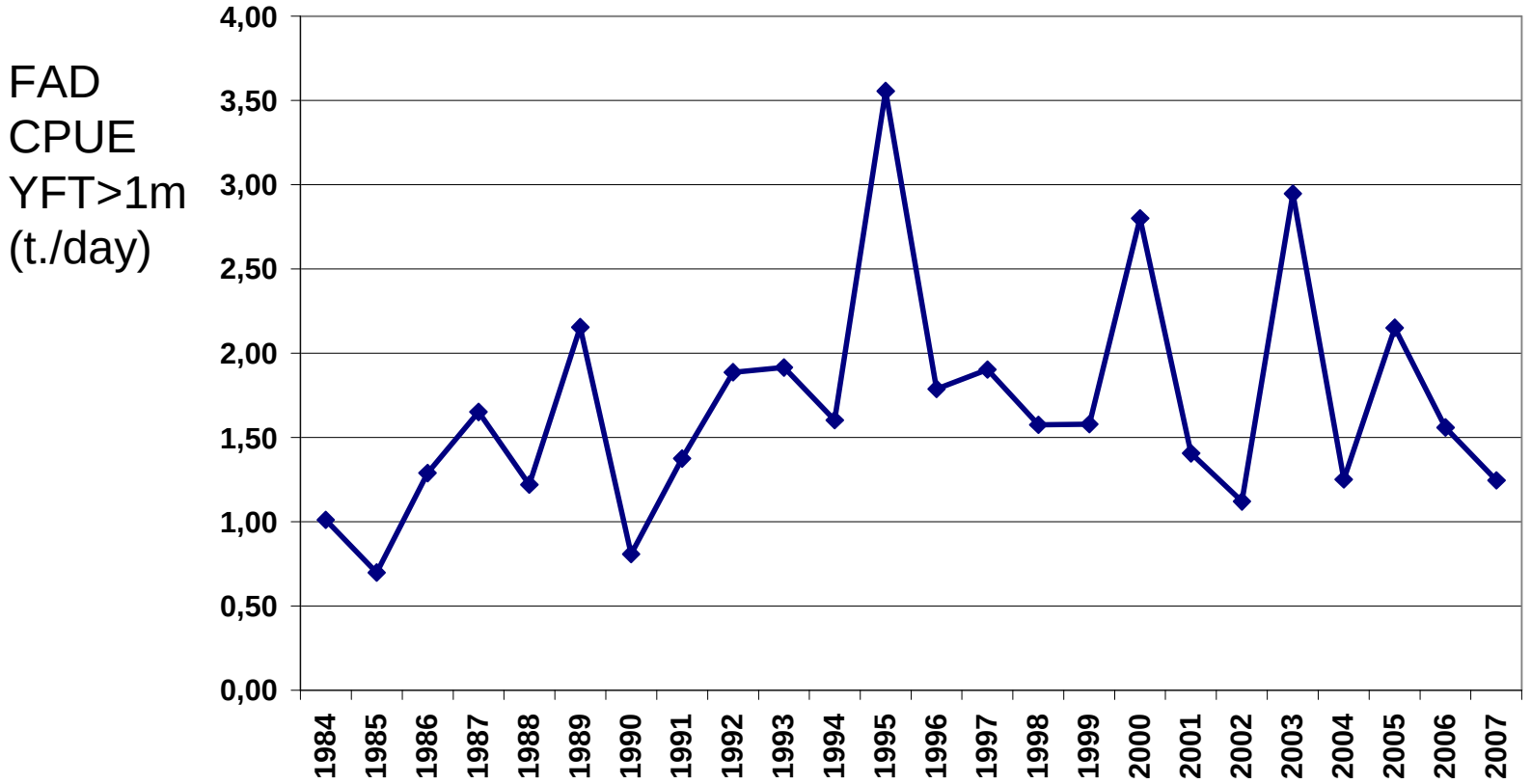
- Is it due to a **lower L infinity of female YFT**: A very realistic hypothesis? A fact observed for most species in the living world….
- Or to a **higher natural mortality of spawning female** YFT? The present MF-CL hypothesis

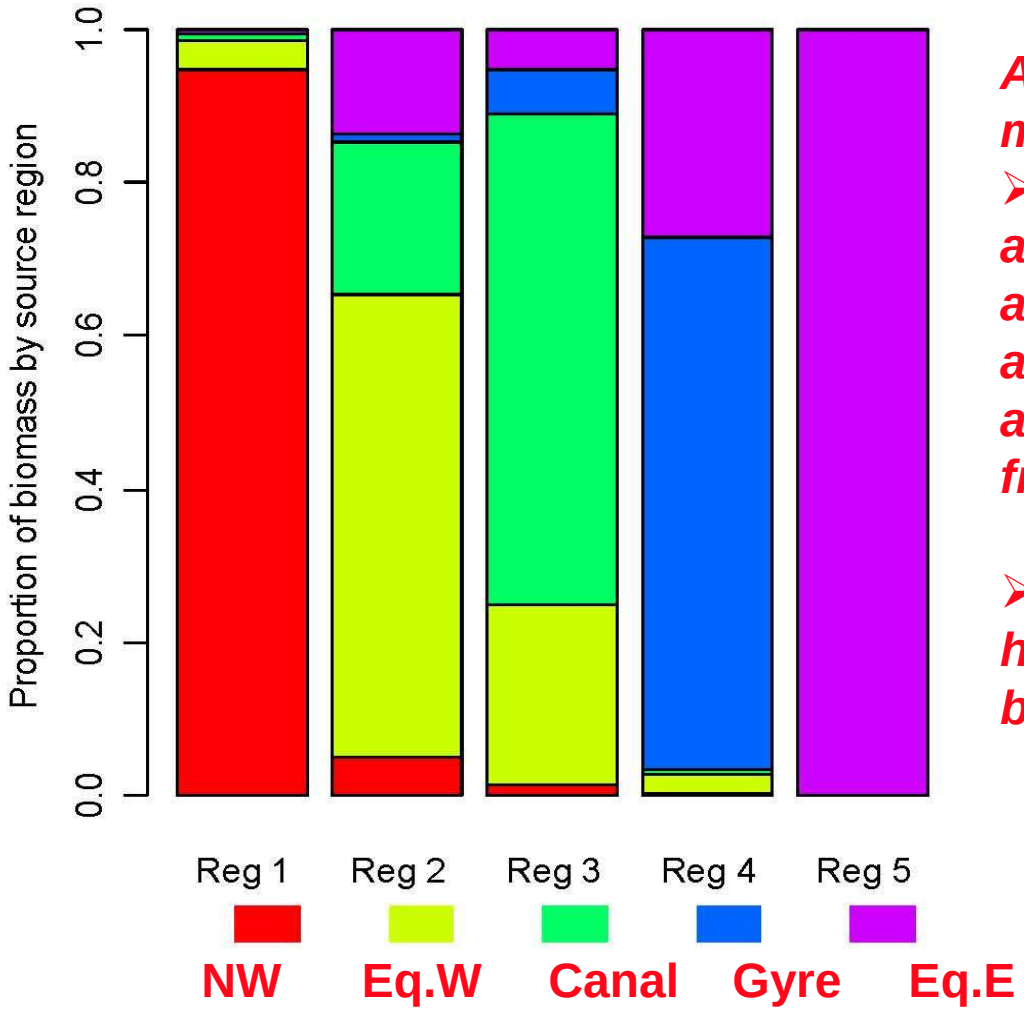




Fixed selectivity patterns by each gear are widely questionable….
For instance the flat selectivity for LL is doubtful…
Adult selectivity for the FAD PS fishery should be much lower! And it has been permanently variable

Significant variability of yearly catches of adult YFT in the PS FAD fishery: significant year to year variability in PS FAD selectivity for large YFT?





A rather strange and artificial lack of mixing between areas, for instance:

- ***Between the isolated EqW and EqE areas, when biologist tend to assume at least some equatorial mixing of adult YFT in the Chagos/maldives area (YFT taken in SAF waters being from the YFT Canal pop.)***

- ***Conclusion: IO juvenile YFT are highly mobile and present mixing are by far too low..***

MF-CL mixing rates are independent of YFT ages: a fairly unrealistic rule,
As movement patterns are clearly dependent of the 3 ages and 3 growth stanzas

The surprising lack of Equat W-E movement is in contradiction with PS recoveries in the Eastern Eq area. MF-CL PS should also fish in the Esatern IO!

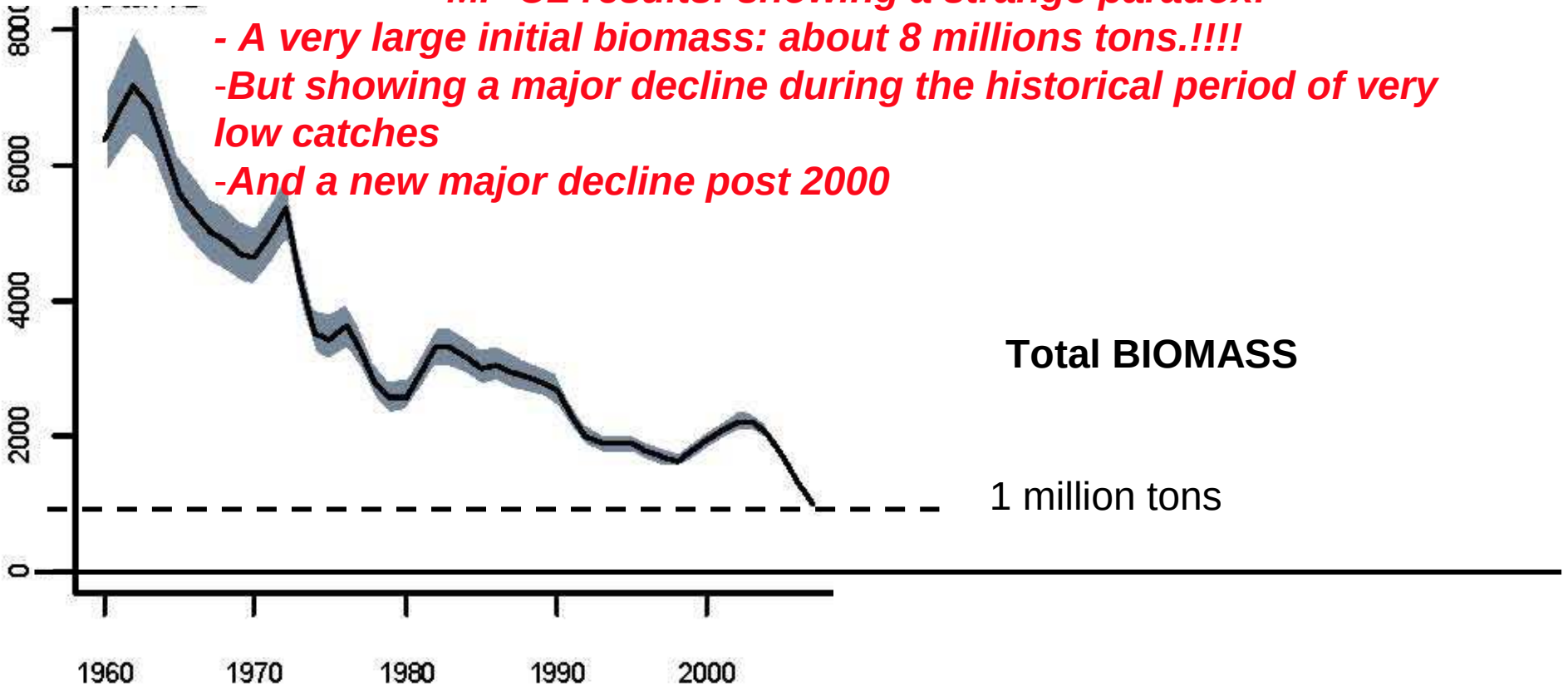
Questionable biomass levels and trends in the MF-CL results?

MF-CL results: showing a strange paradox:

- A very large initial biomass: about 8 millions tons.!!!!

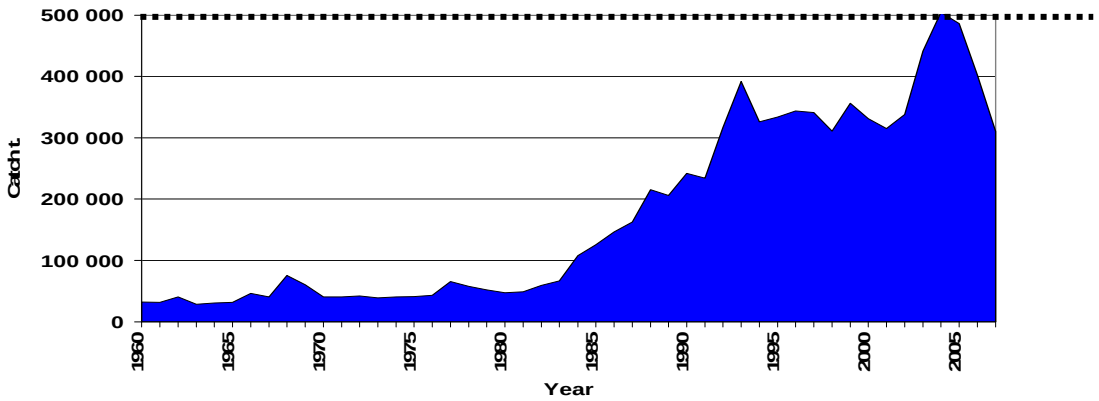
-But showing a major decline during the historical period of very low catches

-And a new major decline post 2000



Total BIOMASS

1 million tons

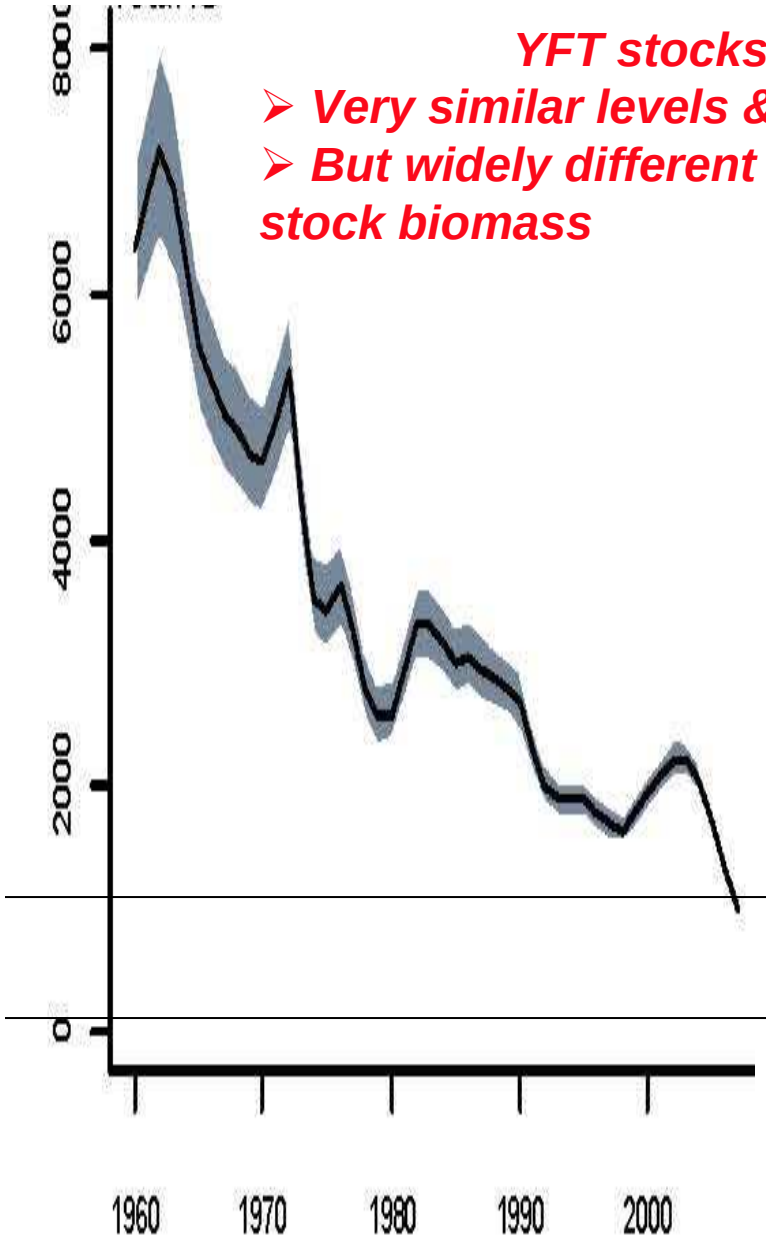


0.5 million tons

Catch

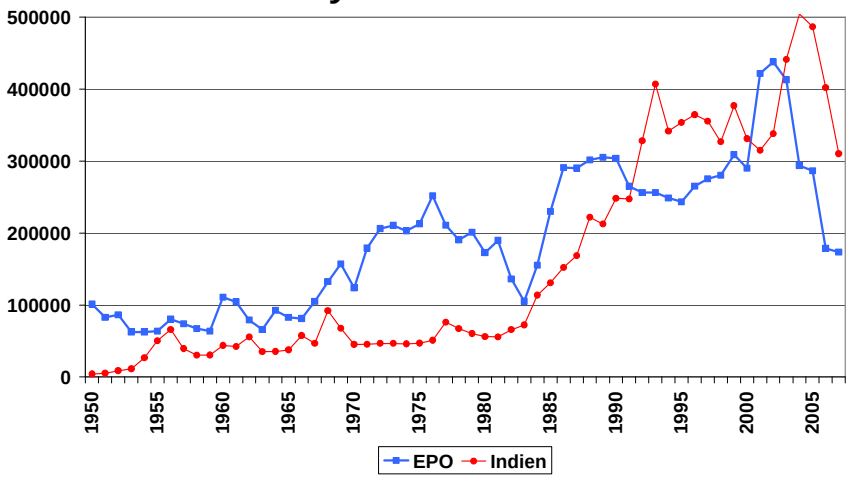
YFT stocks in the IO and in the Eastern Pacific Ocean:

- ***Very similar levels & trends of catches***
- ***But widely different trends and order of magnitude in the estimated stock biomass***

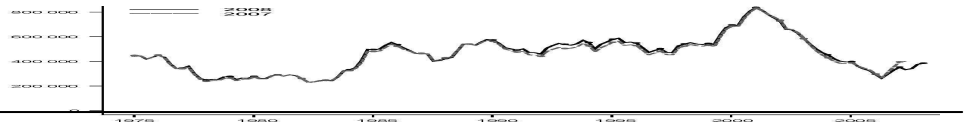


Indian ocean biomass

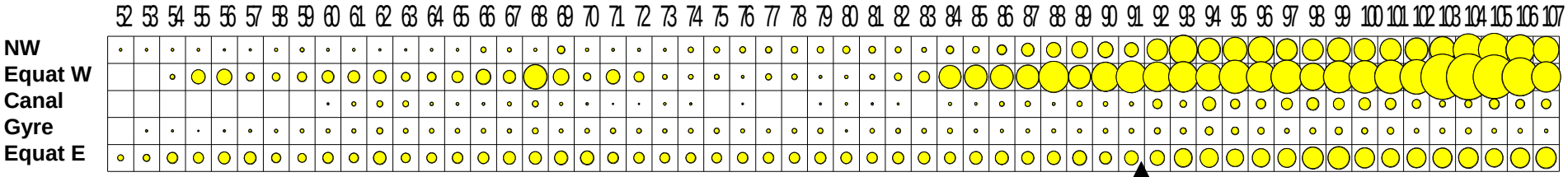
Yearly catches



1 million t.

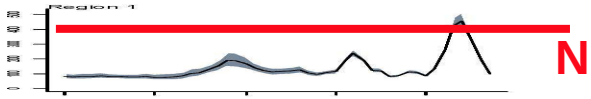


Eastern Pacific biomass

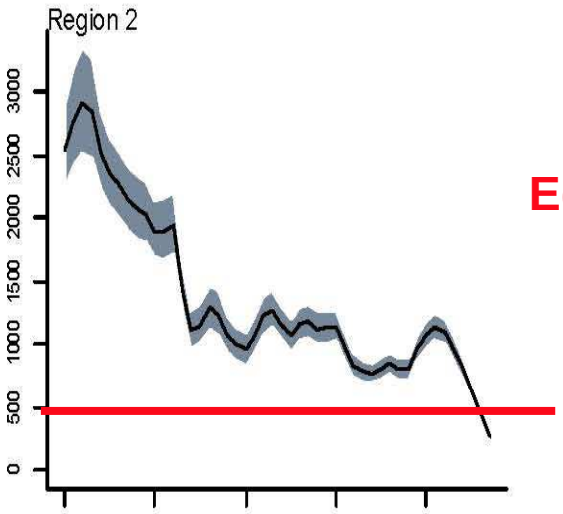


Total Yellowfin catches in the 5 SA areas

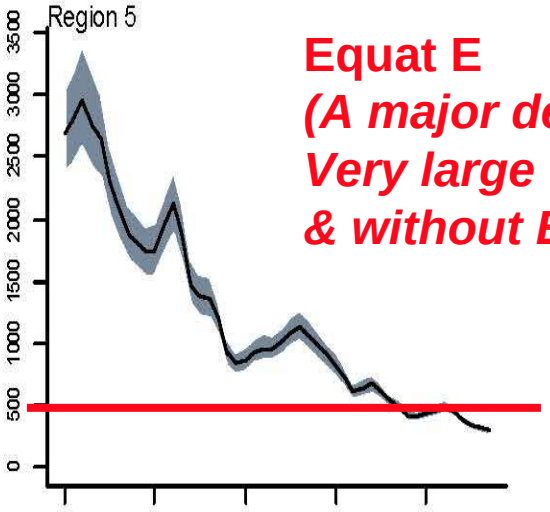
Estimated biomass trends / area



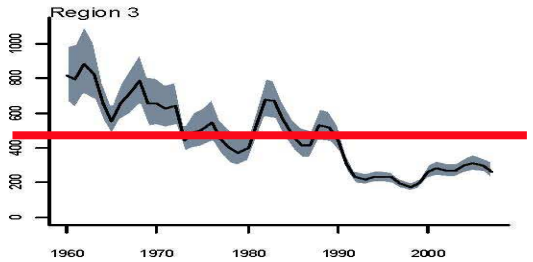
N W



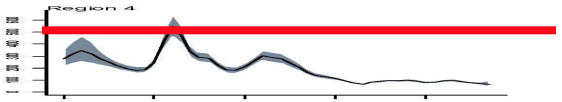
Equat W



Equat E
(A major decline but without Very large YFT catches? & without E-W mixing?)



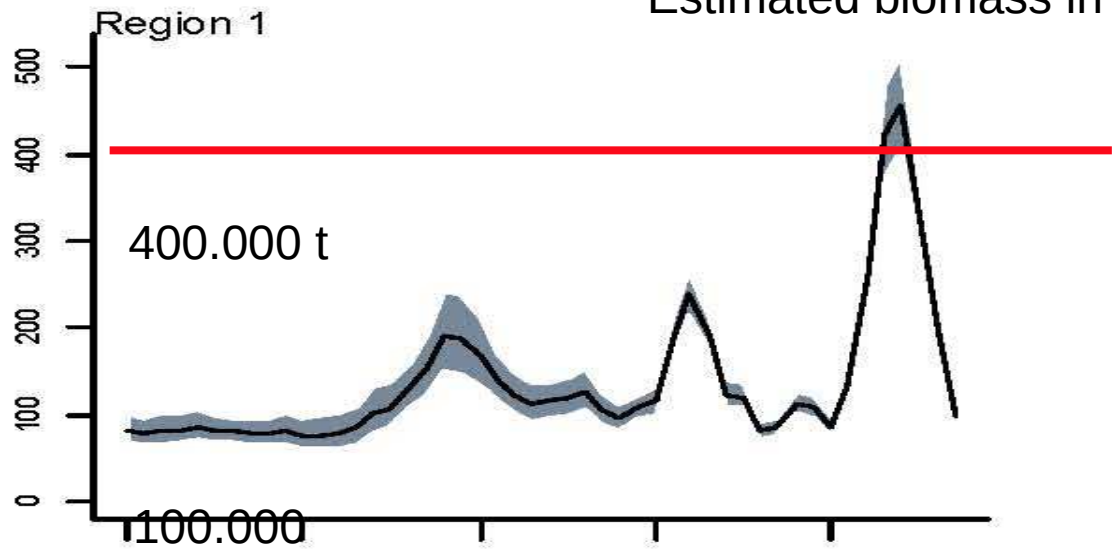
Canal



Gyre

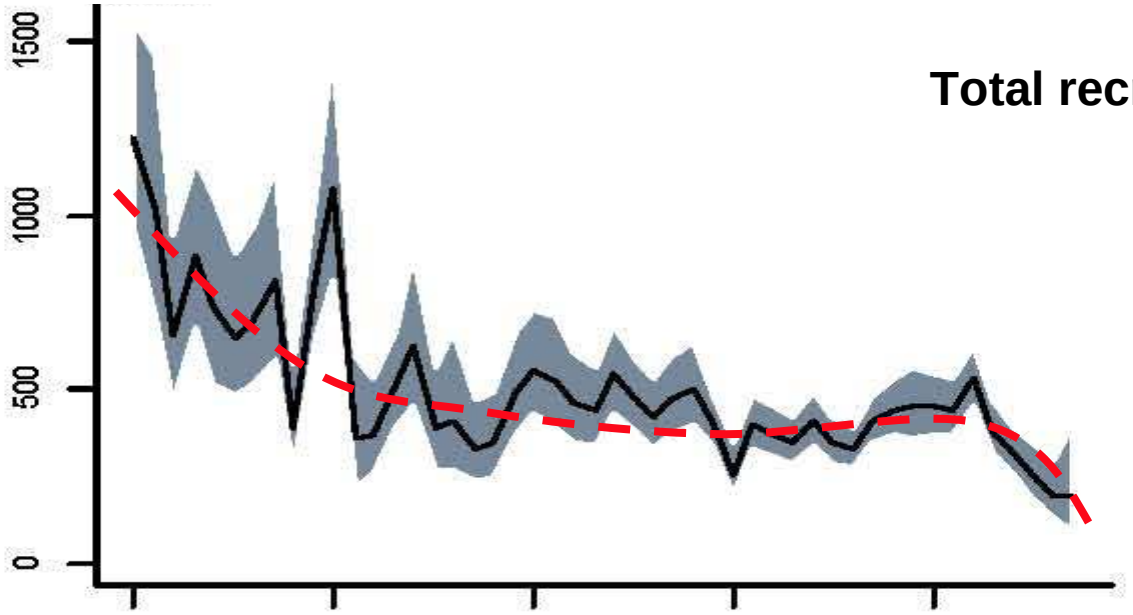
Biomass levels and trends in each area seems to be questionable, and often quite inconsistent with levels of catches and CPUE in each of these areas

Estimated biomass in area 1 NW:



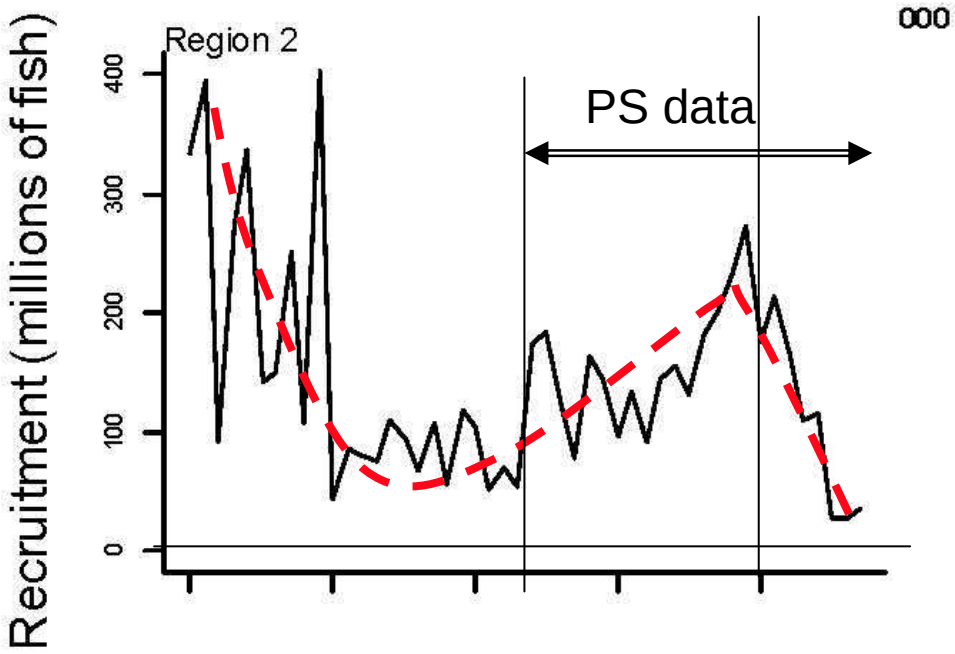
Estimated biomass in area NW 1 seems to be far too low….
Total YFT catches in area 1 NW are very high: Taiwan, Oman, Yemen, Iran et al…
Reaching yearly levels over 100 or 130.000 t.
, these catches are possibly underestimated in MF-CL?

This isolated biomass in area 1 NW is too isolated as most tuna biologist tend to conclude + or - firmly:
- ***That this is not a major spawning/recruitment area,***
- ***That a large fraction of the medium sizes YFT born in area 2 Eq-W are moving at puberty to the North,***
- ***and later move back to their spawning area at adult sizes***

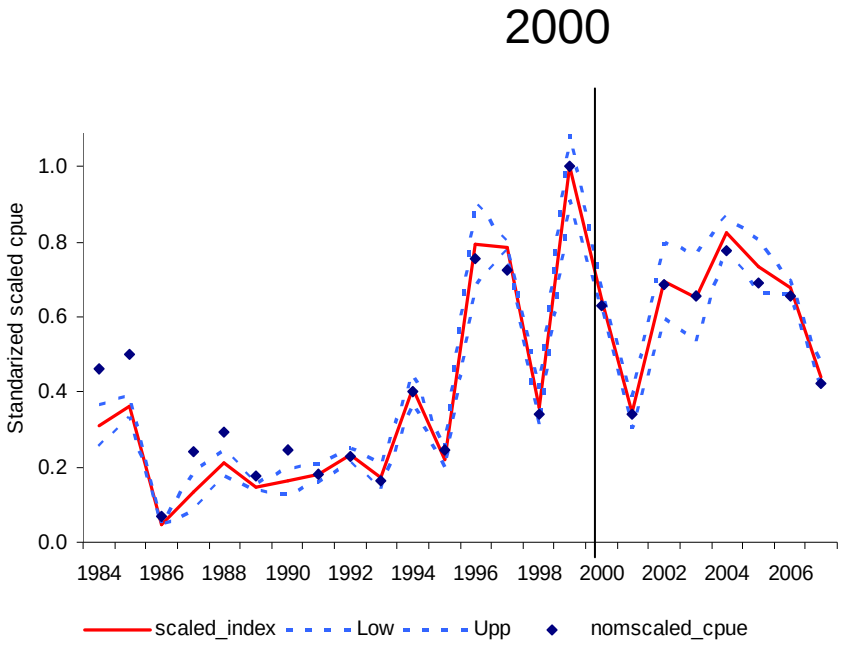


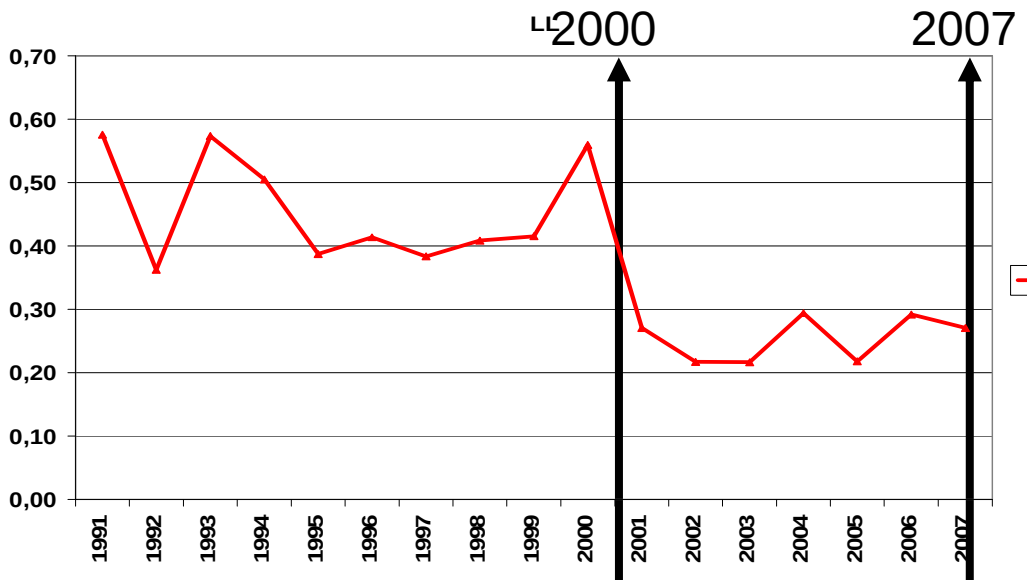
Total recruitment

Estimated Recruitment show a strange trend during the entire period ,
Driven by the CPUE decline and especially in 2000-2007:
No visible decline of Age 0 YFT PS CPUE



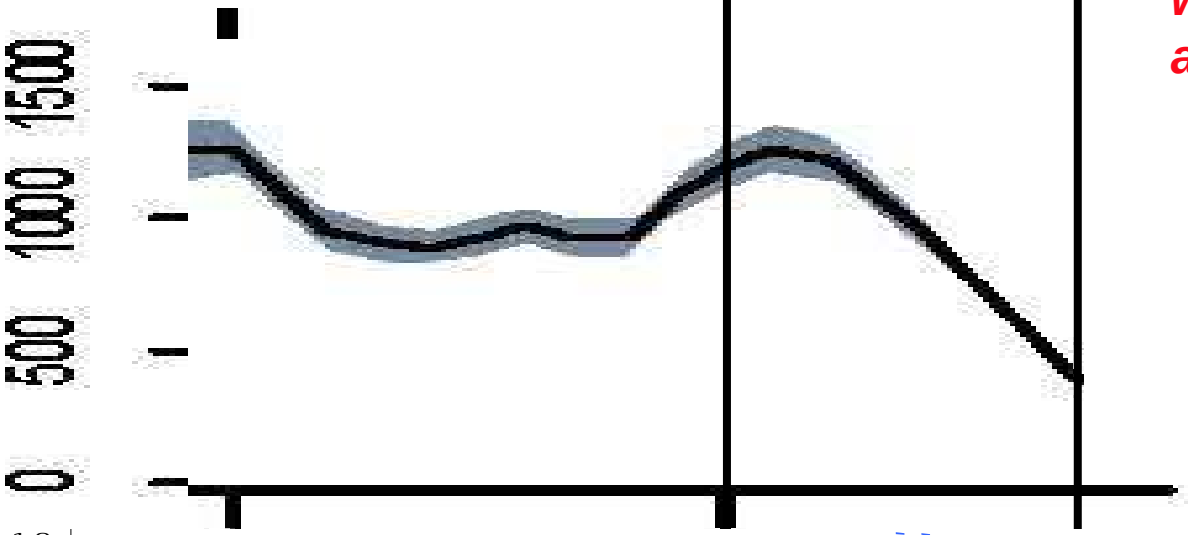
Recruitment in the PS area W Equat IO



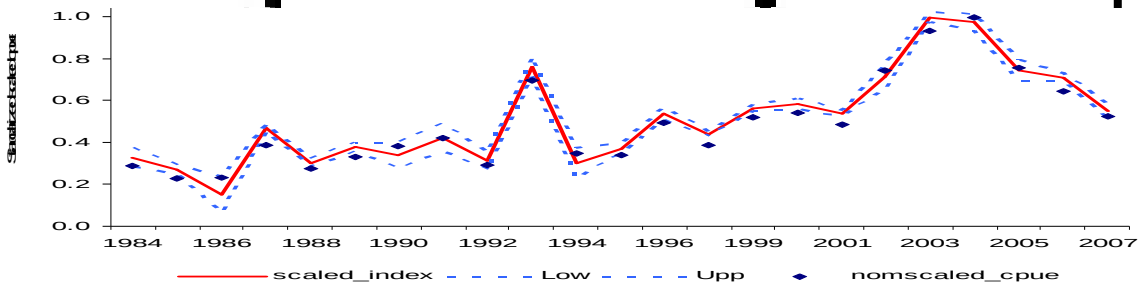


LL Japan GLM CPUE

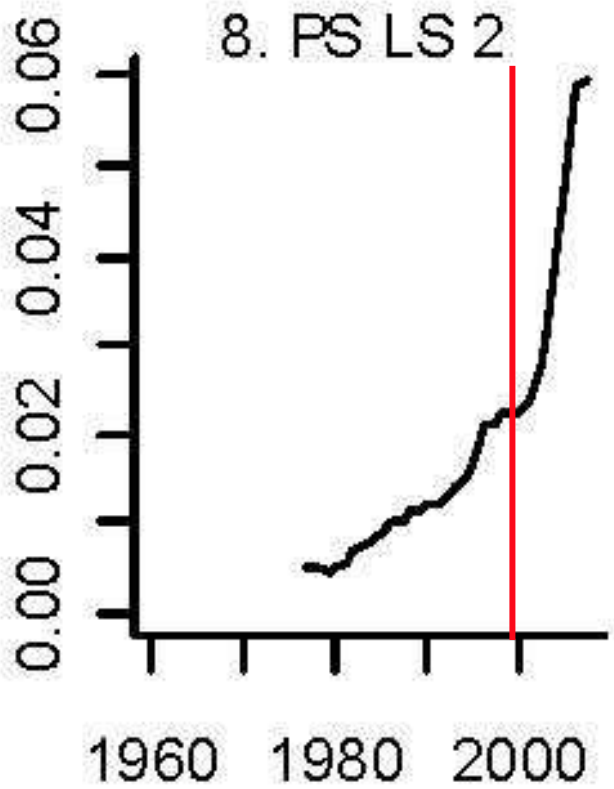
Major decline in the post 2000 stock biomass when LL & PS adult cpue are stable

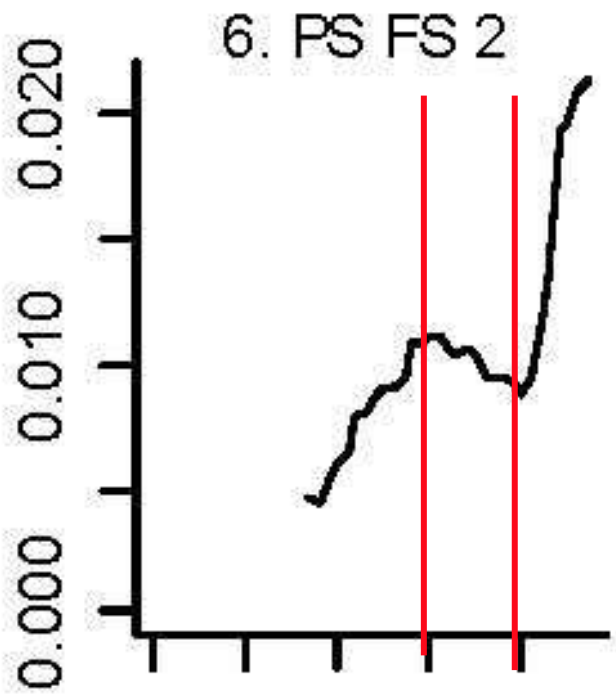


MF-CL
Adult
biomass



GLM PS adult CPUE



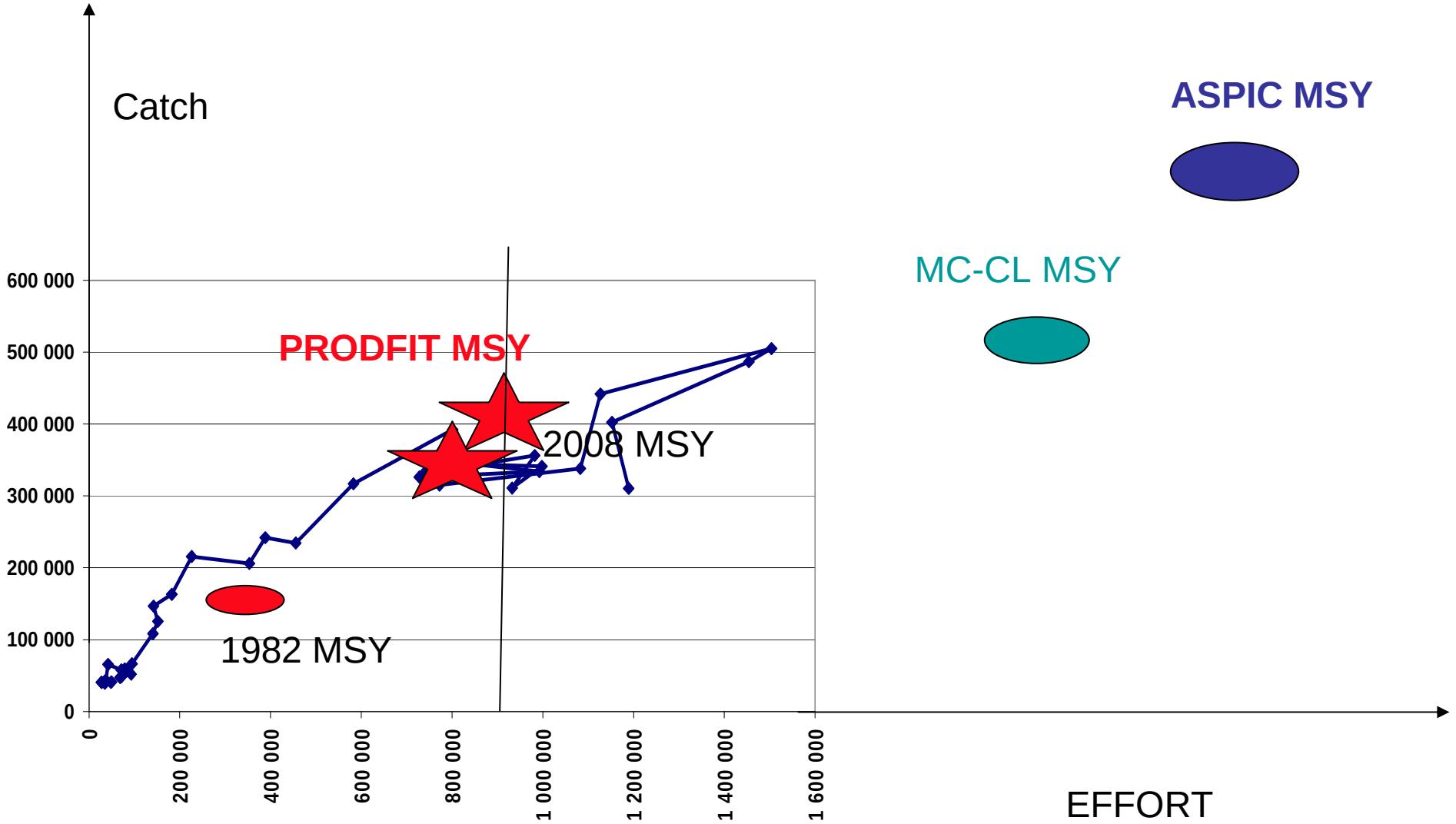


FAD **free school catchability**

Very strange & unrealistic changes in PS catchabilities:

- Strange decline in the Free schools catchability during the 1990-2000 period??

- Very strange major increase in both the Free schools q during the 2000-2007 period WHY???????



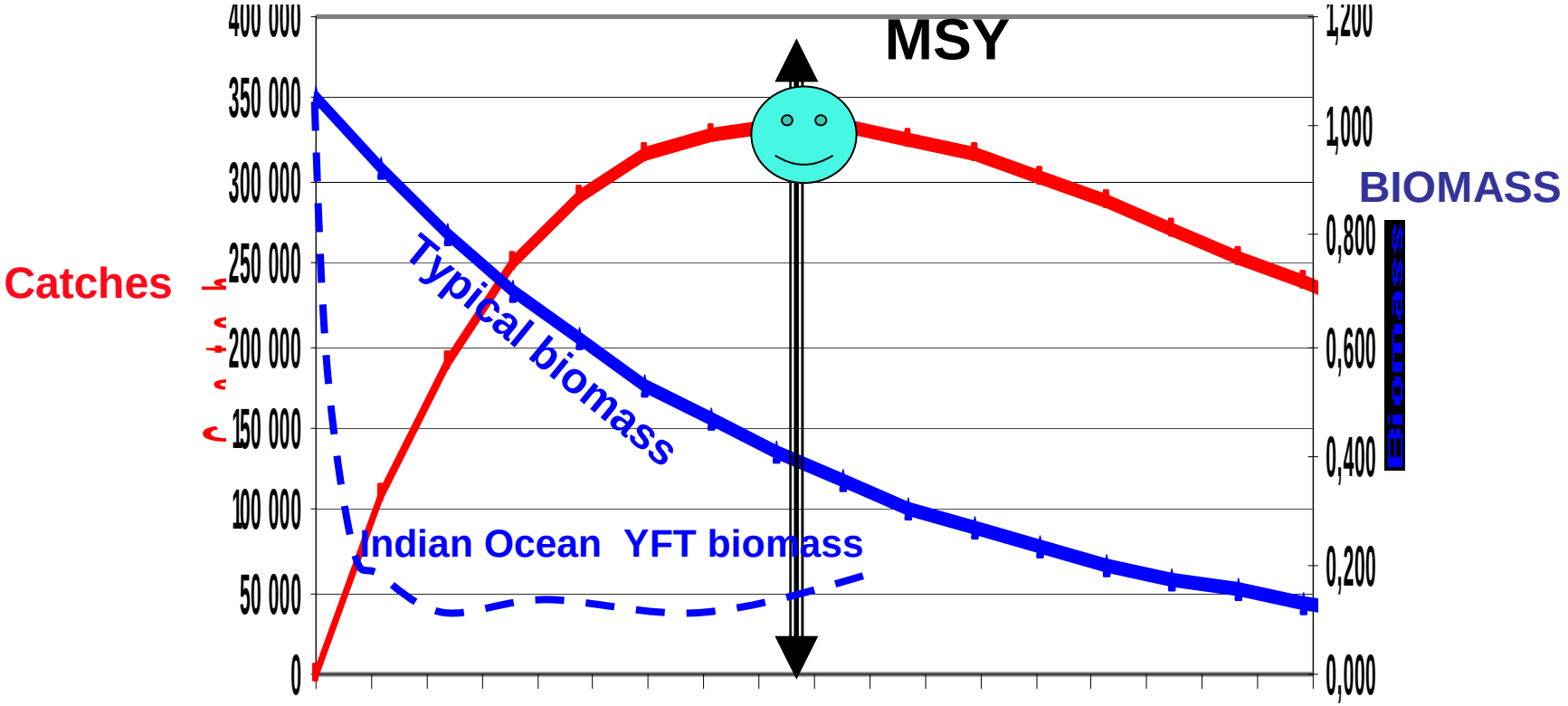
Wide uncertainties in potential MSY and present stock status

Conclusion on MF-CL model & results

- ***This is a well structured First attempt to run MF-CL on the Indian Ocean YFT stock: this was clearly a highly positive step!***

- ***But many/most of the present parameters and results appear to be widely questionable and probably false***
- ***There is now a deep need to try to reduce these uncertainties and problems, and to do other MF-CL more realistic runs***
- ***But unfortunately all MF-CL models will always face major difficulties to control the relationship between LL CPUE and adult biomass and the permanent changes in fleet efficiency and fleet selectivity ,***
- ***and the complexity and variability of age specific movement patterns…***

Mañana….. : APECOSM?????



<u>Indian Ocean YFT LL CPUEs and its Yields trends constitute the most extreme case ever observed world wide</u>

A personal conclusion by Alain Fonteneau:

LL CPUEs trend does not correspond to the trend of the adult YFT stock but:

- **It has been driven by a major 10 folds decline of its catchability during the 1952-1970 period**
- **& since 1970 driven by a constant & steady increase of its fishing power (1 or 2% yearly?) that has been widely masking the YFT stock decline**
- **All YFT S. A. models should be able to incorporate these 2 basic hypothesis of major changes in the LL catchabilities (first <0, and later >0 ones)**