Achieving Higher Economic Value under the Same Conversation Goal:

Tradeoff Analysis of the Eastern Pacific Ocean Tropical Tuna Fishery between Longline and Purse-seine Fishing

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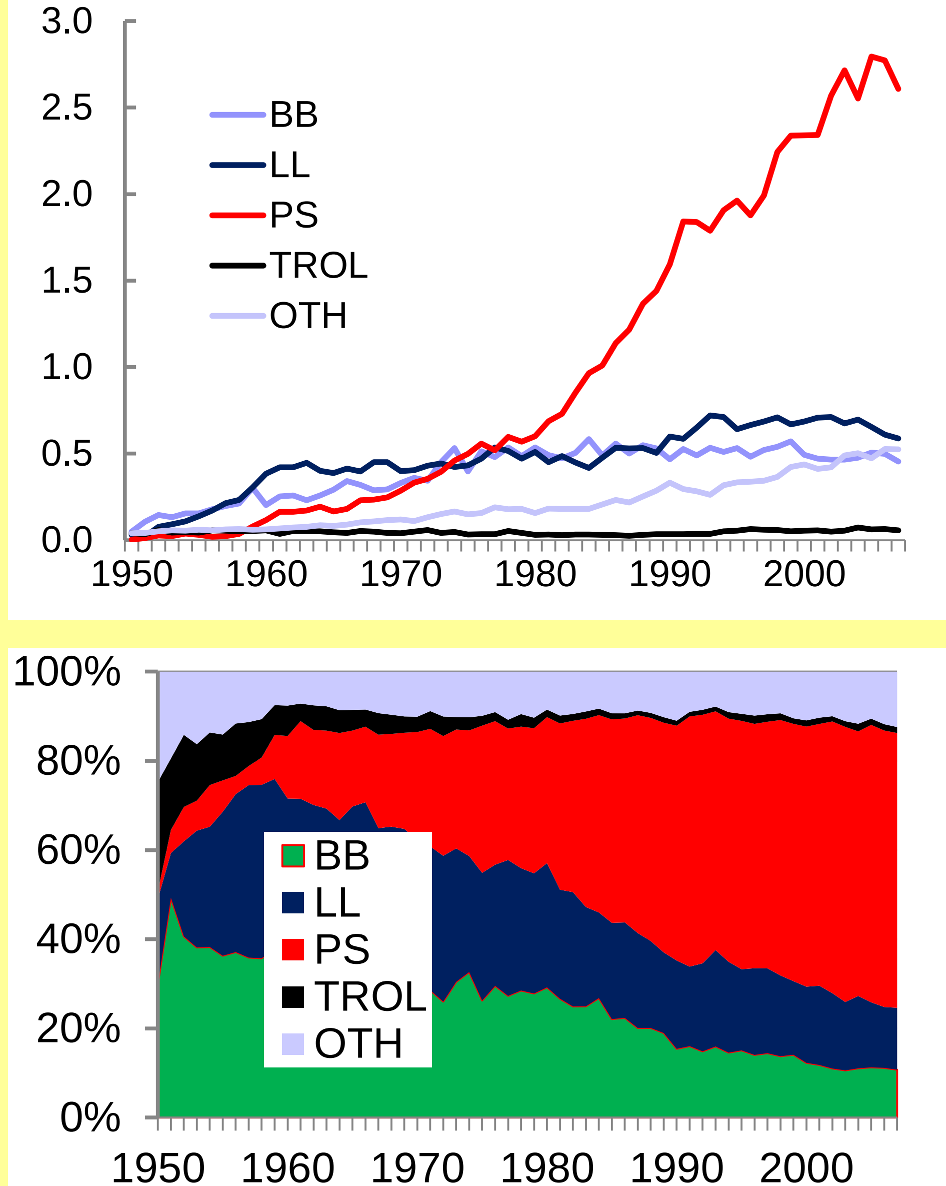
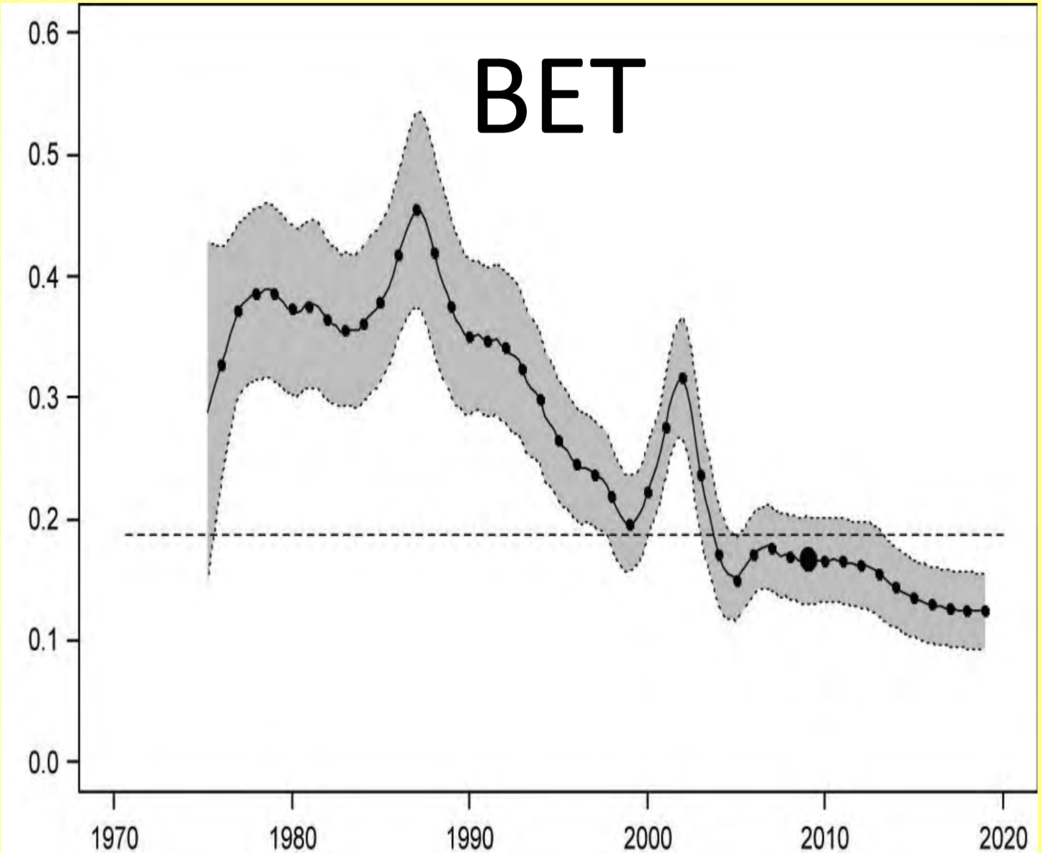
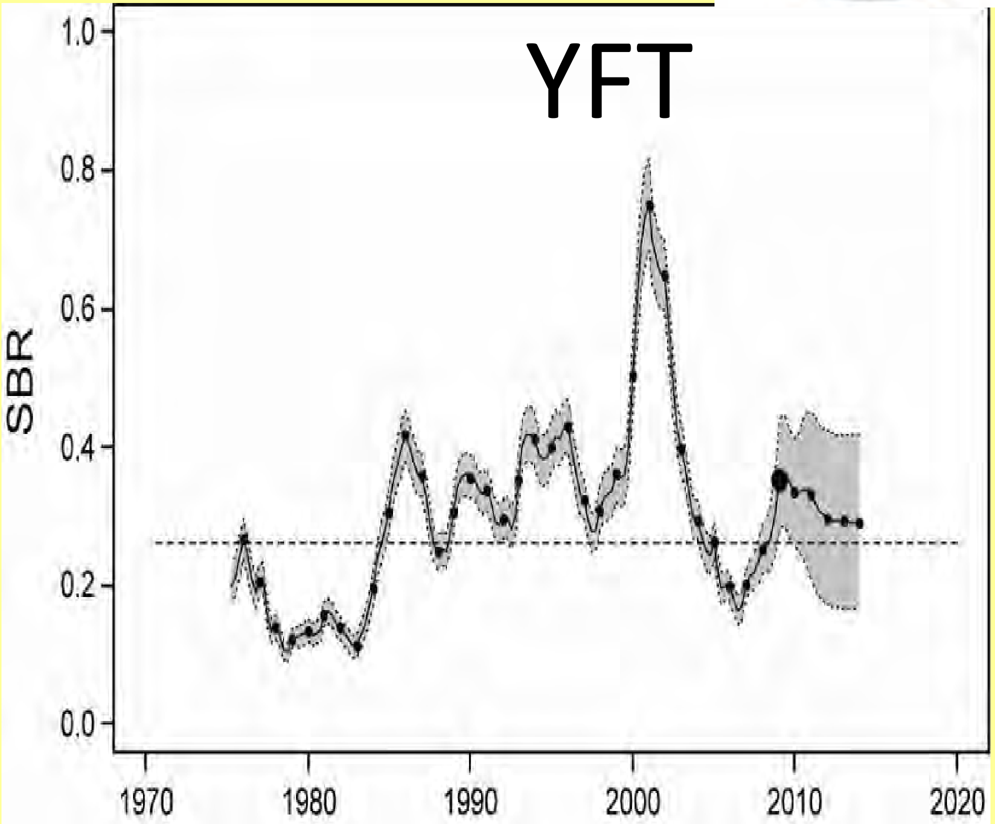


Fig. 5 World tuna catch by species and share
(Source: FAO and RFMO databases)

Spawning biomass ratio (SBR)





- **Under the allocation of effort in 2008, MSY for BET occurs at a spawning biomass level that is 19% of the unexploited level.**
- **The current IATTC recommends reducing both the longline and purse-seine fishing effort proportionally by 20.5% during 2009-2011.**

Landings by Species/Gear in the EPO

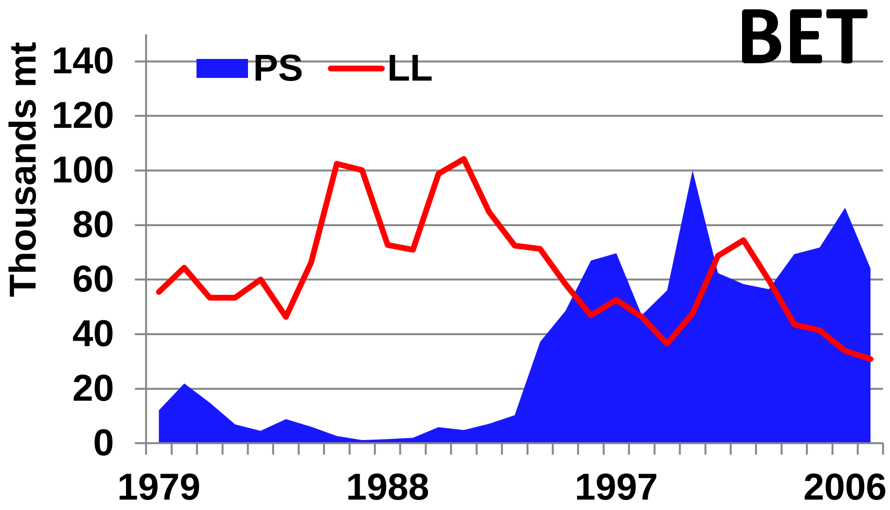


Fig. 2a Catches of BET

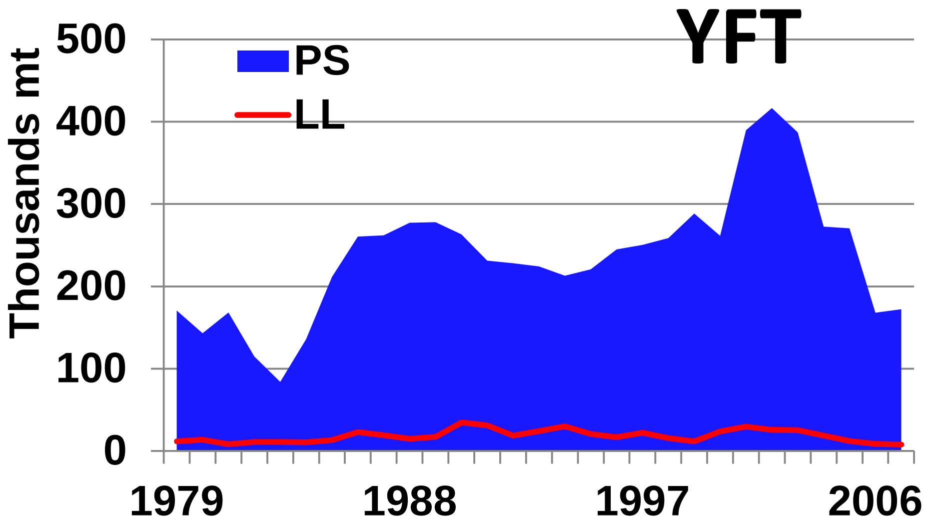


Fig. 3a Catches of YFT

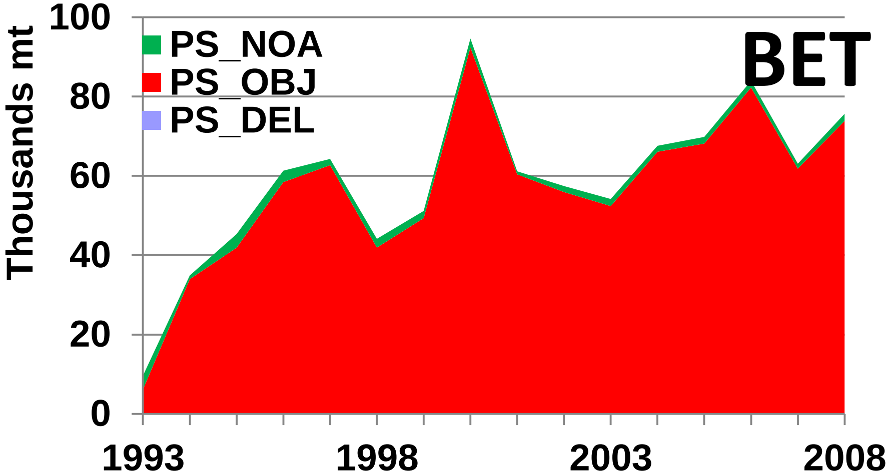


Fig. 2b BET by PS Gears

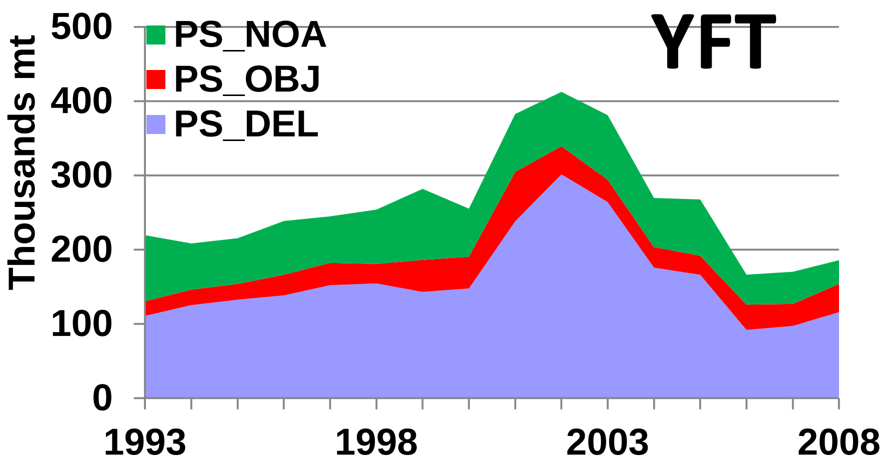
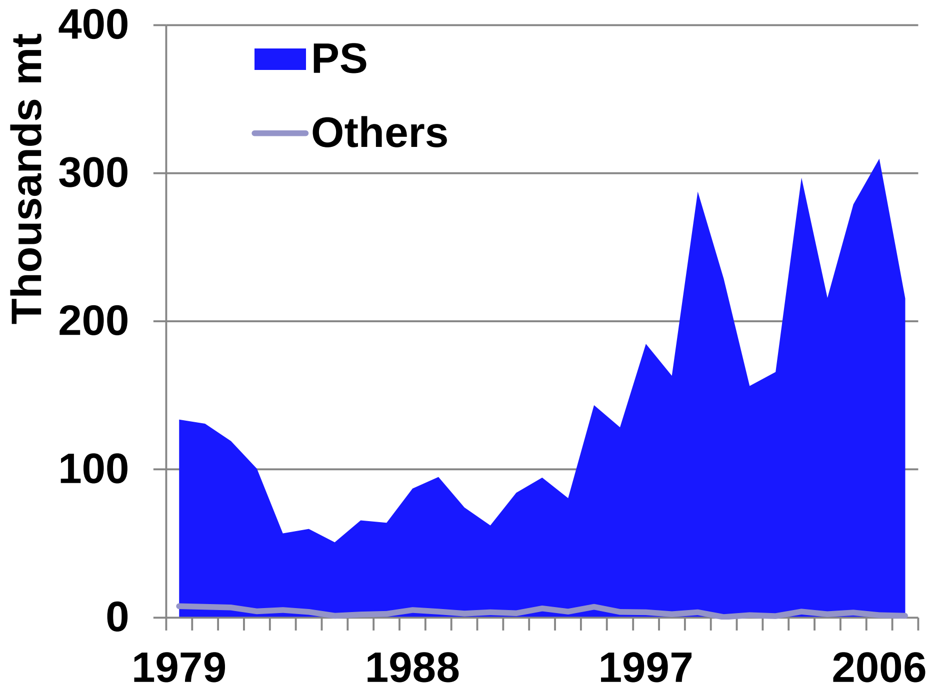
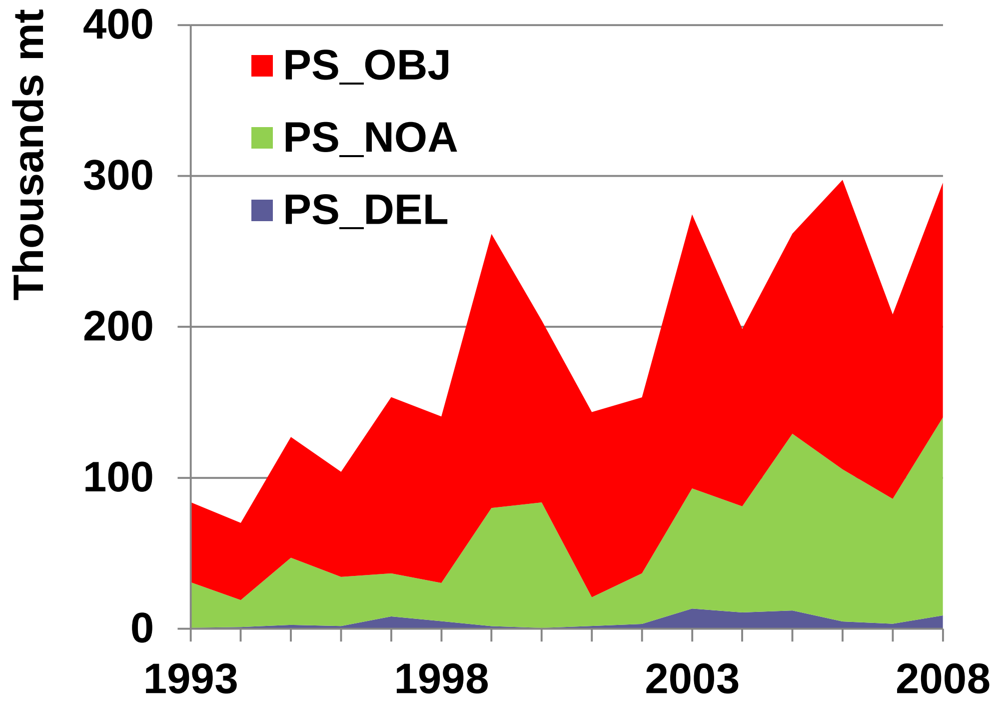


Fig. 3b YFT by PS Gears

SKJ

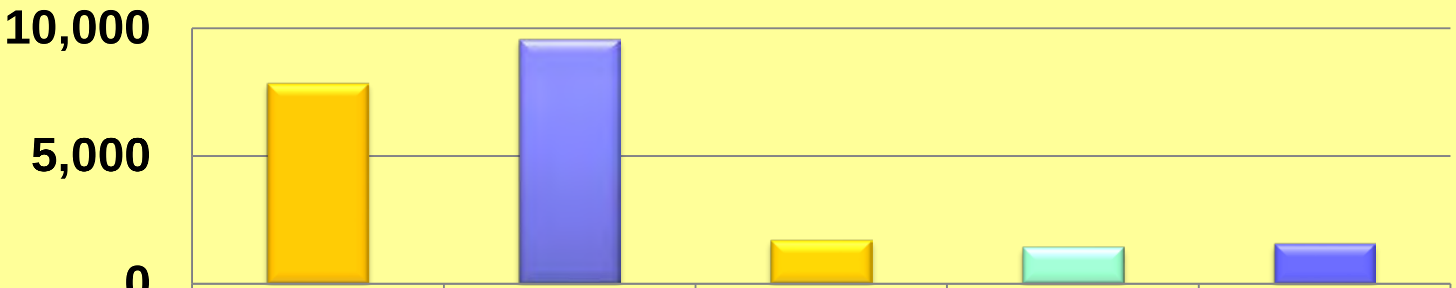


Catches of Skipjack



SKJ Landings by PS in the EPO

Ex-vessel Prices in 2007 (US$/MT)



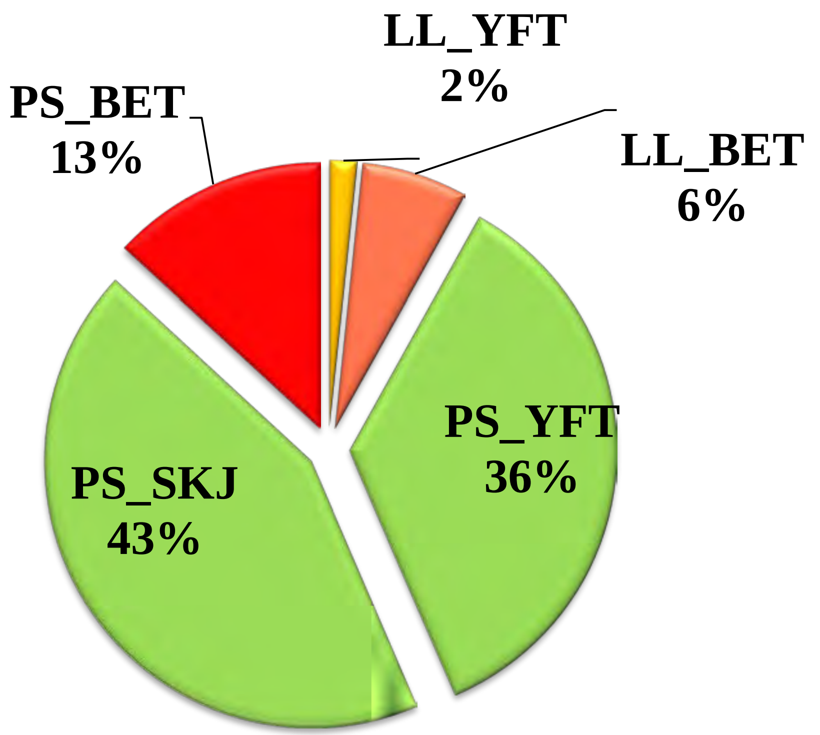
	LL_YFT	LL_BET	PS_YFT	PS_SKJ	PS_BET
Price ($/MT)	7,858	9,576	1,710	1,425	1,568

Both yellowfin and bigeye tuna in EPO are caught at sizes too small to take full advantage of their individual growth and the higher price obtained for large fish in the sashimi market.

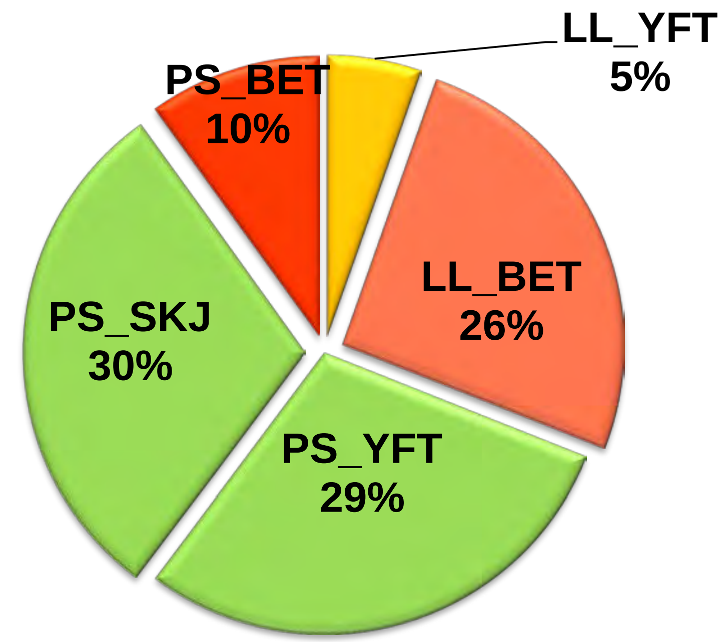
Purse-seine vs Longline

Achieving higher revenue requires an understanding of both economic and biological tradeoffs among different management actions.

Landings & Values by Gear & Species in EPO



Landings (excluding discards) (Total: 480,562 MT)



Revenue (Total: US$ 1 Billion)

Objectives

Three analyses are conducted to evaluate the economic and biological tradeoffs of different levels of purse-seine and longline fishing effort.

1. **Evaluate the different combinations of effort that could produce the target biomass level.**

2. **Simulate combinations of effort that optimize equilibrium (long-term) yield and economic value.**

3. **Measure the dynamic (short-term) effect of different combinations of effort.**

Methods

- **Biological model**

The analyses are based on the IATTC's stock assessments for bigeye (Aires-da-Silva and Maunder, 2010) and yellowfin tuna (Maunder and Aires-da-Silva, 2010).

No reliable assessment is available for skipjack tuna. Therefore, changes in equilibrium yields for skipjack were assumed to be proportional to changes in purse-seine equilibrium yields for yellowfin tuna.

Assumption

- It is assumed that if the catches of small bigeye and yellowfin were reduced, the gains to the biomass of those species due to growth would exceed the losses to it due to natural mortality.

- This would increase the availability of large bigeye and yellowfin to the longline fishery, which, in turn, would increase the total catches of those species, provided there was sufficient fishing effort by longliners.

- It is further assumed that bigeye and yellowfin are well mixed within the EPO, in which case reductions in the catches of small tunas anywhere in the EPO would be beneficial to longliners operating anywhere in the EPO.

Methods

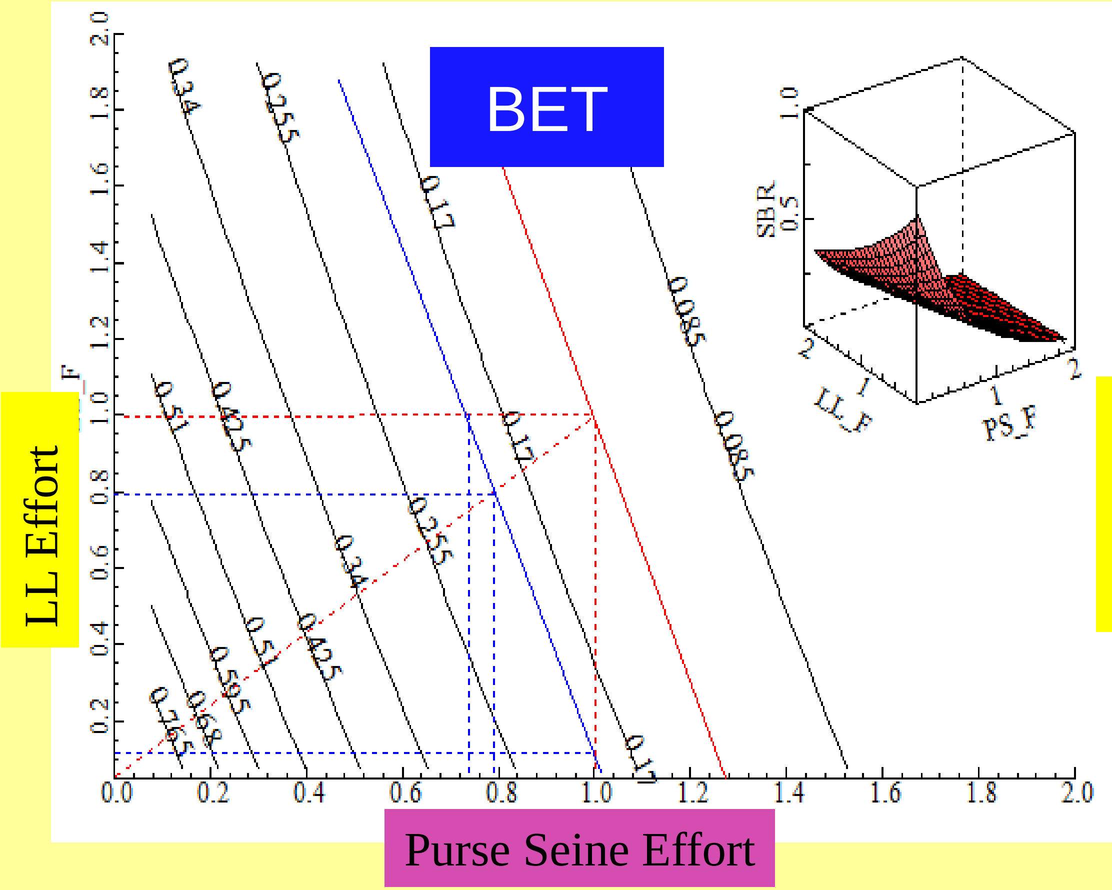
- **Economic value**

The economic value was simply calculated by summing the ex-vessel prices multiplied by the total landings for each of the three species and each gear. In the dynamic calculations, the value is summed over all projected years.

- **Equilibrium value**

The stock assessment models for bigeye and yellowfin tuna is used to calculate the SBR, catch, and economic value of the fisheries for different levels of longline and purse-seine fishing effort in a steady state. A large number of simulations in effort combinations are used to analyze the tradeoff.

Spawning Biomass Ratio (SBR)



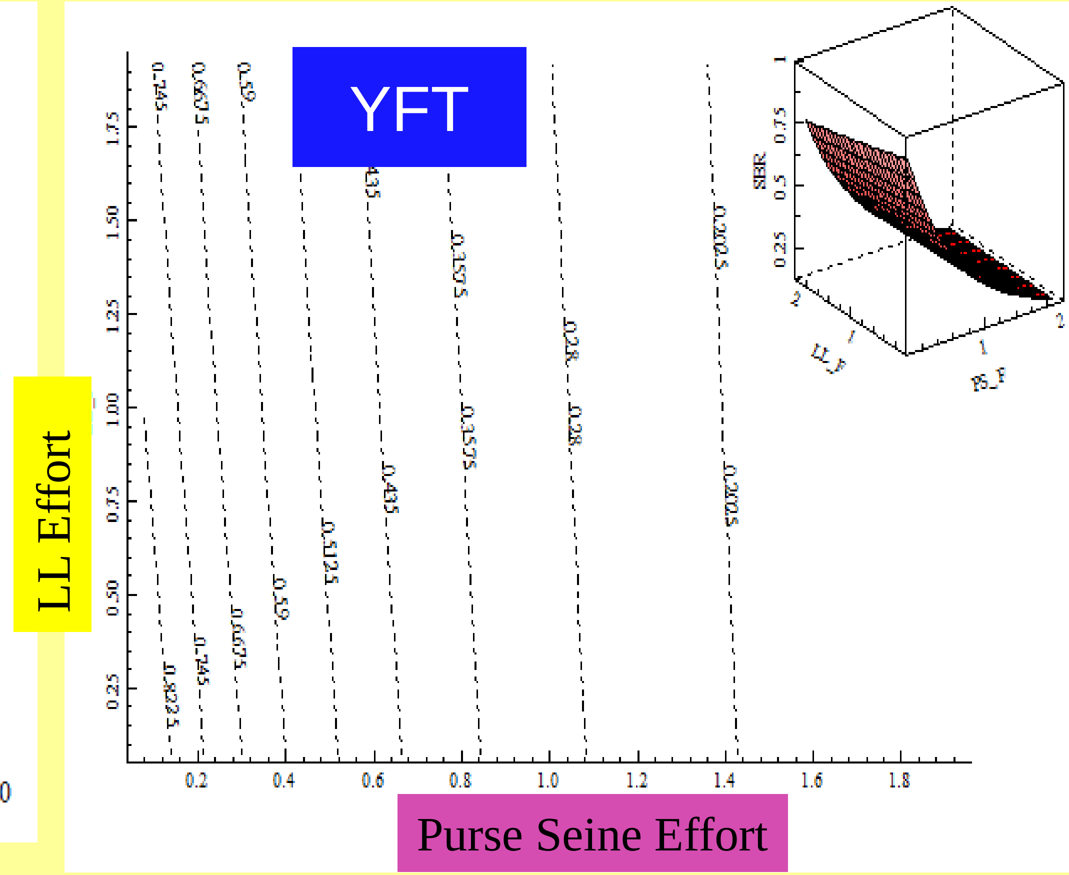


Figure 1&2 Surface and contour plot of equilibrium bigeye and yellowfin tuna spawning biomass ratio (SBR) under different PS and LL effort levels relative to effort levels in 2008

Four Scenarios: SBR of BET

**A) Standardized LL&PS Effort in 2008;
(PS=1, LL=1)**

**B) 20.5% equal proportional reduction in LL and PS,
(PS=0.795, LL=0.795)**

**C) Fixed LL effort and a 16.3% reduction in PS
(PS=0.737, LL=1)**

**D) Fixed PS effort and a 86.7%reduction in LL,
(PS=1, LL=0.133)**

Equilibrium Catches and Values

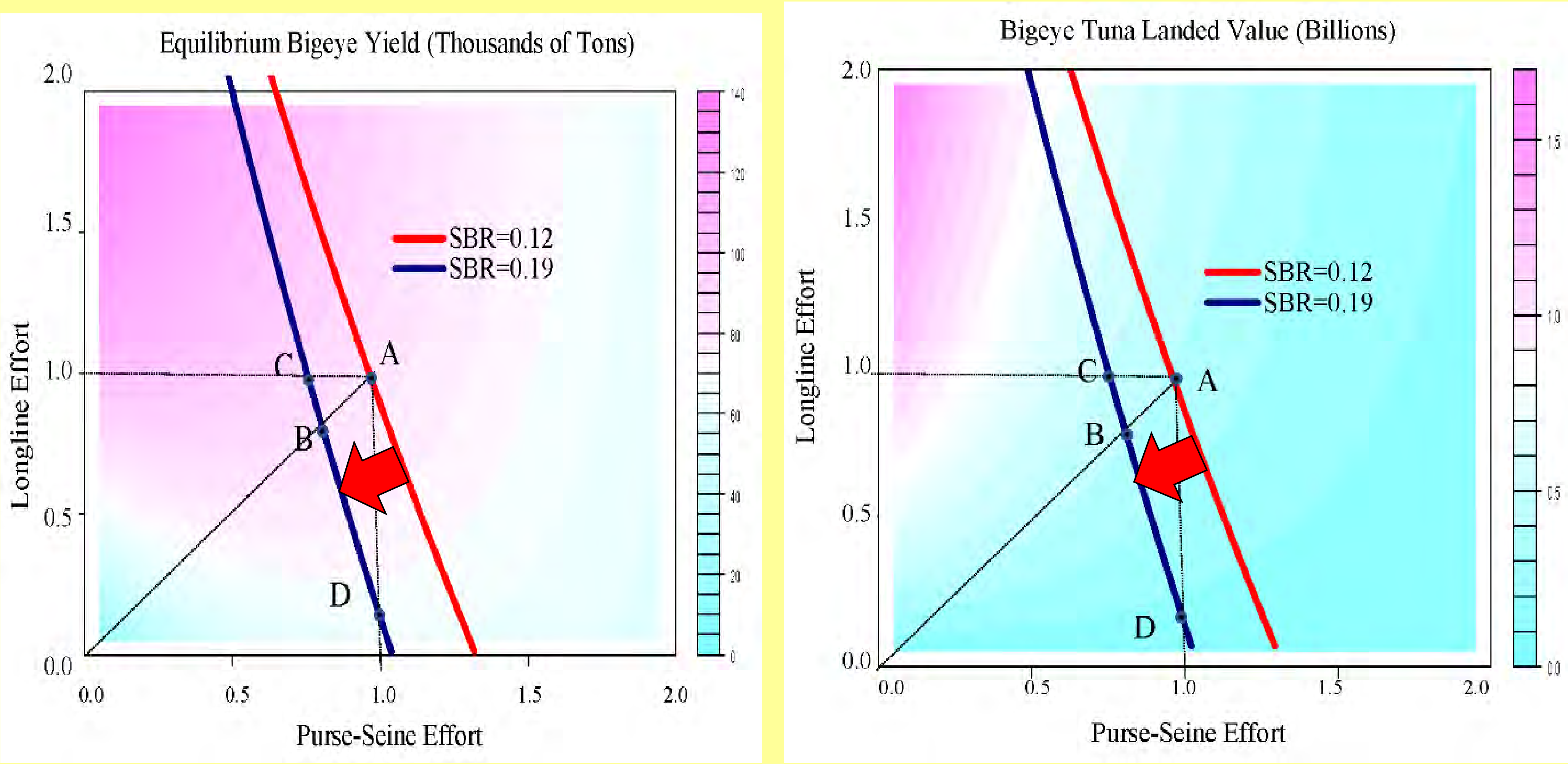


Fig. 2a&3a Contour plot of BET steady-state catches and value

Changes in landings Value (Billion US$)

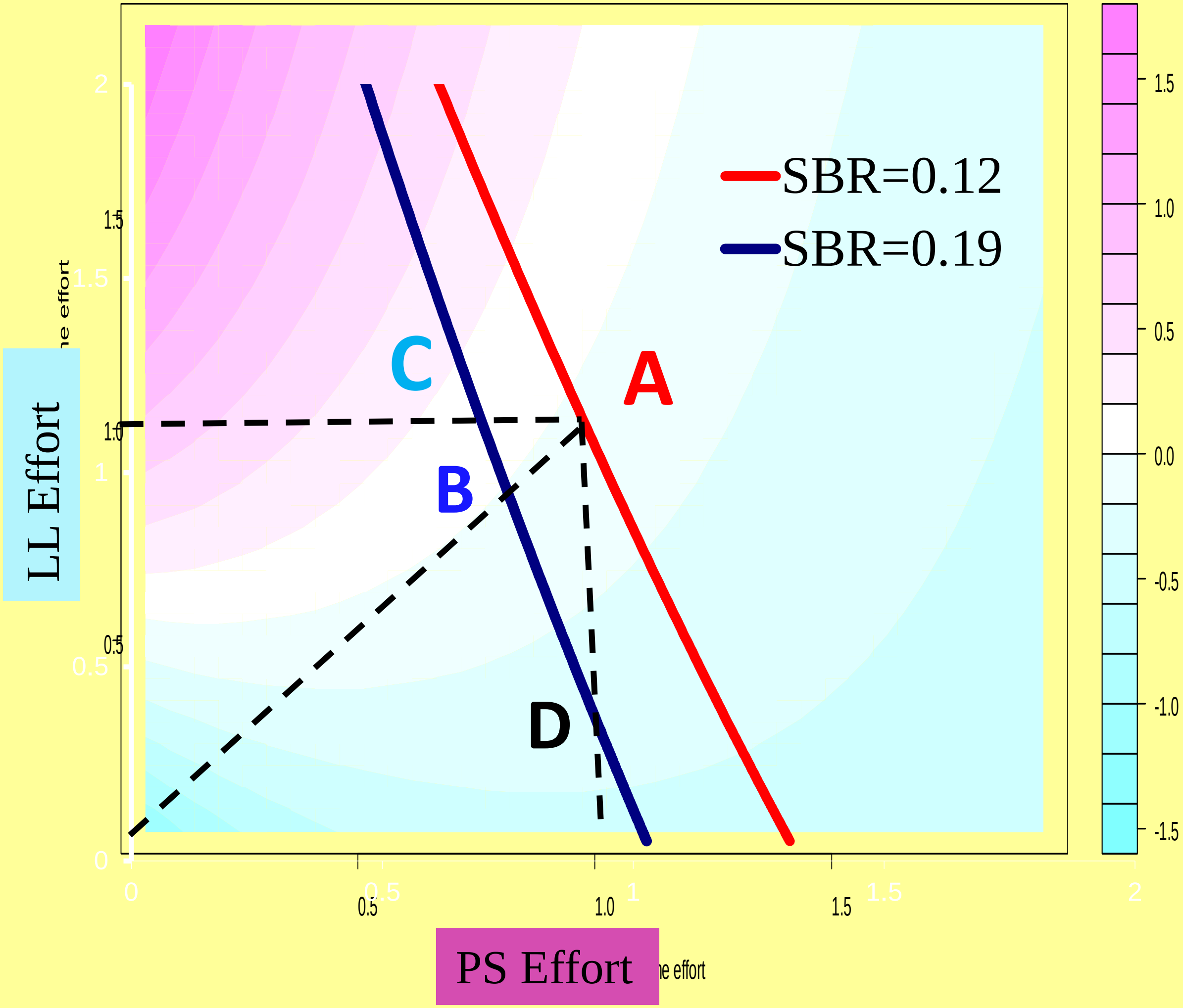


Figure 3 The Change in total landings values of the EPO

1% reduction in PS effort associated with floating objects (roughly 84 sets) would

- ✓ **reduce the PS catch by 301 tons,**
- ✓ **allows a 1,170-ton increase in the LL catch**
- ✓ **increase the total revenue by $10.74 millionc of LL after compensating for the loss of catches by the PS.**

Table 1 LL and PS Landings and Value under BET SBR = 0.19

Fishery Species Scenario*	Retained Catches LL (1,000 mt)	Retained Catches PS (1,000 mt)	Revenue LL (mil. $)	Changes to Case B (mil. $)	PS (mil. $)	Changes to Case B (mil. $)	Total (mil. $)	Changes to Case B (mil. $)
All Tuna								
Case A	42	532	366		838		1203	
Case B	49	514	436	**Base**	810	**Base**	1246	**Base**
Case C	63	500	551	115	788	-22	1339	93
Case D	7	551	65	-371	869	59	934	-311

For the purse-seiners, there are $22 million loss, however there is a net gain of $94 million revenue in total.

<u>In addition, the purse-seine fleet would not have any costs of fishing so the benefit to them would be higher.</u>

Tradeoff Under Target SBR of Bigeye Tuna

✓ One ton of BET not caught by the PS:

1. $1,540 loss in PS

2. $36,878 gain in LL revenue.

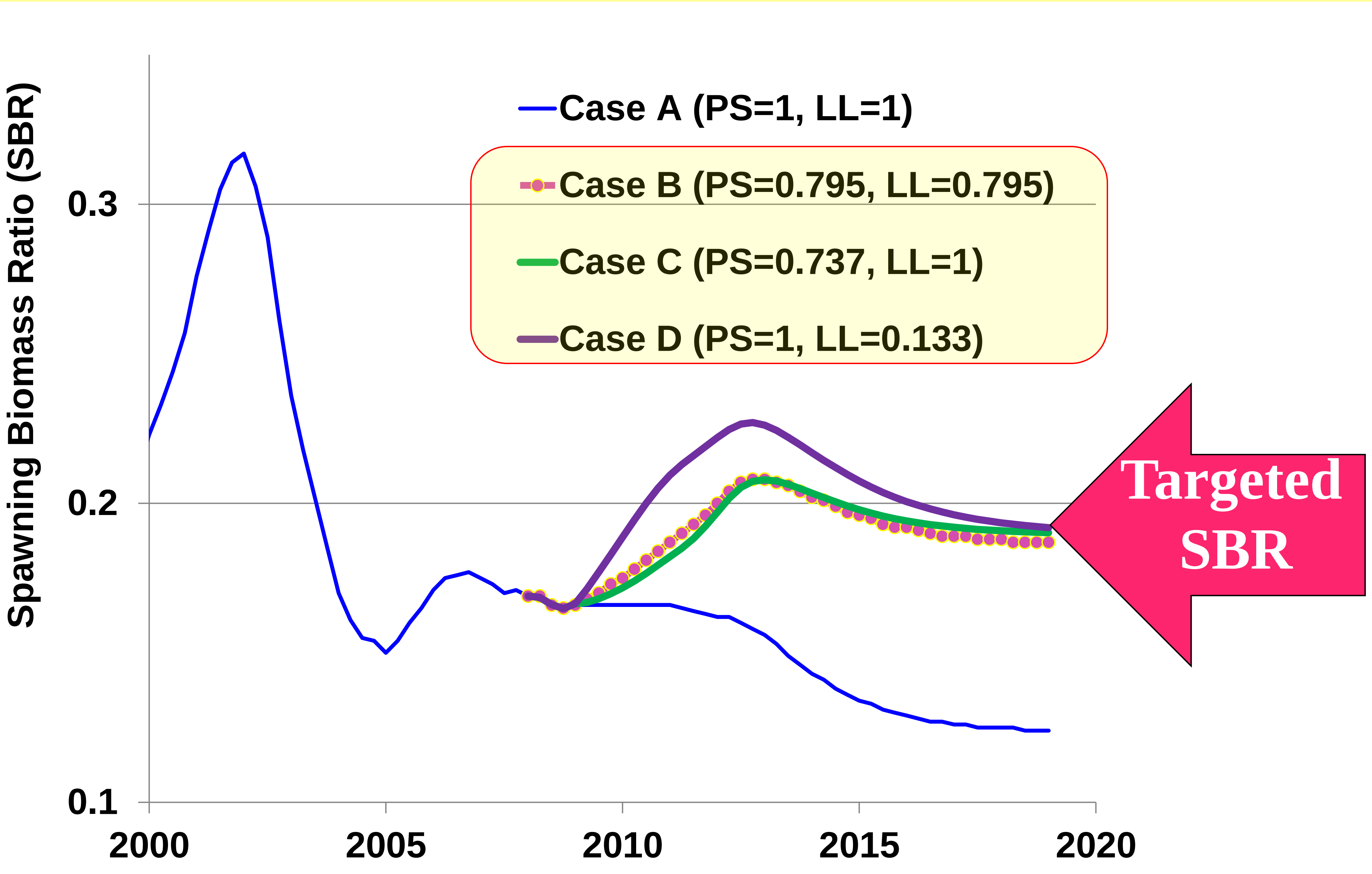
3. after providing $1,540 compensation to the loss of PS's BET landings value,

4. the total BET landings value would increase to $35,340.

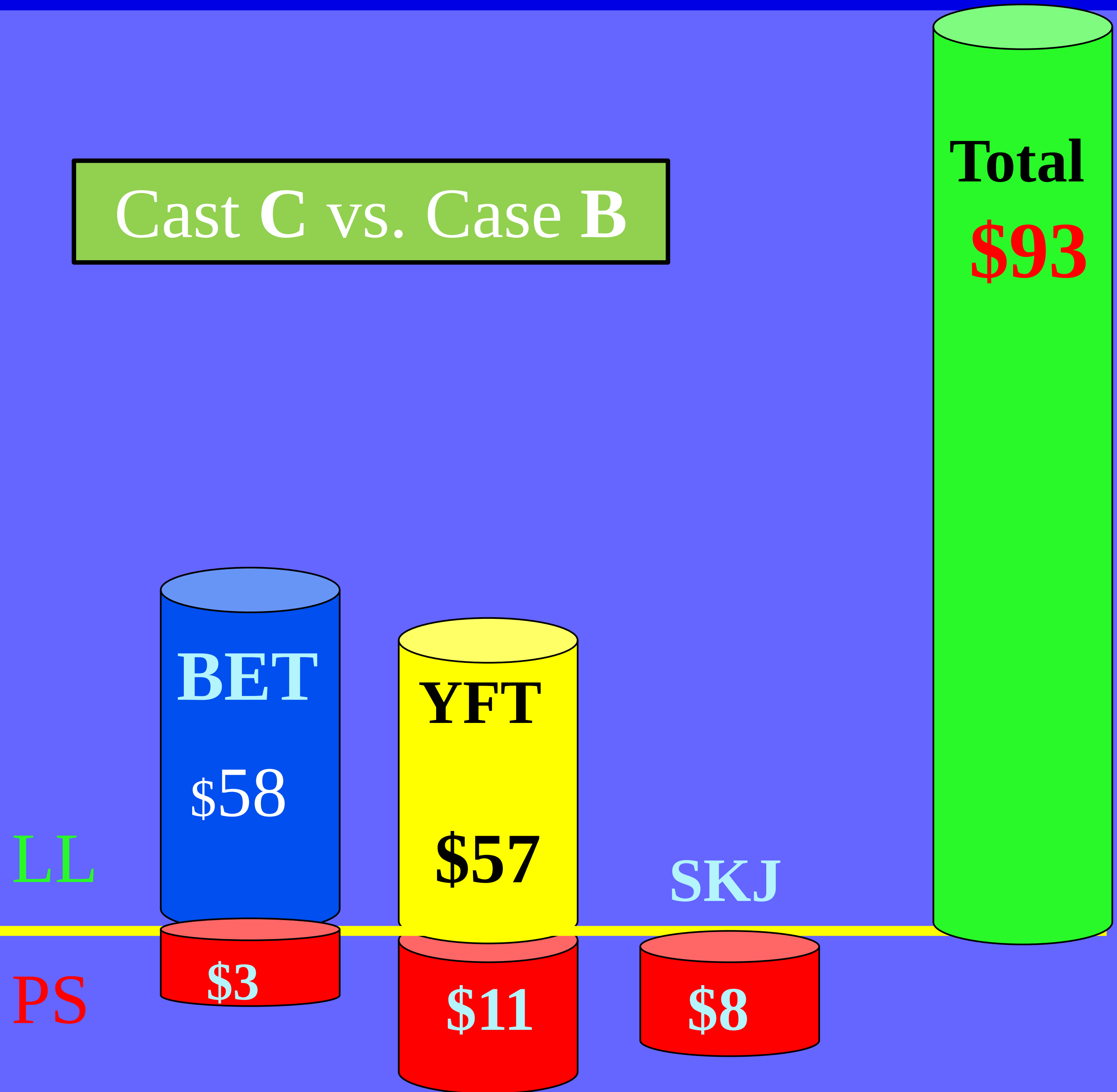
✓ 1% reduction in PS effort associated with FOB (roughly 84 sets):

1. reduce the PS catch by 301 tons,
2. allows a 1,170-ton increase in the LL catch, and
3. increase the total revenue by $10.74 million after compensating for the loss of catches by the PS.

Dynamic projections of SBR of bigeye tuna



Net Benefits: Case C vs. Case B



Reach the targeted SBR_{BET} = 19%

Net Gain

= $93 million

Conclusion and Discussion

We have shown that the economic value of the resource is highly dependent on the allocation of effort between the LL and PS fisheries.

Management objectives differ among resource users, and there are a multitude of factors that need to be considered.

1). Property rights

2). Compensation

3). Bycatch compensation

4). Vessel buybacks

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