



Economic challenges of the mitigation measures

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Introduction. Contents.

- Economic impacts of different mitigation measures will be studied.
 - The EBAB for LL French in La Reunión and;
 - the Ecological FADs on PS IO French and Spanish fleets.
- Methodology:
 - Risk analysis for analysing the EBAB for LL
 - Multiple methodologies for the FS-FADs-ecological FADs for PS IO
 - Mutivariate analysis.
 - Econometric techniques.
 - Multicriteria sustainability analysis.
 - Real Options valuation.

ECONOMIC IMPACT OF EBAB ON LL FRENCH FLEET IN LA REUNION*



Context = Non-profitability +
increasing cost of natural bait
in La Réunion:

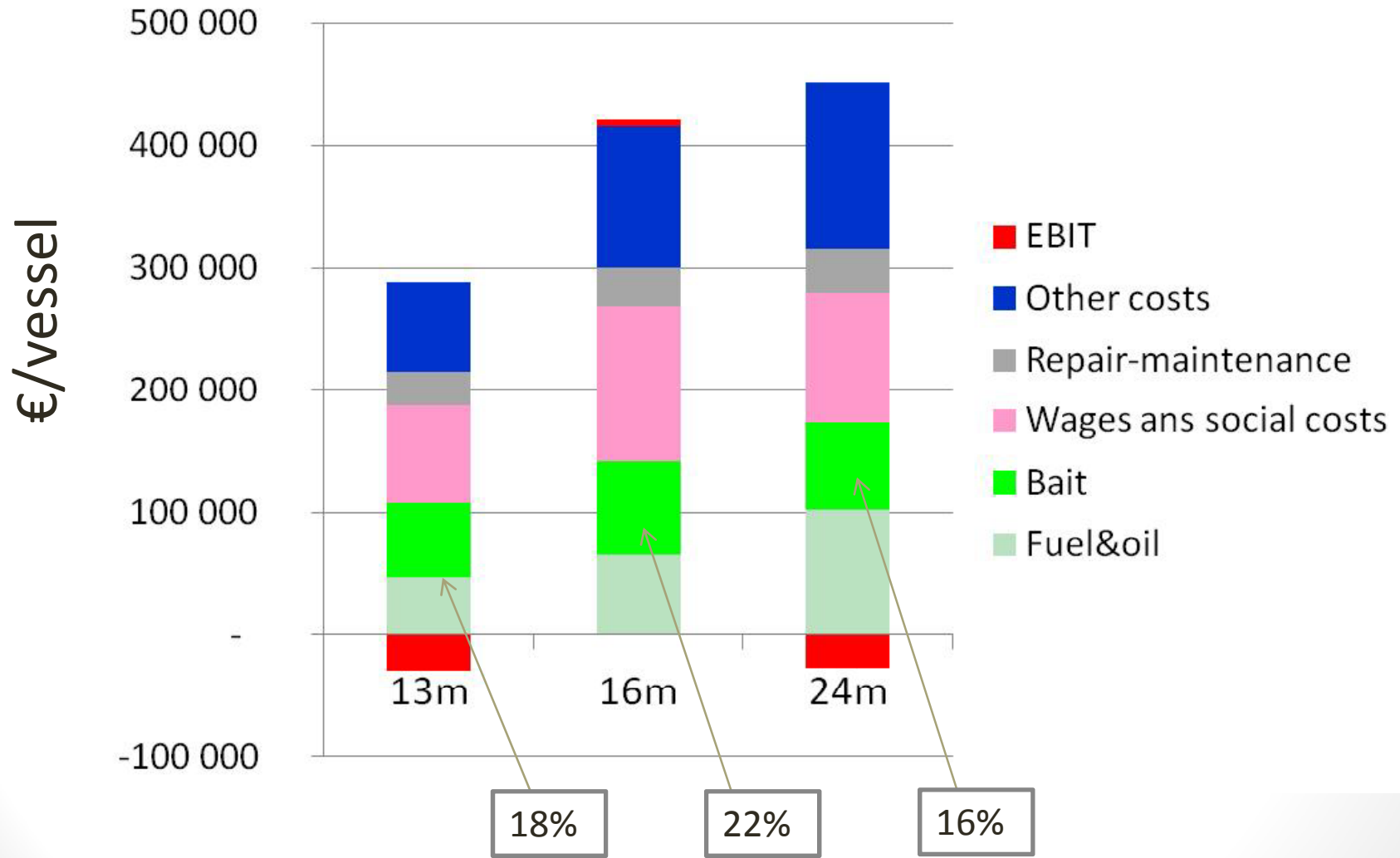
2008 : 1.44 €/kg

2010 : 1.66 €/kg

2012 : 2.40 €/kg

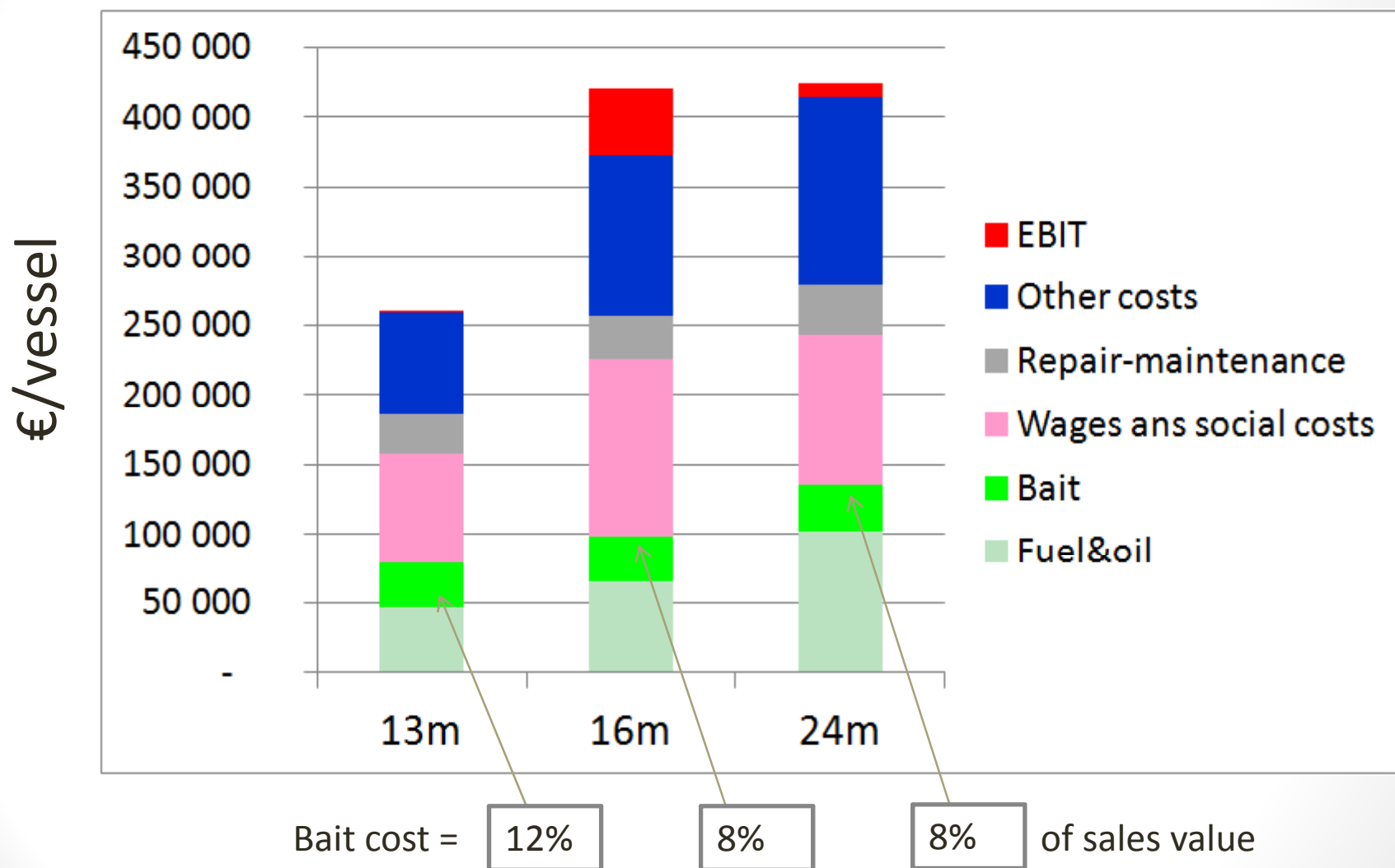
* Special thanks to Pascal BACH for the EBAB Data!

Costs of the French LL fleet La Réunion with natural bait (2010)



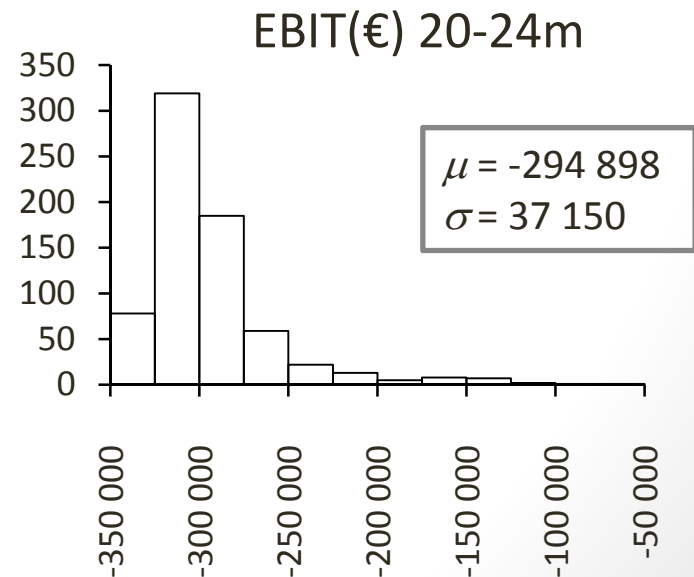
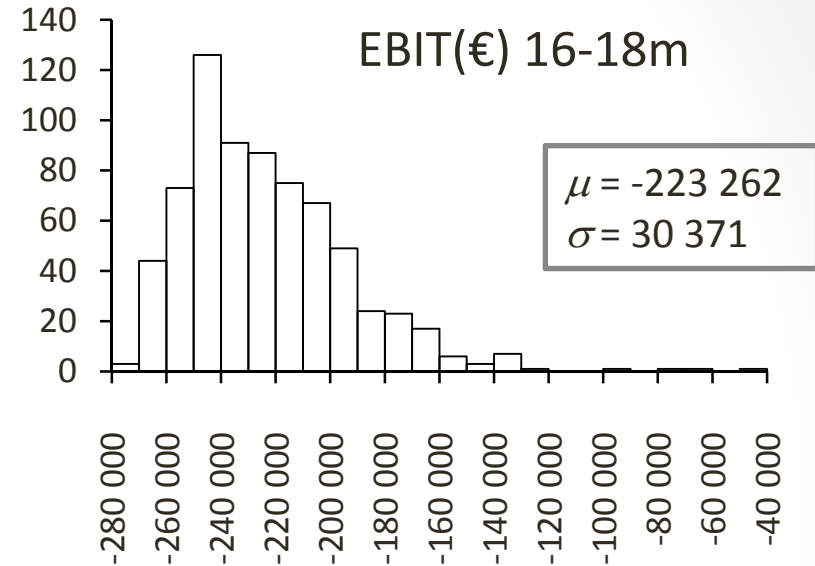
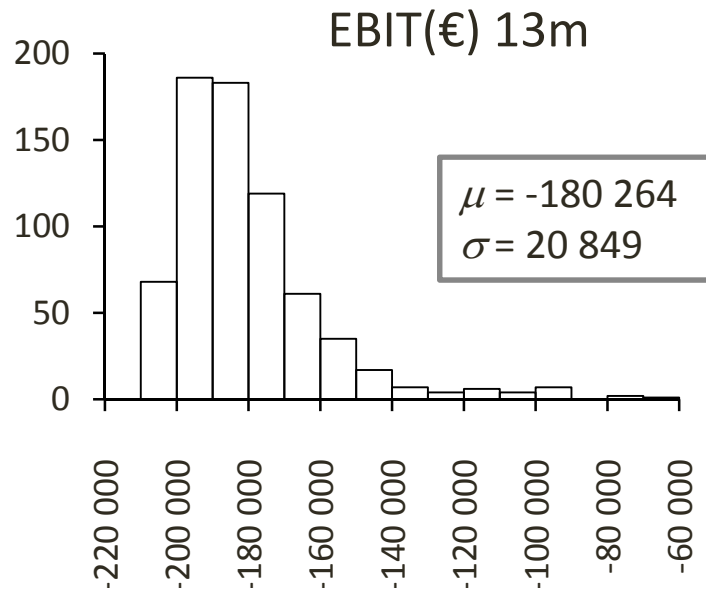
Source: LEMNA-RICEP, from shipowners data in La Réunion

Costs of the French LL fleet La Réunion with EBAB and same CPUE (2010)



Source: LEMNA-RICEP, from shipowners data in La Réunion

Risk analysis (Monte Carlo 700 trials) with EBAB catch yields obtained from the first experimental tests



Ratio CPUE natural bait/EBAB	SPECIES
[1 – 28]	SWF
[1 – 3.2]	YFT
[1 – 8.0]	ALB
[1 – 7.2]	BET
[1 – 1.5]	SAILFISH
[1 – 1.5]	OTHERS

ECONOMIC IMPACT OF ECOLOGICAL FADs ON PS IO FLEETS



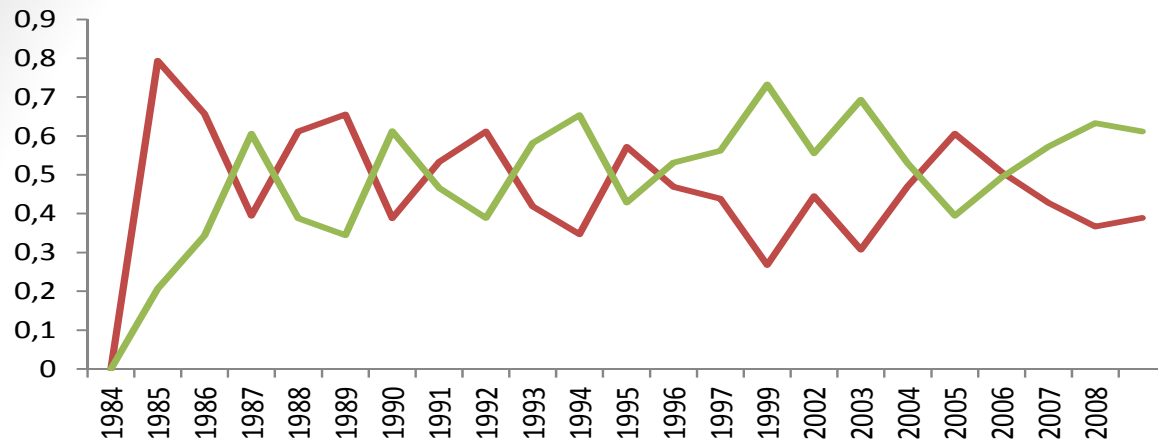
**Cost of an ecological FAD (without buoy) ~ 50€
= €10,000 for 200 FADs = 0.11% of average
sales revenue in 2010!**

Context = threat on FAD-caught tuna:

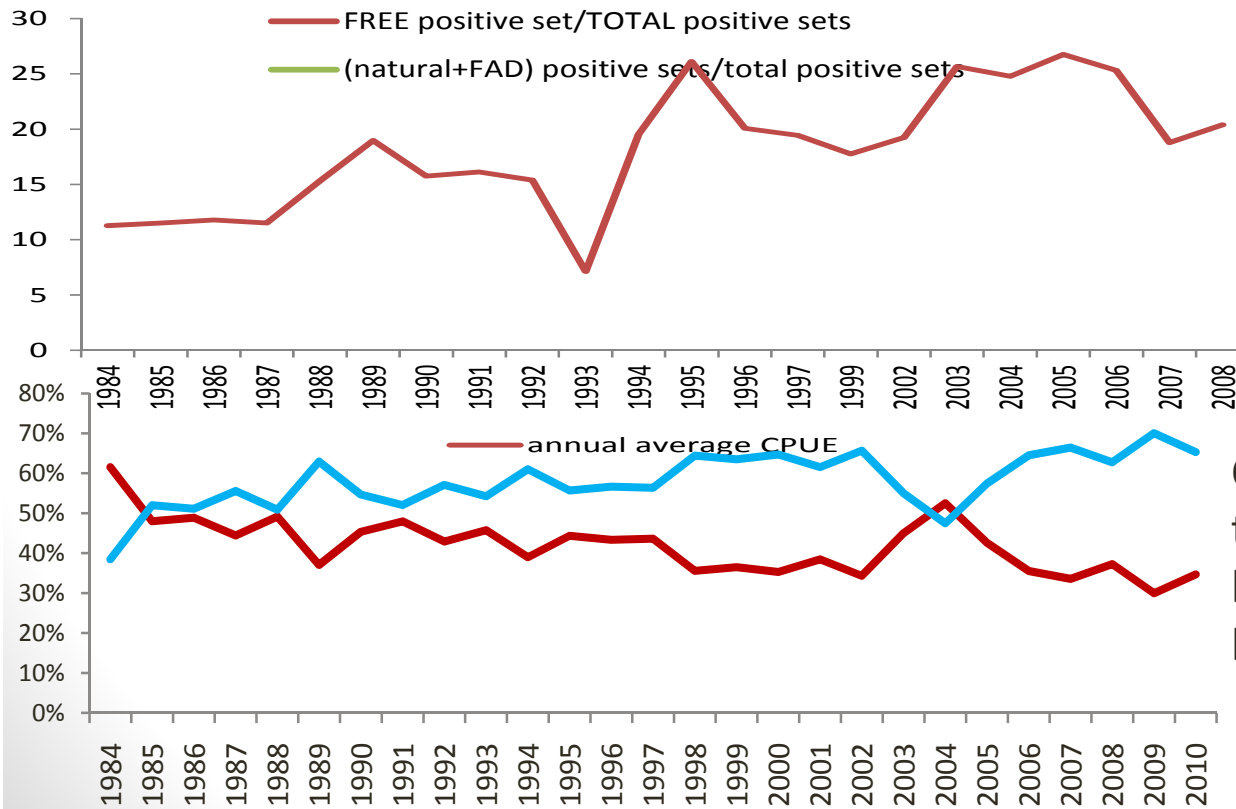
Ban of FAD tuna by UK retailers
MSC label on a FAD-free fishery (PNA)



Spanish PS- fishing activity description



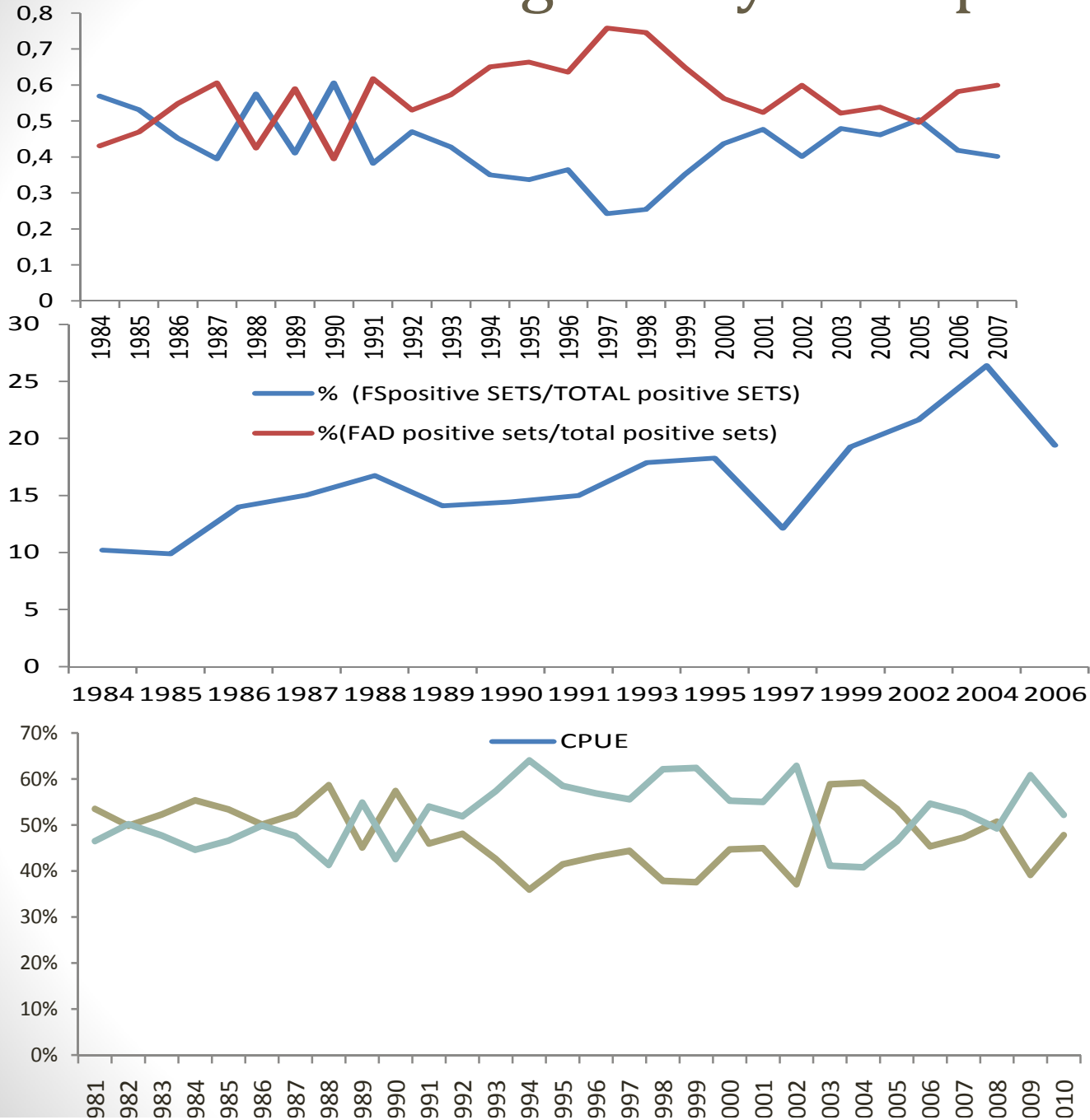
Intensive use of FADs introduced in the early 1990s.



CPUE is higher after FAD introduction

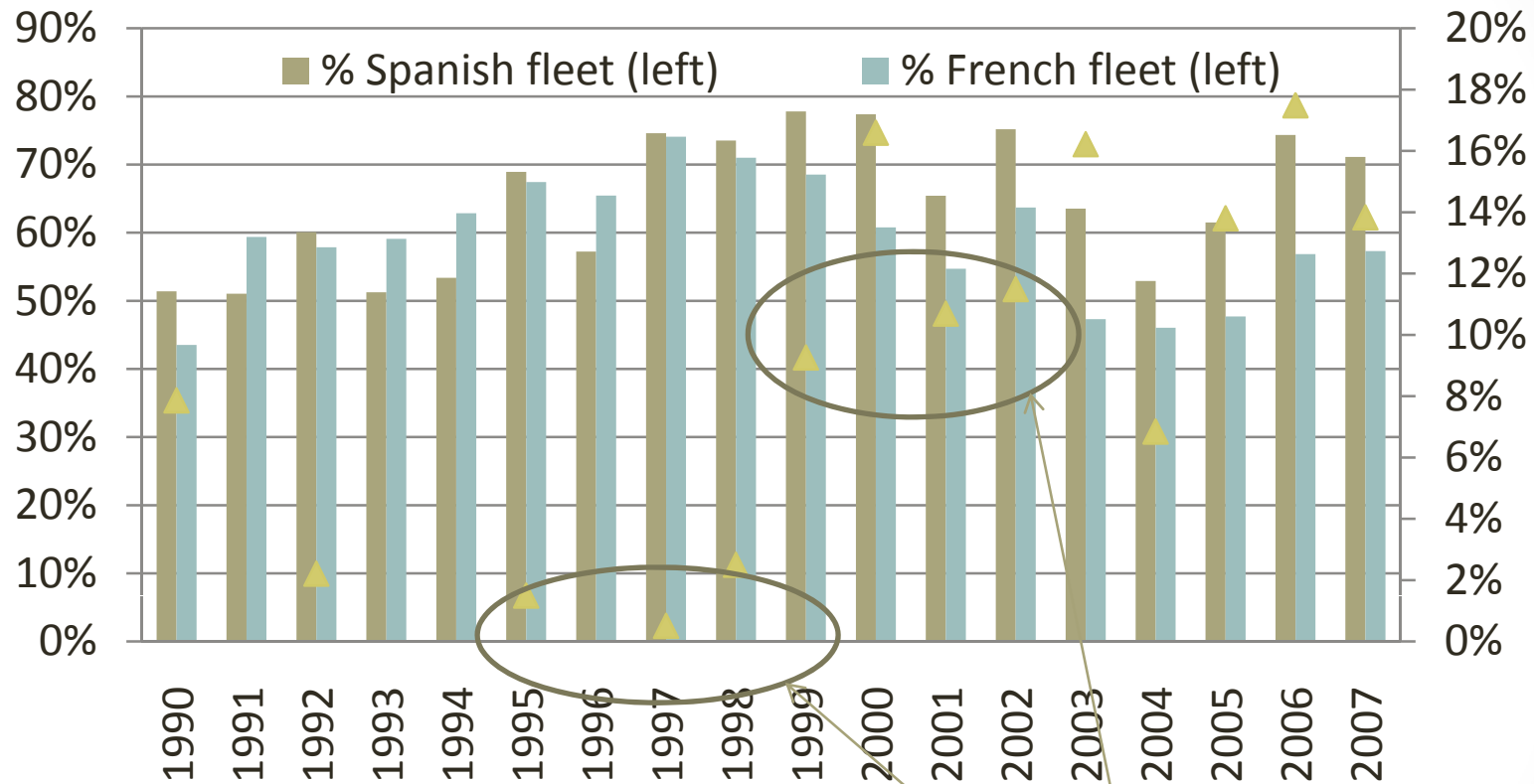
Catch composition remains the same: in general, harvesting the species with lower value.

French PS- fishing activity description



Catch composition. Slightly different from the Spanish fleet strategy. Although, both fleet seem to be oriented to the less valuable species.

Average proportion of FAD tonnage over total tonnage for the French and Spanish PS fleets in the Indian Ocean (1990-2007)



Source: IOTC and Observatoire Thonier-IRD

Shift in 1999

OLS and fixed effects estimates of log tuna catches (1985-2007)

Variables	ALL FLEETS	By flag	
	(1)	(2)	(3)
		FRENCH	SPANISH
Days at sea (ln)	0.344*** (7.17)	0.174*** (3.33)	0.364*** (3.45)
Positive sets on FADs (ln)	0.390*** (16.14)	0.439*** (17.25)	0.355*** (6.83)
Positive sets on FSS (ln)	0.295*** (13.46)	0.437*** (18.00)	0.126*** (2.89)
Intercept	3.541*** (20.58)	3.733*** (21.76)	4.286*** (8.48)
Year fixed effects	YES	YES	YES
FRENCH (SPANISH=REF)	0.024** (2.04)		
Number of observations	651	471	180
F-stat (Prob)	123.76 (0.000)	165.41 (0.000)	25.28 (0.000)
R ²	0.838	0.903	0.780

Source: data from Observatoire Thonier-IRD and AZTI, authors' calculations.

Note: robust standard errors are in parentheses. Significance levels are respectively 1% (***), 5% (**) and 10% (*).

Descriptive statistics between French and Spanish fleets

	FRENCH	SPANISH
% FAD Tonnage 1990-1998	62%	60%
% FAD Tonnage 1999-2007	56%	69%
% positive sets/total sets 1990-2007	70%	56%
% tonnage YFT 1990-98	34%	43%
% Tonnage YFT 1999-07	41%	38%

Simulation of the impact of an effort transfer from FAD to FSS on total catches (from OLS model) = Severe loss...

	FRENCH	SPANISH
-50 % FAD / +50% FSS	-12%	-18%
-75% FAD / +75% FSS	-31%	-34%
-90% FAD / +100% FSS	-51%	-52%

... compensated by a higher catch value due to the greater proportion of large YFT under FSS

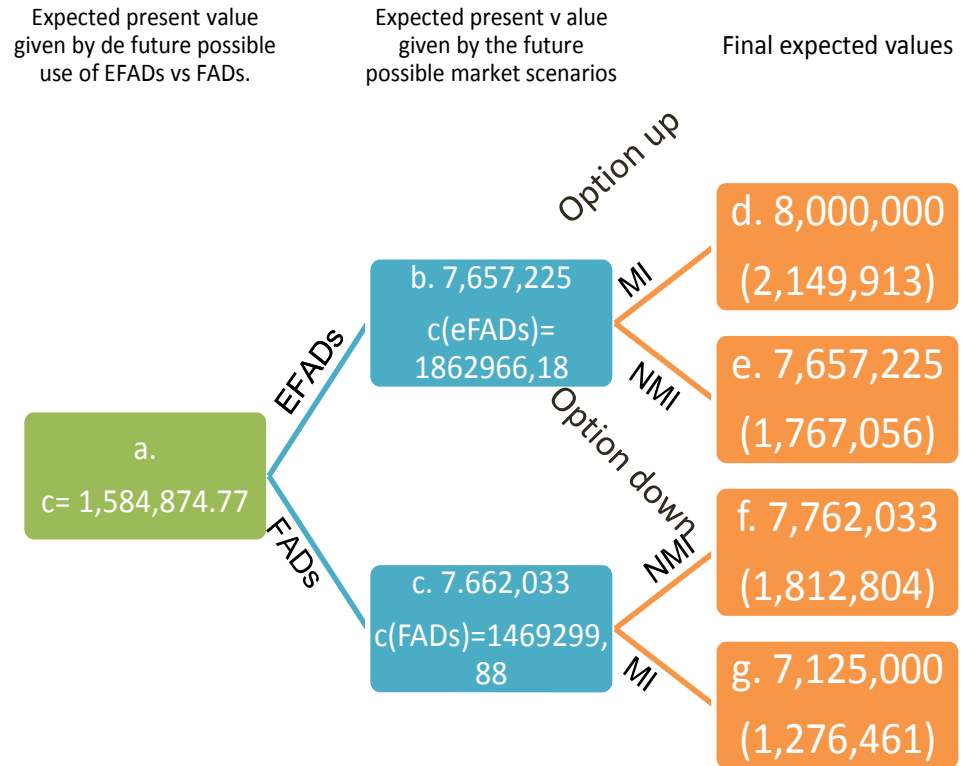
Ecological FADs – Standard FADs - FSS

(expected scenarios – expected value)

- Ecological FADs.
 - Impact on cost structure (MADE project results, 2012)
 - Non important impact on costs in the case of the French fleet (~ 50€). small difference for the Basque fleet: Cost of an ecological FAD (without buoy) ~ 120€ - Cost of a standard FAD (without buoy) ~ 30€.
 - There are not avoided costs.
 - Opportunities for producers if labeling (FAO, 2008)
 - Price premiums (not clear impact on prices?) (MSC +14%; Roheim et al. 2011).
 - Expansion of market share in existing markets, particularly after a demand shock.
 - A label (such as dolphin–safe) can only slightly restore the lost tuna market share (Teisl et al., 2002).
 - Certification costs? (e.g. MSC, advertising campaign...)
 - Labeling affect consumer behavior and market (Teisl et al., 2002):
 - Impact may not be felt instantaneously – (awareness of consumers).
- Standard FADs
 - Opportunity costs of decreasing market share.

PS- Real Option Value I (binomial tree, Cox, Ross and Rubinstein 1979)

- ✓ Fishing uncertainty and also Market uncertainty adds value.
- ✓ Not catch composition difference between EcoFAD and FAD.
- ✓ The Expected Net Present Value (ENPV) attached to the EcoFADs strategy could be higher than the standard FAD Strategy ENPV.
- ✓ Temporal effect: $c(eFADs)$ can be reduced around 8%-10% if consumers lack confidence in the eFADs effect or the market share remains the same after using EcoFADs.

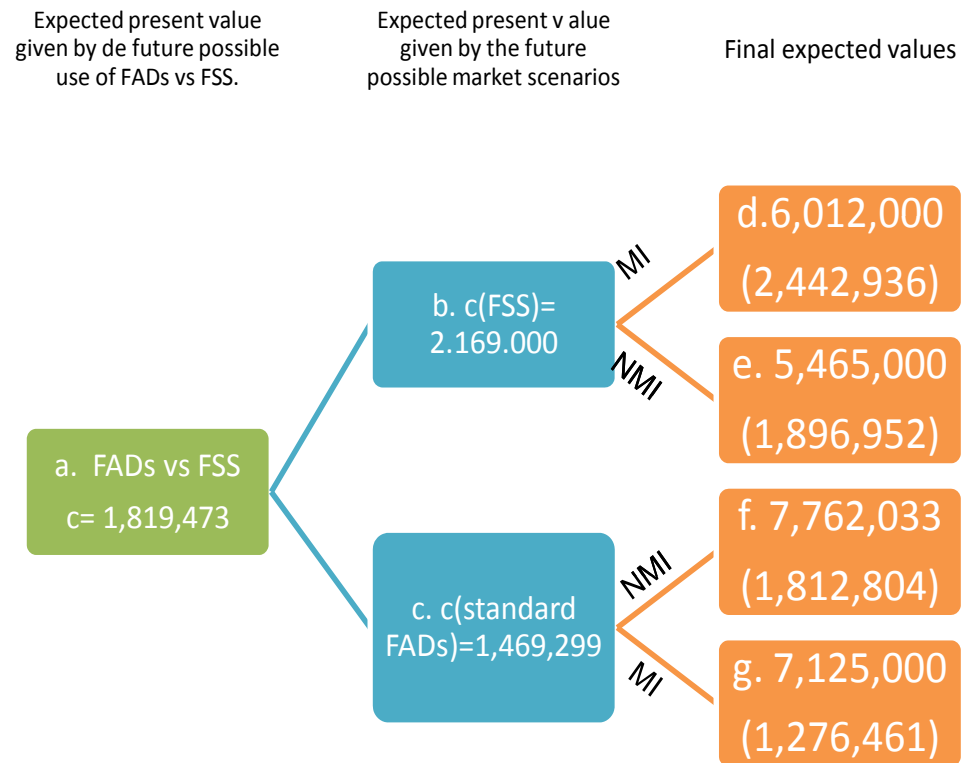


r% (risk-free interest rate)	0,05
Exponential discount	0,95122942
Market probability	0,5
1- Market Probability	0,5

Risk-neutral valuation

PS- Real Option Value II (binomial tree)

- ✓ Effort transfer from FADs to FS could be positive (in economic terms) if catch composition is modified.
- ✓ That is, harvesting more YFT (higher catch value) in a strategy context with lower amount of catches.
- ✓ The Expected Net Present Value (ENPV) attached to the FADs strategy could be lower than the FSS Strategy ENPV.
- ✓ if there is not effort transfer then ENPV (FS) is lower than the ENPV (FADs).



r% (risk-free interest ra	0,05
Exponential discount	0,95122942
Market probability	0,5
1- Market Probability	0,5

Risk-neutral valuation

PS- Real Option Value (Scholes (1973) and Merton (1973))

$$\text{Option value} = \{S(t)e^{-kj} N(d_{1j}) - C(T)e^{-rj} N(d_{2j})\};$$

Where:

$$d_{1j} = \frac{\ln(S / Cte) + (r - k + \frac{\sigma^2}{2})j}{\sigma\sqrt{j}};$$

$$d_{2j} = \frac{\ln(S / Cte) + (r - k - \frac{\sigma^2}{2})j}{\sigma\sqrt{j}} = d_{1j} - \sigma\sqrt{j}.$$

$N(\cdot)$: Cumulated distribution function for a normal variable

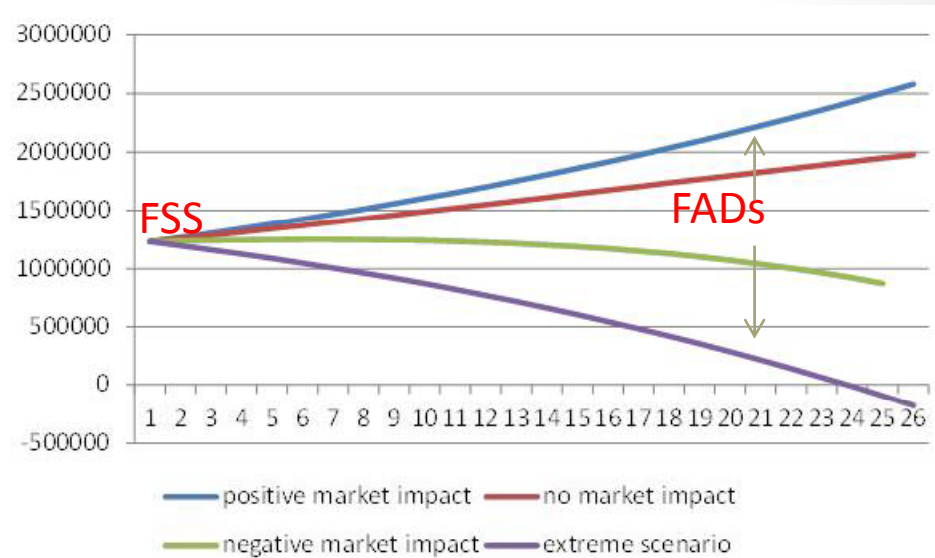


Table. Strategy decision based on the option value without uncertainty

Scenario	FS/FADs	Exercise Price = cost	Revenue	α / β	Revenue	Option value	
S1	FS	3,079,033	4,226,941			1,231,613	
S2	MI FADs	5,849,229	7,662,033*	$\alpha (-)$	0.07	7,125,690	1,276,427
					0.02	7,508,792	1,659,563
	NMI FADs	5,849,229	7,662,033			1,812,804	
S3	MI EFADs	5,890,173	7,657,225*	$\beta (+)$	0.02	7,810,370	1,920,196
					0.05	8,040,086	2,149,913
	NMI EFADs	5,890,173	7,657,225			1,767,053	

(*) based on average values

- ✓ Previous binomial tree provides a discrete time approximation to the continuous process underlying the Black-Scholes model.
- ✓ B&S: The EcoFADs ENPV could be lower than Standard FAD ENPV without market impacts.

Conclusions

- ✓ The cost-benefit analysis of mitigation measures (MM) is very different according to the fishery and MM considered. For FADs, what matters is the opportunity cost of NOT DOING anything (in terms of market loss).
- ✓ The introduction of FADs in the early 1990s has strongly increased the level of effort and catches of the purse-seine fleet in the Indian Ocean, especially for the Spanish fleet compared to the French fleet.
- ✓ Differences between both fleets in terms of total FAD tonnages have significantly increased after 1999.
- ✓ The econometric analysis confirms that the Spanish fleet strategy is clearly more FAD-oriented than the French fleet strategy.
- ✓ Option value or the expected value related to the different fishing strategies: EcoFAD, standard FAD and FSS depends on the risk-neutral probabilities of the fishing strategies and market impacts. $ENPV\text{-EcoFADs} > ENPV\text{-standard FADs}$ and $ENPV\text{-FSS} > ENPV\text{-FADs}$.



Thanks

