

1. Introduction

The North Atlantic albacore (*Thunnus alalunga*) stock is assessed using a virtual population analysis (VPA) tuned by several abundance indices, which are trolling and longline CPUE series. During the 2000 stock assessment session, it was noticed that one of these indices – the age 2 Spanish trolling CPUE series – was bringing contradictory information against the others (ICCAT, 2001).

Besides, the 1996 ICCAT Symposium in the Azores underlined the necessity of research about relationships between tuna fisheries and the variability of tuna habitat related environment (ICCAT, 1998).

Within this framework, the aim of the present study is to look for relationships between the catchability of albacore by trolling and different environmental variables.

2. Materials and method

• Choice of the assessment model for catchability analysis :

- The assessment was particularly sensitive to the age 3 Spanish trolling CPUE series, and the age 2 Spanish trolling CPUE series tended to overestimate the stock abundance when used alone.
- The best fit to the catch at age data (according to Akaike's statistic) was reached using longline (Japanese and Taiwanese) indices only.

For these reasons, in this study we chose to keep the results of the VPA using only longline CPUE series as abundance indices. However these results do not differ much from the ones in ICCAT (2001).

• Catchability values :

the results of this VPA and the standardized CPUE series allowed us to calculate the annual catchability values of North Atlantic albacore of each age group, according to Gulland's (1983) formula :

$$\frac{C_t}{F_t} = q_t \times \bar{N}_t, \text{ in which } \bar{N}_t = \frac{N_t - N_{t+1}}{F_t + M_t}$$

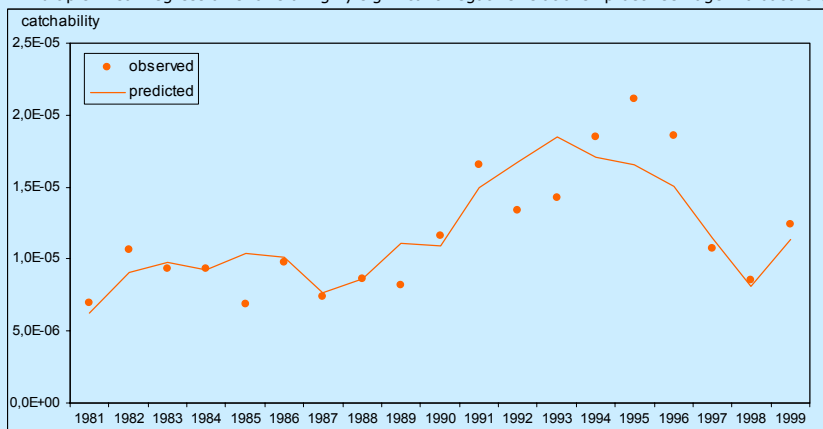
• Environmental variables used :

- sea surface temperature on Basque Coast
- duration of insolation on Basque Coast ⁽¹⁾
- precipitations on Basque Coast ⁽¹⁾
- average sea agitation (sea state, code S) on Basque Coast ⁽¹⁾
- Gulf Stream Index (with a 18-24 month lag)
- Winter NAO index
- average abundance-at-age of albacore

⁽¹⁾ data provided by MNHN Biarritz (France) and Météo France Biarritz

3. Results

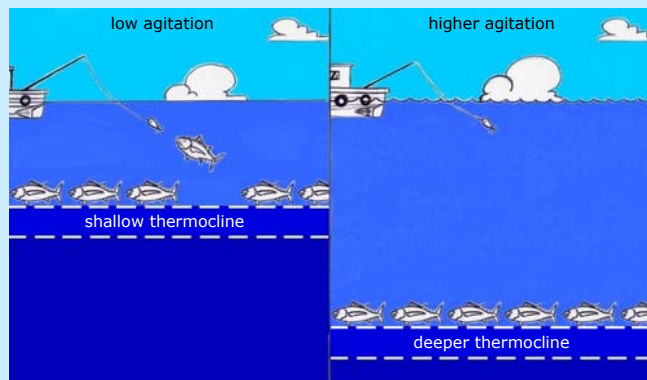
A multiple linear regression shows a highly significant negative relationship between age 2 albacore catchability by trolling and :



Model equation : $Y = 6,17 \cdot 10^{-5} - 8,82 \cdot 10^{-6} (\text{AGIT}) - 1,9 \cdot 10^{-8} (\text{INSOL}) - 2,58 \cdot 10^{-12} (\text{ABUN})$

4. Possible interpretations

• Sea agitation determines the depth of seasonal thermocline, above which age 2 albacore usually stay (Bard, 1981). Consequently, this factor may influence the **vertical availability** of albacore to surface gears.



• The duration of insolation may influence the distribution and/or abundance of the preys of age 2 albacore. This might affect the distribution and repletion of albacore, and consequently their availability and vulnerability to trolling. But we lack of knowledge about the specific ecology and dynamics involved to be able to give a more thorough interpretation of this result.

5. Conclusion

This work allowed us to put in evidence the effects of some environmental variables related to the habitat of age 2 albacore on their catchability by trolling. These results should be considered with care, as they are based on indirect methods of estimation of abundance-at-age and catchability, so their validity depends on the reliability of these estimations. However, they arise the necessity of taking into account environmental variables in the standardization of CPUE series used for stock assessment.

and :

- June through October **average agitation** of the sea (AGIT),
- June through October **duration of insolation** (INSOL),
- the annual **average abundance** of this age group (ABUN).

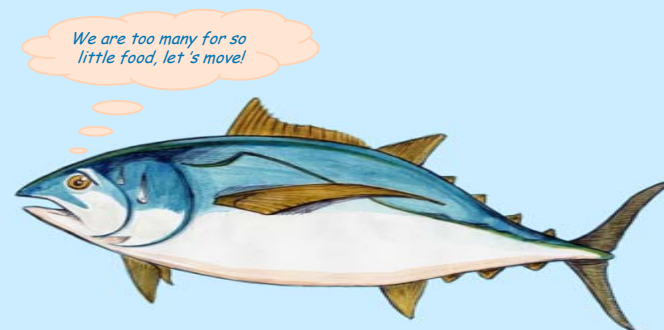
Analysis of Variance					
Source	Sum of Squares	df	Mean Squares	F	p level
Model	2,358.10 ⁻¹⁰	3	7,860.10 ⁻¹¹	12,695	0,0002147
Resid.	9,288.10 ⁻¹¹	15	6,192.10 ⁻¹²		
Total	3,287.10 ⁻¹⁰				

Regression coefficients						
	β	std. err. of β	b	std. err. of b	t (15)	p level
Intercept			6,172E-05	8,982E-06	6,8721	5,305E-06
AGIT	-0,4572	0,1395	-8,822E-06	2,693E-06	-3,2767	0,0050964
INSOL	-0,4727	0,1420	-1,901E-08	5,710E-09	-3,3297	0,0045714
ABUN	-0,5843	0,1443	-2,577E-12	6,363E-13	-4,0502	0,0010469

R² = 71,74%

Residuals : normal distribution (Kolmogorov-Smirnov test) but higher variability for low values of agitation and abundance

• The zone above the seasonal thermocline is a tropically poor zone in summer (Harvey, 1969). Thus, the negative effect of abundance on catchability may be due to a density-effect, through which albacore would have a wider distribution and more frequent movements when more numerous (for a better use of trophic resources), which would decrease the **geographical availability** to fishing fleets.



REFERENCES

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