EFFECT OF PDO AND SOI ON NON ASSOCIATED YFT CATCHES IN INDIAN OCEAN: THE CASE OF SPANISH PURSE SEINER FISHERIES

José C. BÁEZ[1,2*], María L. RAMOS[3], Marta GONZÁLEZ-CARBALLO[3] and Ivone A. CZERWINSKI[4]

1. Instituto Español de Oceanografía, Centro Oceanográfico de Málaga, Fuengirola, Spain.
2. Facultad de Ciencias de la Salud, Instituto Cs Biomédicas. Universidad Autónoma de Chile, Chile.
3. Instituto Español de Oceanografía, Centro Oceanográfico de Canarias, Santa Cruz de Tenerife, Spain
4. Instituto Español de Oceanografía, Centro Oceanográfico de Cádiz, Cádiz, Spain.

*Corresponding author: Instituto Español de Oceanografía, Centro Oceanográfico de Málaga, Puerto Pesquero de Fuengirola s/n, 29640 Fuengirola, Spain, phone: (+34) 952197124, e-mail: (JCB) josecarlos.baez@ieo.es, (MLR) mlourdes.ramos@ieo.es, (IAC) ivone.czerwinski@uca.es

INTRODUCTION

In a recent study, Baez et al. (2020) after analyzing the combined effect of the main atmospheric teleconnections affecting the Indian Ocean (i.e. South Oscillation Index -SOI-, Pacific Decadal Oscillation -PDO-, and Indian Ocean Dipole -IOD-) on YFT catches of Spanish purse seine freezer fleet operating in the Indian Ocean, they concluded that there is a lagged effect modulated mainly by PDO-SOI, which could be related to a good recruitment, larval survival, or improved spawning. Thus, negative PDO phase (or positive SOI phase) lagged between 3 and 6 years could favor future stock abundance, while positive PDO phase (or negative SOI phase) lagged 3 or 6 years could negatively affect future stock abundance.

However, Báez et al. (2020) analyzed the total YFT catches per year without separating by type of schools. On the other hand, they analyzed all the climatic oscillations in combination. The objective of this study is to test the effect of the main teleconnections (i.e. PDO, SOI and IOD) of the Indian Ocean, using different lags (until 6 years lagged), separately and independently on the YFT catches to free bank. The final objective was to find the main climatic oscillations and lags, most influential on the YFT catches on non-associated.

MATERIAL AND METHODS

Data origin

We use the catch data from YFT not associated schools, from the Spanish fishery updated in Báez and Ramos (2019). The YFT not associated schools catches was standardized by Searching days (cYFT FS, thereafter). Since 2017, the Indian Ocean yellowfin tuna stock has been subject to an interim Rebuilding Plan (IOTC

Resolution 19/01 at present). Due to yellowfin catch limits adopted by the IOTC, we observed a strategy change by fishermen, thus fishermen shifting from targeting free-swimming adult yellowfin tuna on monospecific schools to target skipjack tuna on FAD, to avoid reaching the YFT catch limit too soon. For this reason, we decided use for the analysis the years 1984 to 2017.

Statistical analysis

Using a different approach than Báez et al. (2020), we use Generalized Linear Models to adjust the Capture of YFT FS standardized to Searching Days versus the climatic indices, separately, using different lags. The discrimination capacity of the models (trade-off between sensitivity and specificity) was evaluated with the receiving operating characteristic (ROC) curve. Furthermore, the area under the ROC curve (AUC) provides a scalar value representing the expected discrimination capacity of the model (Lobo et al., 2008).

RESULTS

A total of twenty-one GLM models were fitted using PDO, SOI and IOD as independent variable and The YFT not associated schools catches was standardized by Searching days (cYFT FS, thereafter), as dependent variable.

Table 1 shows the AUC values for each of the models. It has been marked with one star, two or three stars depending on its lower AUC value.

Independent variable	AUC	Independent variable	AUC
PDO without lag	170.134	SOI without lag	169.016
PDO 1 lag	**168.820***	SOI 1 lag	**168.353*****
PDO 2 lag	170.535	SOI 2 lag	170.187
PDO 3 lag	170.429	SOI 3 lag	170.549
PDO 4 lag	169.976	SOI 4 lag	**168.571****
PDO 5 lag	170.593	SOI 5 lag	169.576
PDO 6 lag	170.092	SOI 6 lag	170.458
IOD without lag	170.305	IOD 4 lag	170.004
IOD 1 lag	169.855	IOD 5 lag	170.494
IOD 2 lag	169.530	IOD 6 lag	169.624
IOD 3 lag	168.853		

DISCUSSION

The results shown here are not comparable with the results found by Báez et al (2020), since different schools are used, and different approaches are used in the models, however, in a similar way to that reported by Báez et al. (2020). We found that lagging SOI and PDO could better explain the variations presented in the series than IOD.

Other considerations, such as technical developments, the effect of piracy, etc., have not been taken into account in this work. In fact, it does not claim to show a standardized CPUE, but points to new variables that should be taken into account in future studies.

On the other hand, the fact that this work has not explored the combined effects between the different climatic indices does not imply that they really they have a combined effect.

Many researchers have suggested that climatic teleconnections explain ecological processes, better than single local variables. The reason is that climatic oscillations affect multiple weather and oceanographic variables simultaneously in what are called packages of weather (Stenseth et al., 2003) and thus affect the corresponding ecosystem responses (Stenseth et al., 2003; Hallett et al., 2004; Bastos et al., 2016). In fact, the different climatic oscillation indeces averages out oceanographic conditions across time and space and integrates different climate variables in a unique macroscale variable (Stenseth and Mysterud, 2005).

REFERENCES

Báez J.C., Czerwinski I.A., Ramos M.L. (2020). Climatic oscillations effect on the yellowfin tuna (*Thunnus albacares*) Spanish captures in the Indian Ocean. Fish Oceanogr. 2020;00:1–12. https://doi.org/10.1111/fog.12496

Báez J.C., Ramos M.L. (2019). Free school fishery trends for Spanish tropical purse seiners in the Indian Ocean. 21st Working Party On Tropical Tuna (WPTT21), 21/10/2019, San Sebastian (España). WPTT21–12 .

Bastos, A., Janssens, I.A., Gouveia, C.M., Trigo, R.M., Ciais, P., Chevallier, F., Peñuelas, J., Rödenbeck, C., Piao, S., Fridlingsteis, P., and Running, S.W., 2016. European land CO2 sink influenced by NAO and East-Atlantic pattern coupling. Nat. commun. 7, 10315.

Hallett, T.B., Coulson, T., Pilkington, J.G., Clutton-Brock, T.H., Pemberton, J.M., Grenfell, B.T., 2004. Why large-scale climate indices seem to predict ecological processes better than local weather. Nature 430, 71–75

Lobo JM, Jiménez-Valverde A, Real R (2008) AUC: a misleading measure of the performance of predictive distribution models. Global Ecol Biogeogr 17: 145–151.

Stenseth, N.C., Ottersen, G., Hurrell, J.W., Mysterud, A., Lima, M., Chan, K.S., Yoccoz, N.G., Ådlandsvik, B. 2003. Studying climate effects on ecology through the use of climate indices, the Noth Atlantic Oscillation, El Niño Southern Oscillation and beyond. Proc. R. Soc. Lond. B 270: 2087–2096. https://doi.org/10.1098/rspb.2003.2415

Stenseth, N.C., Mysterud, A., 2005. Weather packages: finding the right scale and composition of climate in ecology. J. Anim. Ecol. 74, 1195–1198.