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SUMMARY

This paper updates previous papers on the coincidence and possible relationship between the fluctuations in the North Atlantic Oscillation index (winter N.A.O.) and the changes in the standardized index of catch per unit of effort at age 1 in the north Atlantic swordfish (Xiphias gladius) stock, assumed as a good recruitment index, during the 1983-1999 period. The level of recruitment obtained in 1998, explained as CPUE age 1 in 1999, was around the expected value according to previous predictions.

RÉSUMÉ


RESUMEN

Este documento actualiza documentos anteriores sobre la coincidencia y posible relación existente entre las fluctuaciones del índice de la Oscilación del Atlántico Norte (winter N.A.O.) y los cambios en el índice de captura por unidad de esfuerzo a la edad 1, asumido como un buen índice de reclutamiento, en el stock de pez espada (Xiphias gladius) del Atlántico Norte, para el periodo 1983-1999. El nivel de reclutamiento obtenido en 1998, expresado como CPUE a la edad 1 en 1999, fue similar al valor esperado según predicciones previas.

KEYWORDS

Swordfish, recruitment, NAO index.

METHODS

An updated analysis was done based on 7,400 trips carried out during the period 1983-1999 by Spanish surface longline vessels targeting the North stock of swordfish. Catch and size/age data from each trip sampled were obtained by taking a sampling-census of generally 100% of the fish caught during that trip. Trips selected for sampling in which the number of fishes sampled was under 85% of the total fish caught were omitted from the analysis. Nominal CPUEs in number by age were standardized for the period 1983-1999 using General Lineal Modeling (GLM) procedures which take into account factors such as year, area and quarter (SCRS/00/155). Standardized CPUE data from age 1 (CPUE1) were compared with the updated winter North Atlantic Oscillation
(NAO) index (Hurrel, 1995) defined and also used in previous studies on tuna from temperate zones (Santiago, 1998). The updated NAO index from year $y$ was contrasted with the CPUE1 from year $y+1$. A simple polynomial fit was used as well as a smoothing local regression (loess) to fit the observed data. More details on the methodology used and an in-depth discussion about this coincidence can be found in previous papers (Mejuto, 1999; 2000).

RESULTS AND DISCUSSION

Although the period with available CPUE1 data is still quite short (1983-1999), the highest CPUE1 values were observed to coincide with a low winter NAO index. The highest CPUE1 were observed in the last three years (1997, 1998 and 1999). The CPUE1 seems to be stable and at a minimum level for values of NAO around or greater than one. However a higher CPUE1 seems to be related to NAO values close to zero or negative. The 1997 CPUE1 is the highest in the historical series and also coincides with the very low NAO index recorded in 1996. The CPUE1 of 1998 was around the expected value according to previous predictions from the 1997 NAO index. The CPUE1 of 1999 is also very high and close to the highest level of 1996. A simple polynomial fit model indicates that NAO explain around 50% of the CPUE1 variability (figure 1). Additionally, a smoothing local regression (loess) was also used to fit the observed values, which provides a better empirical view (figure 2).

As was pointed out in a previous paper (Mejuto, 1999, 2000), the low NAO values (around zero or negative) coincide with the highest recruitment levels (CPUE1) observed during the time series. Some hypotheses were presented in previous papers in order to explain this possible relationship and the potential implications of this relationship on the biomass trends over multidecadal cycles.

The CPUE1 obtained for 1998 and 1999 were within the expected range according to the NAO index of 1997 and 1998, but the absolute CPUE1 values were a little higher than expected according to previous observations. We should consider that the year 1998 had a slightly positive NAO value, although it was close to zero, but the seasonal indices (three-month periods) in 1998 were mostly negative (9 out of 12 three-month periods). Additionally the last two years were NAO negative and the related oceanographic factors could be partially carried over to some months in 1998. A more complex relationship is also possible, including the effects of previous multi-annual cycles as well which were not considered in this analysis.

The 1996 and 1997 NAO values could indicate a change in the NAO cycle (Halpert and Bell, 1997, cited on the NOAA web). So, an overall negative multidecadal NAO cycle would be expected in future decades. However, short cycles (1-2-3 year periods) with positive value-trends are also possible within this expected multidecadal negative cycle. These positive values could be very useful in order to check modeling and fit the possible relationship between NAO indices and the recruitment levels.

At the same time, research is needed to examine what oceanographic-atmospheric factors linked or summarized by the winter NAO index would best explain the variability in the recruitment index of the swordfish in the North Atlantic. SST anomalies and/or changes in trade winds, changes in currents, etc., have been related to NAO fluctuations with associated changes in the recruitment of several species. A extensive discussion about this possible relationship and the possible links to the reproductive strategy of the swordfish is provided in papers previous cited.
It is important to note that the relationship between environmental variables and recruitment have been detected and proposed in several species. It is common for these relationships to remain for long periods of time and later, in some cases, they suddenly disappear for unknown reasons, affecting the credibility of the scientists who have proposed these hypotheses.

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LITERATURE CITED.


Figure 1. NAO index values for the 1980-1998 period (year y), NAO trend (polynomial fit) and CPUE age 1 (year y+1) obtained from commercial trips of the Spanish longline fleet. Polynomial fit of CPUE age 1 (year y+1) versus winter NAO index (year y).

Figure 2. Expected values of annual standardized index of CPUE age 1 (solid line) of the North Atlantic swordfish related to N.A.O. index one year before, using a smoothing local regression (loess) to fit the observed values (dots).