

Growth of a deep-water, predatory fish is influenced by the productivity of a boundary current system

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Supporting information

Note S1 – Crossdating and detrending

Potential errors in growth increment marking were identified by statistical crossdating using the program COFECHA (i.e. crossdate in Spanish; ¹). Among other functions, this program performs a windowed cross-correlation analysis. In this analysis, the cross correlations (at lags -10 to 10 years) between segments of each individual mean series (IMS) and segments of the mean index chronology (MIC) (excluding the IMS of interest) were calculated using a 15-year moving window. A low positive or any negative correlation of a segment at zero lag indicated possible errors in the marking of increments, and high correlations at lags other than zero indicated alternative alignments. When the correlation at zero lag was low or negative, the otolith image and marked transects were checked visually, and if appropriate, errors were corrected.

Detrending of otolith increment series is often accomplished using a spline with a 50% frequency cut-off at 22 years or a negative exponential function²⁻⁶. Because we only measured growth increments formed after maturity, the negative exponential function, which accommodates rapid declines in increment thickness early in life, was not used. To select appropriate spline rigidity for detrending, we systematically explored a range of rigidities to determine the effects on chronology quality. In this case, optimal detrending should maximize the mean of the pairwise correlations among all series (excluding correlations of series with themselves), referred to as \bar{r} , while avoiding the introduction of artifactual correlations (e.g., those due to alignment of ontogenetic trends in multiple individuals). A commonly-used measure of chronology quality is the expressed population signal (EPS) which depends on \bar{r} and the number of individual series analyzed (t)^{7,8}:

$$EPS(t) = \frac{t \times \bar{r}}{t \times \bar{r} + (1 - \bar{r})}$$

The EPS value can range from 0 to 1 with a higher EPS indicating that the MIC better represents the hypothetical chronology that would result from including the entire population in the sample⁸. A higher EPS also indicates a better reconstruction of the statistical link between climate and the mean growth in the population⁷. While selecting a detrending scheme that maximizes \bar{r} (or EPS) may be appropriate in some circumstances, it is possible that maximising \bar{r} could result in retention of aspects of an ontogenetic trend when many individuals have similar ages and capture years. To help mitigate this risk, spline rigidities that resulted in any non-stationary series, as determined by Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests ($\alpha = 0.1$)^{9,10} were excluded. Following selection of an appropriate detrending scheme, the MIC was recalculated and the cross-dating verification with COFECHA was repeated.

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