Supplementary materials

Additional information regarding statistical methods employed in the present study is presented below.

Regarding the structural equation model (SEM) technique: Model specification was conducted based on *a priori* knowledge of similar systems. Model identification was performed using the *t-rule*. Model estimation utilized a robust maximum likelihood estimator to account for the non-normal distribution of the data (Bertsimas and Nohadani, 2019). The strength and sign of links, as well as the quantification of the model structure, were determined through simple and partial multivariate regression, along with Monte Carlo permutation tests (1000 replicates). The Bayesian Information Criterion (BIC), Chi-square test and respective p-value, were employed to evaluate the robustness and fit of the overall path model. The individual path coefficients indicate the strength of the relationship between causal and response variables. The structural equation model was performed using the "*lavaan*" R package (Rosseel, 2012).

Regarding the wavelet analysis (CWT) technique and moving variance (with Granger causality test): Wavelet analysis is widely used for the decomposition of the variance over a time/frequency diagram and has been shown robust in assessing geophysical and ecological time series (Percival and Walden, 2000; Tarik et al., 2021). This allowed computing the wavelet coherence to quantify their correlation in the time frequency space. Continuous Wavelet Transform performs a local time-scale decomposition of time series quantifying its spectral characteristics as a function of time (Percival and Walden, 2000; Chavez and Cazelles, 2019). The Morlet wavelet function was used as it better describes time series with unknown frequencies and allows a better separation of the phase and the amplitude of the studied signal (Percival and Walden, 2000; Chavez and Cazelles, 2019). The 5% statistical significance level was determined by using bootstrap simulations (1000 times) considering a first order autoregressive process with lag-1 autocorrelation. The statistical significance was assessed relative to the null hypothesis that the signal is generated by a stationary process (Percival and Walden, 2000). The wavelet analysis was performed using the "*biwavelet*" R package (Tarik et al., 2021). Additionally, Granger causality test was performed to verify if future values of decapod larvae abundance could be predicted based on sea surface temperatures time series, using the "*lmtest*" R package (Zeileis and Horthorn, 2002).

Table 1S- Information on marine heatwaves (MHW) events for the Mondego estuary region (Portugal), from 2003 to 2012. Period of occurrence, duration in days, mean intensity of each MHW event, which represents the cumulative rise in temperature (°C) for the event.

Period of occurrence	Duration (number of days)	Mean intensity (ºC) (mean T / n of days)
29 Aug – 07 Sep, 2003	10	1.9
23 Jun – 28 Jun, 2004	6	2.3
26 Jul – 24 Aug, 2004	30	2.6
06 Jun – 18 Jul, 2006	13	2.4
14 Jul – 23 Jul, 2006	10	2.2
28 Sep – 16 Oct, 2006	19	2.3
24 Oct – 11 Dec, 2006	48	2.3
05 Jan – 10 Jan, 2007	6	1.5
22 Jan – 26 Jan, 2007	5	1.0
07 Mar – 12 Mar, 2007	6	1.1
19 Feb – 02 Mar, 2008	12	1.2
23 Jul – 02 Aug, 2008	11	1.8
21 Jun – 06 Jul, 2009	16	2.7
21 Apr – 20 Apr, 2010	10	2.7
13 Jan – 20 Jan, 2011	8	1.0
16 Apr – 21 Apr, 2011	6	1.9
2 May – 20 May, 2011	19	2.4
24 May – 31 May, 2011	8	2.7
02 Jun – 10 Jun, 2012	9	1.8
16 Aug – 28 Aug, 2012	13	2.1

Supplementary Materials' Bibliography

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