Evidence of climate-driven regime shifts in the Aegean Sea's demersal resources: a study spanning six decades

Dimitrios Damalas[1], Vassiliki SGARDELI[1], Paraskevas Vasilakopoulos[2], Georgios TSERPES[1], and Christos MARAVELIAS[3]

[1]HCMR
[2]European Commission Joint Research Centre Ispra Sector
[3]University of Thessaly

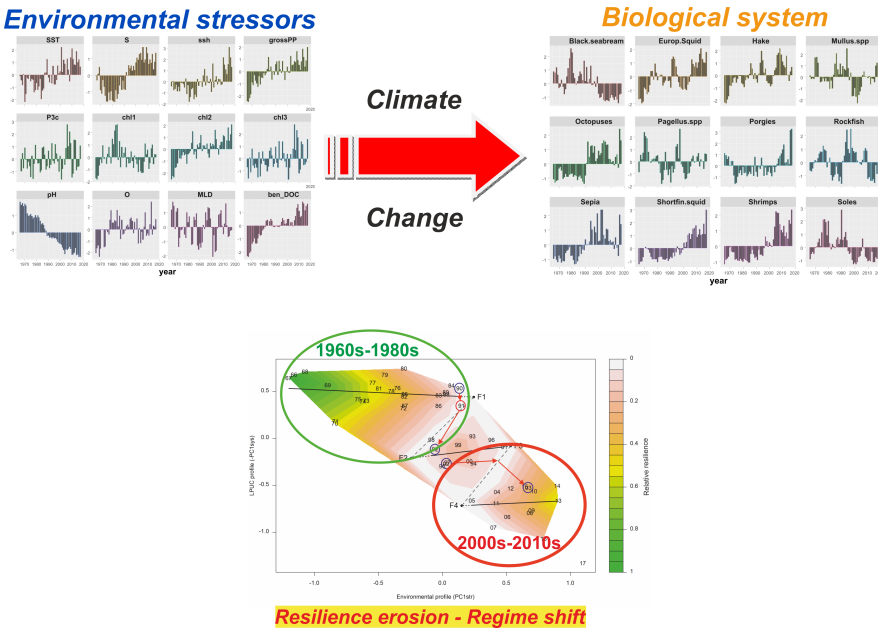
August 26, 2021

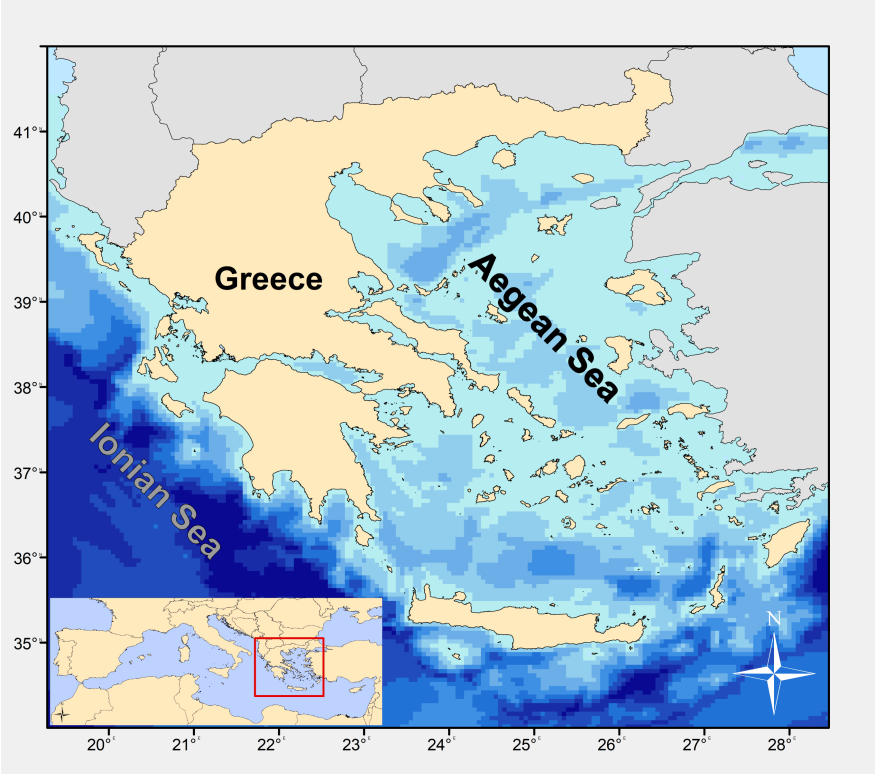
Abstract

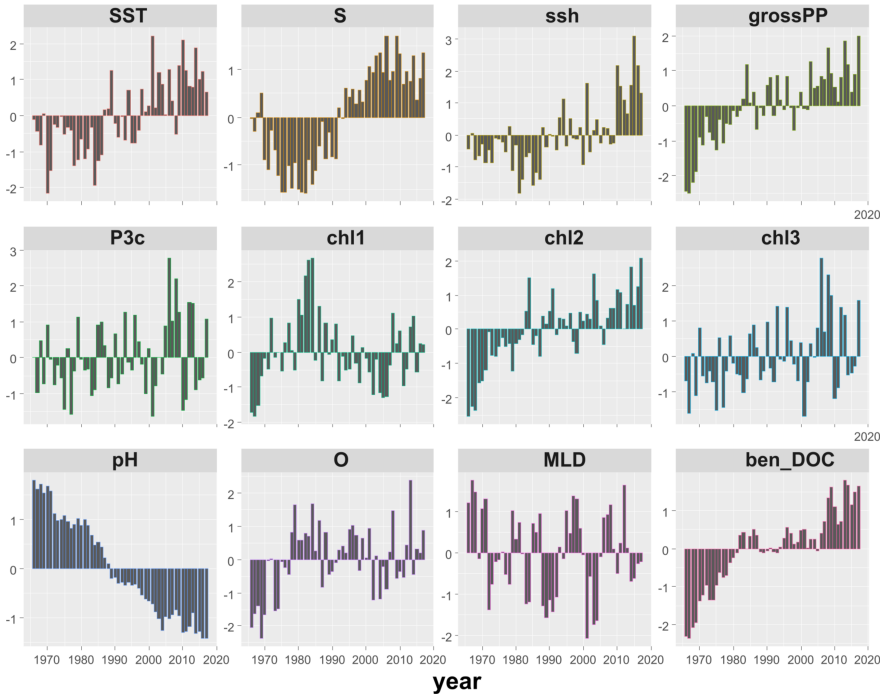
Climate change (CC) can alter the configuration of marine ecosystems, however ecosystem response and resilience to change are usually case-specific. The effect of CC on the demersal resources of the Aegean Sea (east Mediterranean Sea) was investigated during the past six decades applying a combination of multivariate analysis, non-additive modelling and the Integrated Resilience Assessment (IRA) framework. We focused on the study of: (i) the biological 'system' complex, using proxies of biomass (landings per unit of capacity) for 12 demersal taxa and (ii) the environmental 'stressor' complex, described by 12 abiotic variables. Pronounced changes have occurred in both the environmental and biological system over the studied period. The majority of the environmental stressors exhibited strikingly increasing trends (temperature, salinity, primary production indices) with values started exceeding the global historical means during late 1980s-early 1990s. It is suggested that the biological system exhibited a discontinuous response to CC, with two apparently climate-induced regime shifts occurring in the past 25 years. There is evidence for two fold bifurcations and four tipping points in the system, forming a folded stability landscape with three basins of attraction. The shape of the stability landscape for the Aegean Sea's biological system suggests that while the initial state (1966-1991) was rather resilient to CC, absorbing two environmental step-changes, this was not the case for the two subsequent ones (intermediate: 1992-2002; recent: 2003-2016). Given the current trajectory of environmental change, it is highly unlikely that the biological system will ever return to its pre-1990s state, as it is entering areas of unprecedented climatic conditions and there is some evidence that the system may be even shifting towards a new state. Our approach and findings may be relevant to other marine areas of the Mediterranean and beyond, undergoing climate-driven regime shifts, and can assist to their adaptive management.

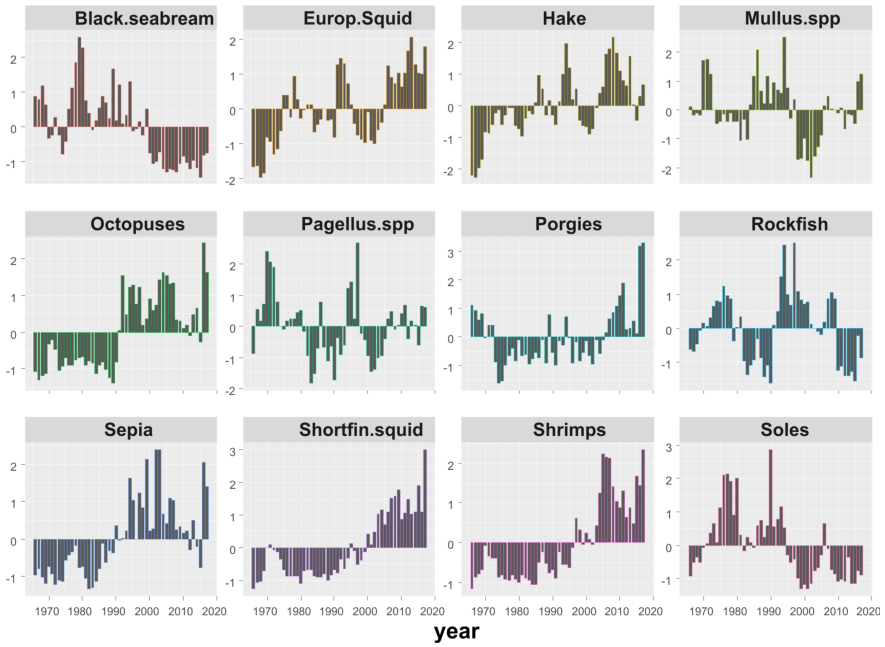
Hosted file

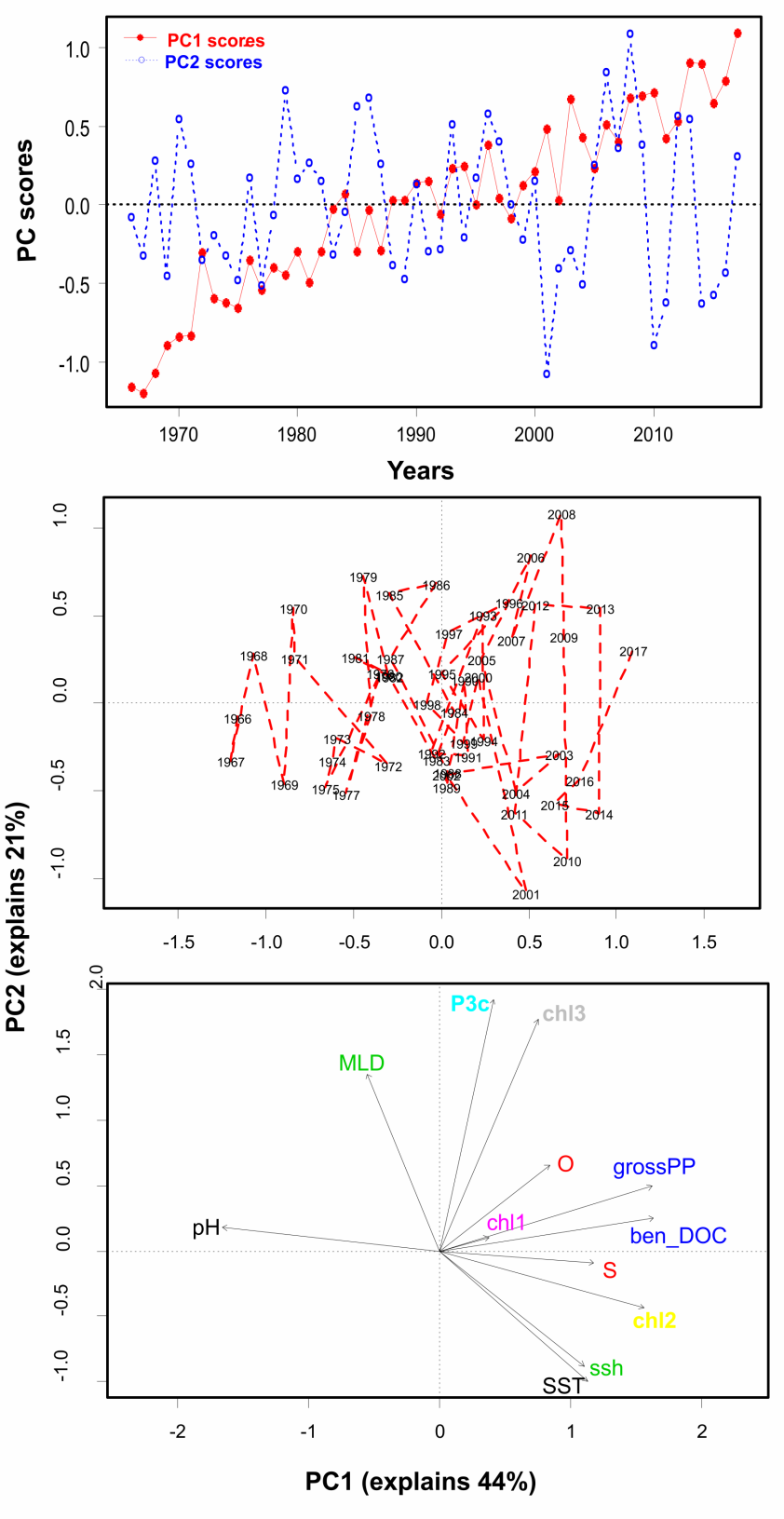
`Aegean_Demersal_Regime_Shift_Ecol & Evol_Submission_1.docx` available at https://authorea.com/users/431856/articles/535326-evidence-of-climate-driven-regime-shifts-in-the-aegean-sea-s-demersal-resources-a-study-spanning-six-decades

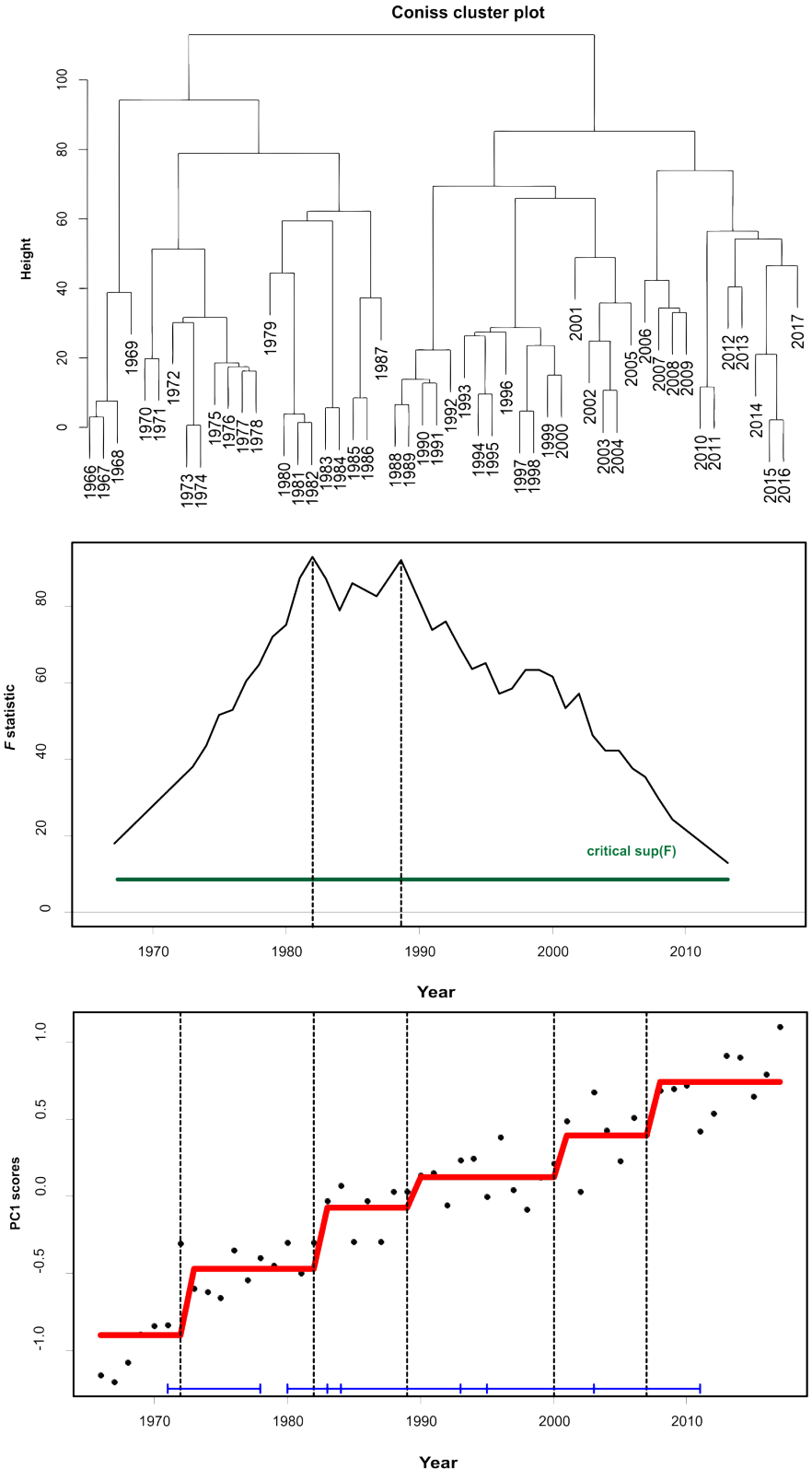


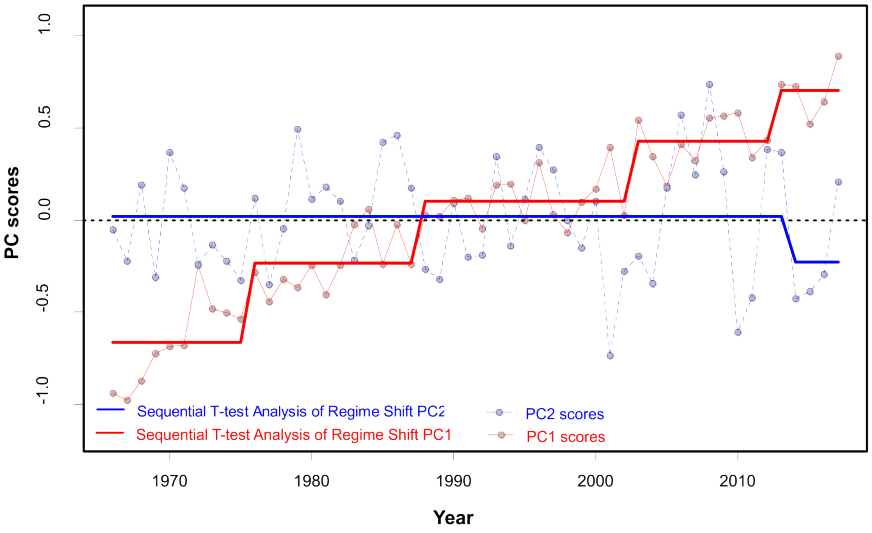


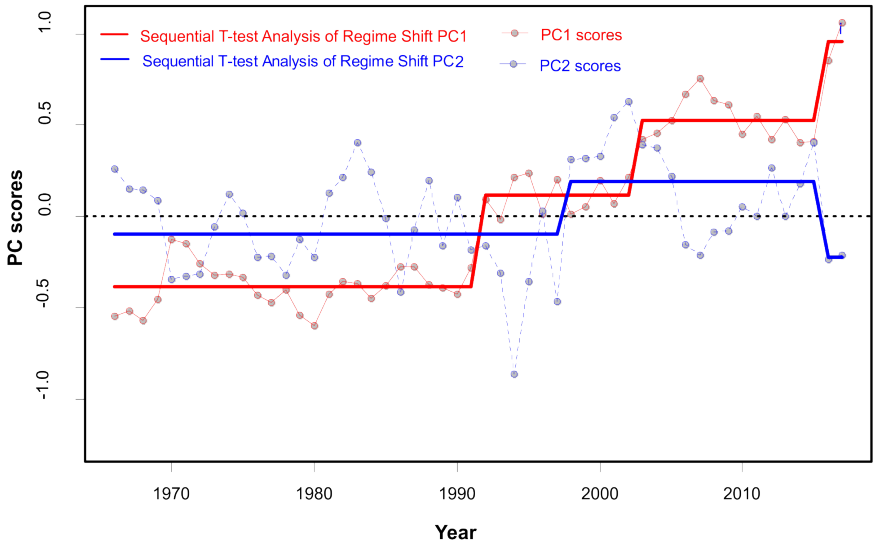


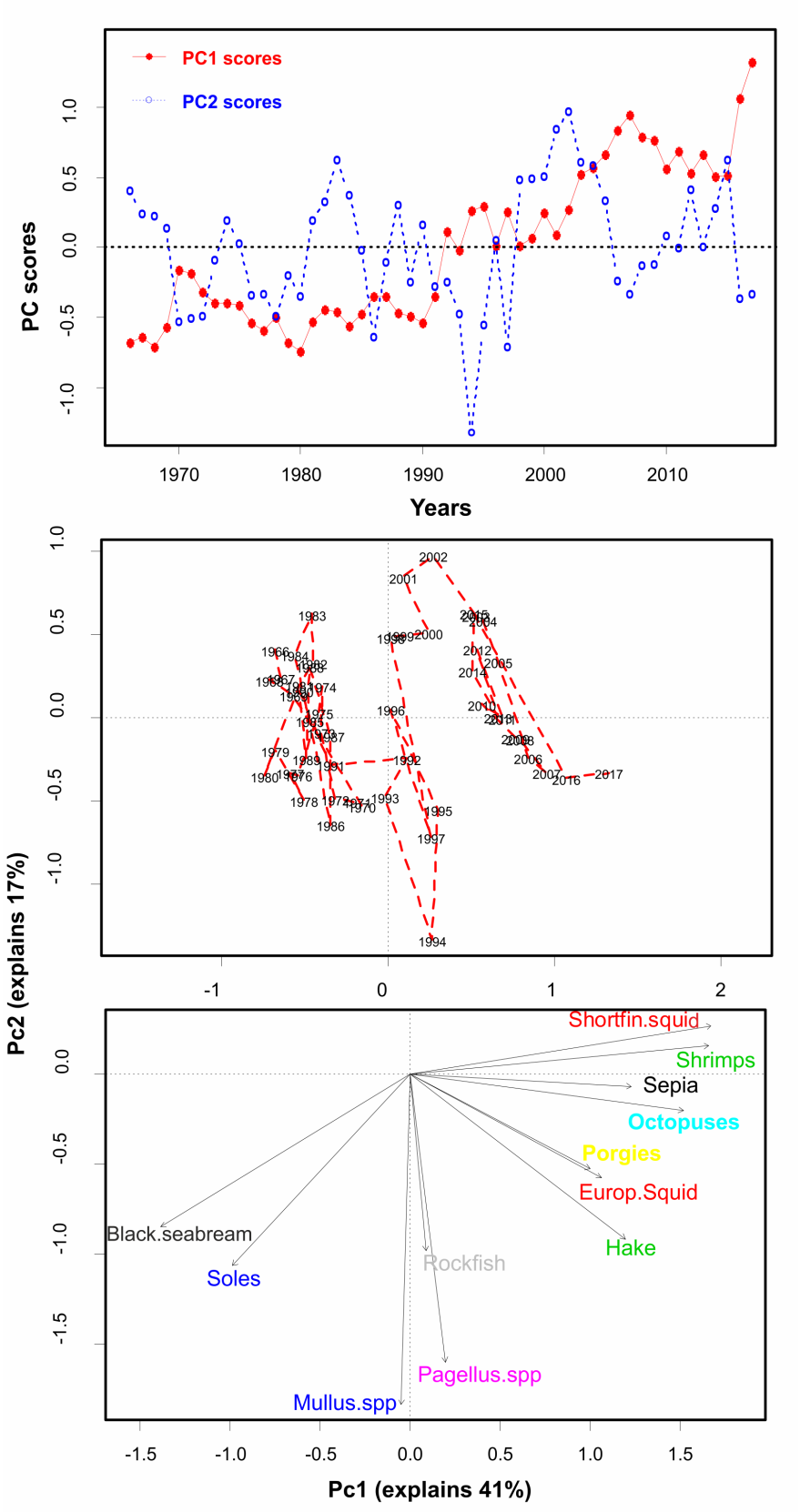












∞