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[Retrospective analysis of the pelagic ecosystem of the Western Mediterranean Sea: Drivers, changes and effects](#)

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Abstract: In the Western Mediterranean Sea, forage fishes have changed in abundance, body condition, growth, reproduction, and distribution in the last decades. Different hypotheses have been proposed to explain these changes, including increase in fishing mortality; changes in environmental conditions affecting species fitness, and planktonic productivity and quality; recovery of top predators; and increase in competitors. We investigated the main drivers and changes of the pelagic ecosystem and their effects using an ecosystem-based modelling approach. Specifically, we (1) quantified the potential historical contribution of various drivers of change, (2) investigated changes in temporal trends and spatial distributions of main ecosystem components, and (3) identified ecological consequences of these changes in top predator and competitors, their fisheries and ecosystem traits during 2000–2020. We updated an established Ecopath food-web model representing the Spanish and French Mediterranean sub-areas (GSA06 and GSA07) in 2000 with recent available data. We applied the temporal dynamic Ecosim module, and tested historical time series of fishing effort, fishing mortality and environmental factors as potential drivers. Observed biomass and landings of key species were used to validate model projections. A spatial-temporal Ecospace model was developed to project species distribution changes. Results showed historical biomass and catch changes driven by a combination of high fishing pressure and environmental change (i.e. increase in temperature and salinity, and decline in primary productivity). Small pelagic fish showed significant temporal changes and predicted shifts in their distributions, following a latitudinal gradient. Predators and competitors showed changes as well, displaying heterogeneous spatial patterns, while fisheries landings declined. Overall, results matched observations (e.g., decline of sardine, fluctuations of anchovy and increases in bluefin tuna) and illustrated the need to complement traditional assessments with integrative frameworks to move towards an

ecosystem-based approach in the Mediterranean. They also highlighted important knowledge gaps to guide future research in the region.

Keywords: Small pelagic fish, Pelagic organisms, Fisheries, Climate change, Ecosystem health, Mediterranean Sea