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Hindcasting the dynamics of an Eastern Mediterranean marine ecosystem under the impacts of multiple and cumulative stressors

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Abstract: An important challenge for conserving and managing marine ecosystems is to advance our understanding of how multiple human stressors, environmental factors and marine resources interact and influence each other. The ecosystems of the Israeli Mediterranean coast have undergone significant ecological changes in recent decades caused primarily by the introduction of invasive species through the Suez Canal, intense fishing activities and the effects of climate change. An Ecopath model representing the continental shelf of the Israeli Mediterranean coast was calibrated and fitted to the available time series from early 1990’s to 2010 using the Ecosim temporal dynamic modeling approach. The model was first used to explore the historical dynamics of the ecosystem considering the effect of invasive species, fishing activities and climate change (through changes in temperature and salinity) as the main ecosystem drivers. Secondly, different scenarios from early 1990’s to 2010 were developed to evaluate historical cumulative effects of the different drivers. Historical model predictions satisfactorily matched available observed data, especially regarding the invasive groups. However, lack of data from the pelagic environment limited our ability to compare model output with historical observations. Overall, results showed an increasing proportion of invasive species in biomass and catch over time, with important effects on the food-web. Results also highlighted the important role that fishing activities and climate change are playing in the ecosystem through overexploitation and displacements of native groups, respectively. Results of the hypothetical scenarios highlighted the cumulative impacts of the stressors, suggesting synergistic effects in several cases between the impacts of invasive species, fishing and climate change.

Keywords: Ecopath with Ecosim; South-Eastern Mediterranean Sea; Invasive species; cumulative impacts.