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[Cross-scale environmental impacts across persistent and dynamic aggregations within a complex population: implications for fisheries management](#)

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**Abstract:** Accounting for marine stocks spatiotemporal complexity has become one of the most pressing improvements that should be added to the new generation of stock assessment. Disentangling persistent and dynamic population subcomponents and understanding their main drivers of variation are still stock-specific challenges. Here, we hypothesized that the spatiotemporal variability of density in two adjacent fish stocks is associated with spatially structured environmental processes across multiple spatiotemporal scales. To test this, we applied a generalized empirical orthogonal function and dynamic factor analysis to fishery-independent and -dependent data of red mullet, a highly commercial species, in the Western Mediterranean Sea. Areas with persistent and dynamic high aggregations were detected for both stock units. A large-scale climatic index and local open-ocean convection were associated with both stocks, while other variables exhibited stock-specific effects. We also revealed spatially structured density dynamics within the examined management units. This suggests a metapopulation structure and supports the future implementation of a spatial stock assessment. Considering the common—generally unrealistic—assumptions of panmictic structure and absence of connectivity with neighbouring stock units, our methodology can be applied to other species and systems with putative spatial complexity to inform more accurate population dynamics and structure.

**Keywords:** *Mullus barbatus*, empirical orthogonal function, dynamic factor analysis, Mediterranean Sea, open-ocean convection, stock identification