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Title: An empirical approach to assess and understand drivers and trade-offs between multiple marine ecosystem functions

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Abstract: Understanding the drivers and trade-offs between multiple ecosystem functions and their associated services requires new ways of investigating and quantifying the stock and fluxes of energy and organic matter through food webs. Although recent advances in food-web modelling allow us to address many of these issues, validating the robustness of predictions and the derived estimates of ecosystem functions requires comparable empirical estimates from real ecosystems. This is particularly challenging in the oceans because available observations on marine food webs offer little information on ecosystem functioning. In this study, we aim to empirically quantify multiple ecosystem functions at large spatial scales using scientific surveys of demersal fish communities across continental shelf seas in the North Atlantic. We combine these observations with an extensive collection of species traits to estimate several ecosystem functions (e.g. biomass, production, metabolism, productivity) and their variability in space and time. Furthermore, we investigate trade-offs between ecosystem functions and assess which communities and environments favor certain functions. Through variance partitioning methods, we then quantify the contribution of environmental and biotic drivers on each ecosystem function. We give specific attention to how taxonomic diversity explains food web functions across trophic levels. Identifying key drivers of several ecosystem functions at large spatial scale, across environmental and diversity gradients, has the potential to provide useful guidance for an ecosystem approach and sustainable management of marine ecosystems.

Keywords: ecosystem functioning, fish communities, trade-offs, biodiversity

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