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TITLE: Dispersal, environmental niches and oceanic-scale turnover in deep-sea bivalves

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ABSTRACT:

Patterns of beta-diversity or distance decay at oceanic scales are completely unknown for deep-sea communities. Even when appropriate data exist, methodological problems have made it difficult to discern the relative roles of environmental filtering and dispersal limitation for generating faunal turnover patterns. Here, we combine a spatially extensive dataset on deep-sea bivalves with a model incorporating ecological dynamics and shared evolutionary history to quantify the effects of environmental filtering and dispersal limitation. Both the model and empirical data are used to relate functional, taxonomic and phylogenetic similarity between communities to environmental and spatial distances separating them for 270 sites across the Atlantic Ocean. This study represents the first ocean-wide analysis examining distance decay as a function of a broad suite of explanatory variables. We find that both strong environmental filtering and dispersal limitation drive turnover in taxonomic, functional and phylogenetic composition in deep-sea bivalves, explaining 26 per cent, 34 per cent and 9 per cent of the variation, respectively. This contrasts with previous suggestions that dispersal is not limiting in broad-scale biogeographic and biodiversity patterning in marine systems. However, rates of decay in similarity with environmental distance were eightfold to 44-fold steeper than with spatial distance. Energy availability is the most influential environmental variable evaluated, accounting for 3.9 per cent, 9.4 per cent and 22.3 per cent of the variation in functional, phylogenetic and taxonomic similarity, respectively. Comparing empirical patterns with process-based theoretical predictions provided quantitative estimates of dispersal limitation and niche breadth, indicating that 95 per cent of deep-sea bivalve propagules will be able to persist in environments that deviate from their optimum by up to 2.1 g m(-2) yr(-1) and typically disperse 749 km from their natal site.

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