Which functional diversity measures for systemic conservation planning?

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Abstract

Human activities are changing climate and habitats worldwide, leading to a significant increase in extinction rates. Consequences of extinctions are not restricted to the loss of species per se but also it result in a loss of functional traits and thus the erosion of functional diversity which in turn negatively affects ecosystem functioning and services. Thus, several studies emphasized the importance of incorporating functional diversity in systematic conservation planning. Numerous measures of functional diversity have been proposed, however, so far no consens has been reached on which better discriminate the processes shaping the functional structure of communities. Despite a multiplicity of indices, conservation planning applications for functional diversity are limited to dendorgram-based metrics. Dendorgram-based metrics have shown strong limitations in representing the functional distances between species, and their relevance for conservation planning is thus questionable. In this study, we propose an alternative conservation planning approach based on functional attribute diversity (FAD) that optimize the sum of the distances between species in multidimensional trait space. In order to determine which functional diversity measure performs better for conservation purposes, we compare two optimization methods based on FD and FAD measures. As a case study, we used distribution and traits data for coastal Mediterranean fish assemblages. We calculated functional dissimilarity using a generalization of the Gower's distance. Then, using integer linear programming to optimize an objective function integrating FD or FAD, we establised corresponding conservation area networks. We examined and compared the conservation effectiveness of FD and FAD networks and report the respective advantages and drawbacks of this two approaches.

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