Assessing Functional Structure in European Marine Ecosystems Using a Vector-Autoregressive Spatio-Temporal Model

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Abstract : In marine ecosystems, spatial and temporal species structure is an important component of ecosystems' response to anthropological and environmental factors. Although spatial distribution patterns and fish temporal series of abundance have been studied in the past, little research has been allocated to the joint dynamic spatio-temporal functional patterns in marine ecosystems and their use in multispecies management and conservation. Each species represents a function to the ecosystem, and the distribution of these species might not be random. A heterogeneous functional distribution will lead to a more resilient ecosystem to external factors. Applying a Vector-Autoregressive Spatio-Temporal (VAST) model for count data, we estimate the spatio-temporal distribution, shift in time, and abundance of 140 species of the Eastern English Chanel, Bay of Biscay and Mediterranean Sea. From the model outputs, we determined spatio-temporal clusters, calculating p-values for hierarchical clustering via multiscale bootstrap resampling. Then, we designed a functional map given the defined cluster. We found that the species distribution within the ecosystem was not random. Indeed, species evolved in space and time in clusters. Moreover, these clusters remained similar over time deriving from the fact that species of a same cluster often shifted in sync, keeping the overall structure of the ecosystem similar overtime. Knowing the co-existing species within these clusters could help with predicting data-poor species distribution and abundance. Further analysis is being performed to assess the ecological functions represented in each cluster.
Keywords : cluster distribution shift, European marine ecosystems, functional distribution, spatio-temporal model
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