Modelling the response of the distribution of benthic marine species to climate change

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Abstract

In a context of climate change, understanding the response of species to changes in the environment and the implications for their geographic distribution is of paramount importance. Through the formulation of relationships between the organism and its environment, species distribution models (SDM) provide a tool to assess how species distribution would respond to environmental stressors. Our study presents the development and a first application of a mechanistic and generic SDM, using a multi-agent modelling platform: NetLogo. The model simulates the spatial and temporal population dynamics of a marine bentho-pelagic species with an individual-based mechanistic approach of the life cycle. It couples a Dynamic Energy Budget model of the individual life history traits in relation to temperature and food concentration (e.g. phytoplankton), larval dispersal due to currents (oceanographic connectivity) and competition for space at the recruitment phase. The model is applied to the blue mussel *Mytilus edulis* along the coast of Brittany and scenarios of environmental changes target the effect of seawater warming based on the results of a climate model (Representative Concentration Pathway RCP8.5, model CNRM-CM5). We show that oceanographic connectivity drives the population dynamics and local changes are likely to affect distant population structure. Simulations show that seawater warming modifies the demographic structure of *M. edulis* and the phenology of the reproduction but temporal changes are smaller than the differences due to local environmental conditions.

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