Simulating plant invasion dynamics in alpine ecosystems under climate change and land-use scenarios

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Abstract

Invasive alien species (IAS) have caused severe environmental changes globally, altering species composition and ecosystem function. Mountain areas have largely been spared from large-scale invasions in the past. However climate change and growing human population size have started breaking down barriers in these ecosystems, likely leading to increased invasions in the future. A key step to critically assess the risk of future invasions is to simulate IAS potential spread under environmental change and management scenarios. We therefore parameterized a landscape simulation model (FATE-HD) for IAS functional groups in order to forecast invasions in the Ecrins National Park (French Alps). FATE-HD allows simulating the spatio-temporal dynamics of interacting plant functional groups in response to climate and land use. Both native and alien functional groups compete for light and for soil nutrients and have specific life-history characteristics. Two sets of IAS were modeled: the most abundant IAS present in the Alpine region and a set of new ornamental species with high potential of becoming invasive. Then we tested for the effects of propagule pressure, climate change and land use abandonment. Simulations allowed identifying the most worrying future IAS across a number of habitats in the park as a function of different scenarios. First results suggest that propagule pressure and climate change will interact to increase overall richness, maximum elevation and spread of the modeled aliens. Our study is the first to assess in a comprehensive way the effects of future global changes on the dynamics and spread of IAS in mountain systems.

Keywords: Alien species, mountain ecosystems, dynamic vegetation model, global change scenarios

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