Forecasting eco-evolutionary changes in natural populations: which species' traits matter?

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Abstract

How can we characterize a species' ability to withstand rapid environmental changes? Which species' traits allow for rapid evolution and escape from extinction, and which do not? Although models investigating conditions for evolutionary rescue and adaptation to a changing environment have addressed some of those issues, we still miss a general framework to evaluate which species are most at risk of population decrease and ultimate extinction. In this talk, I will present a modeling work mixing classical species distribution models (SDM) with a simulation-based dynamical eco-evolutionary model (DEEM) to forecast the change of species' range under climate change for a set of species that vary in their adaptive capacity (plastic and evolutionary), life history strategies, dispersal capacity, and reproductive systems, among other key species' traits. This approach allows us to characterize which species' traits are most important for species' persistence. As an illustration, I will present a recently published eco-evolutionary model of the response to climate change of endemic alpine plant species and the Austrian alps. This work compares SDMs and DEEMs prediction of species' range shifts until the next century. We show that, by taking precise account of the demographic and evolutionary dynamics of the perennial plants modeled, we predict a rapid demographic decline caused by a delayed evolutionary answer of local populations. Overall, the SDM predictions show a faster decline of the species' ranges compared to the eco-evo approach, in part because of the positive effect of migration in the later. I will show how variation in a few key species' traits can deeply modify those predictions.

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