Detection of eco-evolutionary dynamics in metacommunities using Joint Species Distribution Models

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1 Title

Detection of eco-evolutionary dynamics in metacommunities using Joint Species Distribution Models

2 Abstract

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3 Introduction

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4 Methods

4.1 Simulation model

We simulated growth and competition dynamics for a multi-species assemblage in a patchy landscape, with site variation in one environmental property.

4.1.1 Environmental variation

Population growth for species in the metacommunity simulation follows a Leslie-Gower model (a discrete-time version of a Lotka-Volterra model (Beverton and Holt 1957) (Leslie and Gower 1958)). We consider the impact of trait evolution for growth using a discrete time quantitative genetic model of evolutionary rescue (Gomulkiewicz and Holt 1995). The model for population size is as follows:

$$N_{i,t+1} = \frac{\hat{W} e^{\frac{-[(\frac{w+(1-h^2)P}{P+w})(E-x_{i,t})]^2}{2(P+w)}} N_{i,t}}{1 + \alpha_{ii} N_{i,t} + \sum_{j \neq i}^{S} \alpha_{ij} N_{j,t}}$$

where N_i, t is the population size of species i at time t, $\hat{W}$ is calculated as $\hat{W} = W_{max}\sqrt{(\frac{w}{P+w})}$, W_{max} is the species' maximum per-capita growth rate, w is the width of the Gaussian fitness function (which determines the strength of selection, as increasing values indicate a weaker reduction in fitness with distance from optimum trait value), P is the width of the distribution of the phenotype x, h^2 is the heritability of the trait x, E is the local environmental optimum trait value, $x_{i,t}$ is the trait value of species i at time t, α_{ii} is the intraspecific competition coefficient (the per capita impact of species i on itself) and α_{ij} is the interspecific competition coefficient. Populations have a critical density N_c, below which the population is subject to extinction due to demographic stochasticity at a probability of p (Gomulkiewicz and Holt 1995).

5 Results

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6 Discussion

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7 References

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Gomulkiewicz, R., and R. D. Holt. 1995. When does evolution by natural selection prevent extinction? Evolution 49:201–207.

Leslie, P. H., and J. C. Gower. 1958. The properties of a stochastic model for two competing species. Biometrika 45:316–330.

8 Figures & Tables