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Spatial heterogeneity and evolution of fecundity-affecting traits

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Abstract

It is widely recognized that spatial structure in a population has some, and occasionally great, impacts on ecological and evolutionary dynamics. However, it has been observed that in the homogeneous Wright's island model with a certain standard demographic assumption, spatial structure does not affect the fitness gradient of a fecundity-affecting trait. The location and convergence stability of singular strategies thus remain unchanged. Furthermore, evolutionary branching is impossible for small dispersal rates, and for a wide class of fecundity functions, evolutionary branching is impossible for any dispersal rate if branching does not occur in the corresponding well-mixed model. Spatially homogeneous structure thus often inhibits evolutionary branching. Here we study the impact of spatial heterogeneity on evolutionary dynamics. We consider an infinite Wright's island model, where different islands have different capacity and fecundity consequences, and therefore the population is spatially heterogeneous. Through the analysis of metapopulation fitness, we derive its first-order and second-order derivatives with respect to mutant's trait, which are explicitly represented in terms of fecundity derivatives. The selection gradient turns out to be a