

## **Predicting Invasion Resistance of Natural Communities**

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Our research involves developing community ecology theory into theories that help explain success of individual invaders, and invasion resistance of communities. The basic idea is that ecological community theory can be used to understand invasions by applying recent niche concepts and their predictions to non-native species and the communities they invade. These ideas lead to the concept of niche opportunity, which defines conditions that promote invasions in terms of resources, natural enemies, the physical environment, interactions between these factors, and the manner in which they vary in time and space. Niche opportunities vary naturally between communities, but may be greatly increased by disruption of communities, especially if the original community members are less adapted to the new conditions. Recent niche theory clarifies the prediction that low niche opportunities (invasion resistance) result from high species diversity. Conflicting empirical patterns of invasion resistance potentially are explained by covarying external factors. These various ideas derived from community ecology provide a predictive framework for invasion ecology; they presage a healthy interplay between the two disciplines (Shea and Chesson 2002).

To provide a better framework for understanding the relationship between invasion resistance of a community and the species diversity of that community, we also study mathematical models of community assembly that examine how communities normally gain new species, how species are lost from a community by interactions with new members, and how non-native invaders may differ from native species that are present in a region and that are candidate members of a local community. Our work so far has focused on community assembly for systems structured by diffuse competition because these provide a simple means of understanding the effects of time, species-pool size, and other characteristics of the species pool on the development of invasion resistance. In such systems, each species can be assigned an absolute fitness that is context independent. Mean fitness of the community, species diversity, and a parameter reflecting the average difference between intraspecific and interspecific competition determine an unambiguous measure of invasion resistance. Further, these systems provide a variety of predictions about the development of invasion resistance. They agree with intuition that more mature communities, i.e., those assembled from larger species pools or having had more time to assemble, will be more invasion resistant. However, they also provide predictions controlling for these factors. Of particular importance is the fitness distribution in the species pool from which a community is assembled. Distributions with no upper tail lead to systems with ever increasing diversity, but limited invasion resistance so that the system is easily invaded. Indeed they are decimated by species from a pool with an upper tail, in spite of the fact that they may be highly diverse and exhibit a positive relationship between realized species diversity and invasion resistance. Species-pool fitness distributions with an upper tail lead to a stochastic equilibrium number of species in a community with time. However, over time, invasion resistance increases without limit and the relationship between realized species diversity and invasion resistance is often negative providing a possible explanation for empirical observations of such negative relationships. (Chesson and Shea 2002).

Chesson, P. and K. Shea (2002). "Invasion resistance and community maturity in model systems of diffusely interacting organisms." [Ecological Society of America Annual Meeting Abstracts](#) [print] **87**: 97-98.

Shea, K. and P. Chesson (2002). "Community ecology theory as a framework for biological invasions." [Trends in Ecology and Evolution](#) **17**: 170-176.