

Increase in the Persistence of Various Invaded Multiplex Metacommunities Induced by Heterogeneity of Motifs

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Abstract : Numerous studies have typically demonstrated the devastation of invasions on an isolated ecosystem or, at most, a network of dispersively coupled similar ecosystem patches. Using such a simplistic 2-D network model, one can only consider dispersal coupling and inter-species trophic interactions. However, in a realistic ecosystem, numerous species co-exist and interact trophically and non-trophically in groups of 2 or more. Even different types of dispersal can introduce complexity in an ecological network. Therefore, a more accurate representation of actual ecosystems (or ecological networks) is a complex network consisting of motifs formed by two or more interacting species. Here, the apropos structure of the network should be multiplex or multi-layered. Motifs between different patches or species should be identical within the same layer and vary from one layer to another. This study investigates three distinct ecological multiplex networks facing invasion from one or more external species. This work determines and quantifies the criteria for the increased extinction risk of these networks. The dynamical states of the network with high extinction risk, i.e., the danger states, and those with low extinction risk, i.e., the resistive network states, are both subsequently identified. The analysis done in this study further quantifies the persistence of the entire network corresponding to simultaneous changes in the strength of invasive dispersal and higher-order trophic and non-trophic interactions. This study also demonstrates that the ecosystems enjoy an inherent advantage against invasions due to their multiplex network structure.

Keywords : increased ecosystem persistence, invasion on ecosystems, multiplex networks, non-trophic interactions

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