

The Markovian Community Dynamics (MCD) framework in Community Ecology

Omri Allouche and Ronen Kadmon
Department of Ecology, Systematics and Evolution
The Hebrew University
Givat Ram 91904, Jerusalem, Israel

Abstract

Ecological research over the years has pointed to the existence of a wide spectrum of 'semi-universal' patterns of species diversity, found over very different life forms and ecosystems (e.g., the species-area relationship, the productivity-diversity relationship, the local-regional diversity relationship, etc.). We present the Markovian Community Dynamics (MCD) framework as a powerful platform for analyzing the mechanisms underlying these patterns. The MCD framework uses a stochastic individual-based model of an ecological community, based on the theory of Markov processes. The analytically-tractable model is both general and highly flexible, and can easily incorporate a wide spectrum of ecological factors including the effects of area, geographical isolation, habitat loss, habitat heterogeneity, life-history characteristics and trade-offs, density dependence, community-level carrying capacity, competition for space, various forms of dispersal (random dispersal, preference for unoccupied sites, preference for suitable habitats), and complete flexibility in the demographic rates of individual species. The MCD framework can be used to formulate and solve modern models of the neutral theory, and is capable of explaining a surprisingly wide spectrum of the 'semi-universal' patterns of species diversity. The generality, high flexibility and analytic tractability of the MCD framework make it a powerful platform for other research fields as well.