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Multi-scaled multi-mechanism biodiversity maintenance theory

Peter Chesson*

pchesson@email.arizona.edu

URL : <http://eeb.arizona.edu/people/dr-peter-chesson>

Contemporary approaches to community assembly, species coexistence, and the maintenance of biodiversity that they imply, focus on spatially local coexistence of species assembled from a regional species pool. However, coexistence in local communities has long been controversial. Moreover, local communities are not natural ecological entities in most cases, but are more defined by convenience for study. In general, they are open to immigration on ecological timescales, and so do not satisfy the requirements for most theories of coexistence and diversity maintenance, which assume that communities are closed. A resolution of these issues comes from scale transition theory and the techniques for quantifying species coexistence that have been developed in that framework. Scale transition theory allows contributions to species coexistence to be integrated over space and time. For a given unit of space, contributions to species coexistence within that unit are expressed in terms of contributions from all units on lower scales. These contributions are measured in terms of strength of recovery of a species perturbed to low density, discounting immigration of that species from other spatial units. This procedure allows assessment of sufficiency of mechanisms on a given scale for the biodiversity found there, thus indicating the extent to which contributions from larger scales are needed to explain the diversity in a given spatial unit of a given size, for a given timescale. The quantification technique allows multiple mechanisms to be assessed simultaneously, and compared for their contributions to biodiversity maintenance. Moreover, this theory breaks down the artificial distinction between the community and the species pool, and instead expresses these ideas as mutually dependent and scale dependent. Finally, this theory reveals a close mutually-dependent relationship between spatio-temporal patterns in the physical and biological environments and the maintenance of species diversity.

*Department of Ecology & Evolutionary Biology, The University of Arizona, P.O. Box 210088, Tucson, AR, USA.