Dispersal evolution in a metacommunity facing climate change

Peter Kamal*[1] and Emanuel Fronhofer[1]

[1]Institut des Sciences de l'Evolution de Montpellier – CNRS – France

Abstract

Global biodiversity is severely threatened by anthropogenic climate change. Species can respond to climate change by shifting their range or adapting to the novel conditions. These responses are mediated by biotic interactions such as competition. Advances in metacommunity theory have shown that the interplay between dispersal, local adaptation, and competition can decimate biodiversity through monopolization effects. Monopolization effects occur when earlier-arriving species outcompete later-arriving species because they had more time to adapt locally. The models used in this literature generally assume fixed dispersal rates. However, dispersal is genetically determined and has been shown to evolve rapidly during range expansions. Therefore, we explore how dispersal evolution modulates metacommunity dynamics under climate change. Using a stochastic, spatially explicit, individual-based model, we find: (i) An evolving dispersal rate can produce a wide range of metacommunity dynamics from species sorting to monopolization - even before climate change. (ii) Which dynamic occurs is heavily determined by the environmental drivers of dispersal evolution such as habitat fragmentation and environmental stochasticity. (iii) Whether a specific dynamic persists during climate change depends largely on the species' potential to adapt locally. (iv) The genotype-phenotype map of dispersal has implications for metacommunity dynamics, and particularly for monopolization. Our findings demonstrate that dispersal evolution, its drivers, and its genetic structure are key ingredients in refining biodiversity projections under climate change.

Keywords: eco evolutionary dynamics, dispersal, metacommunity, climate change, monopolization

*Speaker