Eco-evolutionary dynamics in plant-pollinator systems: implication for diversity maintenance

Avril Weinbach*†[2,1], Nicolas Loeuille[1], and Rudolf Rohr[2]

[2]Ecology Evolution, Department of Biology, University of Fribourg (UniFr) – Department of Biology Ecology Evolution Chemin du Musée 10 CH-1700 Fribourg, Switzerland

[1]Institut of Ecology and Environmental Sciences, Paris (iEES - Paris) – iEES - Paris – Sorbonne Université, campus Pierre-et-Marie-Curie, Bâtiment 44-45 - 4e étage Case Courrier 237 4, place Jussieu 75252 PARIS cedex 5, France

Abstract

Recent pollinator population declines raise concerns for the future of the pollination service. It also strongly affects the evolution of plant-pollinated species. We wonder here if plant evolution can help maintain plant-pollinator coexistence in this pollination crisis context. We build a simple pollinator-plant model that assumes an allocation trade-off between the attractiveness of the plant (e.g. nectar production, flower shape and size) and its intrinsic growth rate. Using eco-evolutionary dynamics, we investigate the evolution of plant investment in attractiveness (as a proxy for pollination services) and its consequences on species persistence and biomasses production. Especially, we study the role of the allocation trade-off shape and the mutualistic interaction asymmetry on the eco-evolutionary dynamics. First, we show that only a concave allocation trade-off allows the existence of evolutionary stable strategy with coexistence of both the plant and the pollinator. Second, a decline in pollinator population is most likely to results in a plant-driven disappearance of the mutualistic interaction accompanied by the extinction of the pollinator population. However, asymmetry in mutualistic interaction that is beneficial for the pollinator might help maintaining its population. Therefore, our model undercover that in addition to the direct effects due to changes in ecological dynamics, pollinator populations may be further weakened by the evolution of attractiveness in plant populations. Our results also suggest that if actions are taken to save endangered pollinator populations, they need to be enforced early enough to prevent potential negative effects of plant-driven evolution. Finally we discuss impacts of plant flowering phenology on pollinator foraging phenology evolution.

*Speaker

†Corresponding author: avril.weinbach@sorbonne-universite.fr