From friend to foe and back again - Coevolution of partner discrimination and degree of cooperativeness drives transitions in the mutualism-antagonism continuum

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Résumé

Mutualism and antagonism are not unbridgeable opposites but rather span a continuum across which interspecific interactions can evolve. The drivers of evolutionary transitions from mutualism to antagonism and vice versa often remain unclear; for example, in the case of yucca moths, which stop pollination but continue oviposition. Instead of treating both transition directions equally, theory so far focused on identifying mechanisms that promote evolution of mutualism and prevent breakdown to antagonism. These mechanisms often involve some form of partner discrimination ensuring that interaction intensity is higher with more cooperative partners. For this conditionality to evolve in the first place, it is assumed that variation in partner's level of cooperativeness is crucial; however, this is questioned by empirical results. Assuming instead monomorphic populations, we present an eco-evolutionary model of the coevolution of discrimination ability in one partner with degree of cooperativeness in the other. Our results reveal two potential pathways of evolutionary transitions from mutualism to antagonism and vice versa. First, the transient dynamics of the model suggest the possibility of transitions in both directions after strong ecological change such as a radical host shift or colonization of a new environment. This includes the interesting possibility of a back-and-forth transition from antagonism to mutualism and back. Second, we find an evolutionary tipping point: A stable mutualism may break down to antagonism if the cost of mutualistic service or discrimination ability gradually increases above a threshold, beyond which this transition cannot be reversed by reducing costs again. Our study provides a new perspective on transitions in the mutualism-antagonism continuum by jointly investigating transitions in both directions and relaxing the assumption of intraspecific trait variation.

Mots-Clés: mutualism antagonism continuum, coevolution, ecological interactions, ecological modelling, theoretical ecology

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