Zu, Jian; Li, Miaolei; Gu, Yuexi; Fu, Shutong
Modelling the evolutionary dynamics of host resistance-related traits in a susceptible-infected community with density-dependent mortality. (English) Zbl 1444.92073

Summary: This study explores the evolutionary dynamics of host resistance based on a susceptible-infected population model with density-dependent mortality. We assume that the resistant ability of susceptible host will adaptively evolve, a different type of host differs in its susceptibility to infection, but the resistance to a pathogen involves a cost such that a less susceptible host results in a lower birth rate. By using the methods of adaptive dynamics and critical function analysis, we find that the evolutionary outcome relies mainly on the trade-off relationship between host resistance and its fertility. Firstly, we show that if the trade-off curve is globally concave, then a continuously stable strategy is predicted. In contrast, if the trade-off curve is weakly convex in the vicinity of singular strategy, then evolutionary branching of host resistance is possible. Secondly, after evolutionary branching in the host resistance has occurred, we examine the coevolutionary dynamics of dimorphic susceptible hosts and find that for a type of concave-convex-concave trade-off curve, the finally evolutionary outcome may contain a relatively higher susceptible host and a relatively higher resistant host, which can continuously stably coexist on a long-term evolutionary timescale. If the convex region of trade-off curve is relatively wider, then the finally evolutionary outcome may contain a fully resistant host and a moderately resistant host. Thirdly, through numerical simulation, we find that for a type of sigmoidal trade-off curve, after branching due to the high cost in terms of the birth rate, always the branch with stronger resistance goes extinct, the eventually evolutionary outcome includes a monomorphic host with relatively weaker resistance.

MSC:
92D15 Problems related to evolution
92D25 Population dynamics (general)
92D30 Epidemiology
35Q92 PDEs in connection with biology, chemistry and other natural sciences

Keywords:
adaptive dynamics; evolutionary branching; evolutionarily stable coexistence; host-pathogen interactions; evolutionary extinction

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