Demographic fluctuations and selection during host-parasite coevolution interactively increase genetic diversity

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Abstract

Host-parasite interactions can cause strong demographic fluctuations accompanied by selective sweeps of resistance/infectivity alleles. Both demographic bottlenecks and frequent sweeps are expected to reduce the amount of segregating genetic variation and therefore might constrain adaption during coevolution. Recent studies, however, suggest that the interaction of demographic and selective processes is a key component of coevolutionary dynamics and may rather positively affect levels of genetic diversity available for adaptation. Here, we provide direct experimental testing of this hypothesis by disentangling the effect of demography, selection, and of their interaction in an experimental host-parasite system. We grew 12 populations of unicellular algae (Chlorella variabilis) that experienced either growth followed by constant population sizes (3 populations), demographic fluctuations (3 populations), selection induced by exposure to a virus (3 populations), or demographic fluctuations together with virus-induced selection (3 populations). After 50 days, we conducted whole-genome sequencing of each algal population. We observed more genetic diversity in populations that jointly experienced selection and demographic fluctuations than in populations where these processes were experimentally separated. In addition, in those 3 populations that jointly experienced selection and demographic fluctuations, experimentally measured diversity exceeds expected values of diversity that account for the cultures' population sizes. Our results suggest that eco-evolutionary feedbacks can positively affect genetic diversity and provide the necessary empirical measures to guide further improvements of theoretical models of adaptation during host-parasite coevolution.

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