Towards a theory of host recovery dynamics following disease-induced declines: an epi-eco-evo perspective

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Recoveries of populations that have suffered severe disease-induced declines are being observed across disparate taxa. Yet, we lack theoretical understanding of the drivers and dynamics of recovery in host populations and communities impacted by infectious disease. We developed an epidemiological-ecological-evolutionary (E3) model to dissect the anatomy of host recovery trajectories following disease-induced declines and asked three questions: 1) how does host life history, pathogen life history, and initial variability in host defense affect population recovery trajectories? 2) how do recovery trajectories differ between host populations evolving different defense strategies? and 3) how do community interacons alter recovery trajectories and reorganize communies following disease-induced declines? Simulations suggest that host life history is a major driver of recovery trajectories, with faster hosts declining less and recovering more quickly than slower hosts. Host defense strategy also affected trajectories, with hosts using resistance strategies generally recovering more quickly than hosts using tolerance strategies. However, recovery dynamics were highly dependent on community structure. By idenfying predictable characteristics of host recoveries, the E3 model provides a foundation to link observed patterns of host recovery to underlying processes.