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## Appearance of Multistability and Hydra Effect in a Discrete-Time Epidemic Model with Ricker Growth

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# Appearance of Multistability and Hydra Effect in a Discrete-Time Epidemic Model with Ricker Growth

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March 6, 2023

## Abstract

One-dimensional discrete-time population models, such as Logistic or Ricker growth, can exhibit periodic and chaotic dynamics. Incorporating epidemiological interactions through the addition of an infectious class causes an interesting complexity of new behaviors. Previous work showed that infection that abrogates fecundity can lead to unexpected increases in total population size, a phenomenon known as the ‘hydra effect.’ Here, we examine a two-dimensional susceptible-infectious (SI) model with underlying Ricker population growth and show that the disease-free system has a distinct bifurcation structure from the system with infection. We use numerical bifurcation analysis to determine the influence of infection on the types and appearance of qualitatively distinct long-time dynamics. We find that disease-induced mortality leads to the appearance of multistability, such as stable four-cycles and chaos dependent upon the initial condition. In addition, we examine the appearance and extent of the hydra effect, particularly when infection is introduced during cyclic or chaotic population dynamics.