Demographic population cycles and $\mathcal{R}_0$ in discrete-time epidemic models

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A general autonomous discrete-time infectious disease model is used to extend the next generation matrix approach to calculate the basic reproduction number, $\mathcal{R}_0$, in populations with locally asymptotically stable periodic k-cycles in the disease free system, where $k \geq 1$. Under the period k demographic assumption, it is shown that the disease goes extinct if $\mathcal{R}_0 < 1$, but persists if $\mathcal{R}_0 > 1$. Using the Ricker recruitment function, the results are applied to a Susceptible-Infectious-Recovered (SIR) disease model, and to an Infectious Salmon Anemia Virus (ISAv) model. For $\mathcal{R}_0 > 1$, simulations show that the disease-free period k cycle drives the SIR disease dynamics, but not the ISAv dynamics.

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