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Dynamics of SI models with both horizontal and vertical transmissions as well as Allee effects.

A general SI (Susceptible-Infected) model with both horizontal and vertical transmissions is studied within a host population whose fitness, net reproduction term, is impacted by Allee effects with infected individuals experiencing pathogen-induced reductions in reproductive ability. SI models that incorporate frequency-dependent (SI-FD model) or density-dependent (SI-DD model) horizontal transmission are analyzed and compared. The analysis identifies conditions involving reproduction numbers linked to horizontal and vertical transmission that determined the dynamics of SI-FD and SI-DD models, respectively. Specifically, we identify conditions that lead to disease-driven extinction, or disease-free dynamics, or susceptible-free dynamics or endemic disease patterns. We observe that the SI-FD model supports richer dynamics than the SI-DD model. In both SI models, small horizontal transmission rates can lead to susceptible-free dynamics while low levels of reproductive ability within the infective population can lead to disease-driven extinction scenarios. In addition, we identified conditions under which diffusive instability can occur for general SI models as well as prey-predator models.

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