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Phase-plane analysis of steady states of a spruce budworm model with advection

The classical non-spatial Ludwig-Jones-Holling model and its reaction-diffusion version, the Ludwig-Aronson-Weinberger model, describe population dynamics of spruce budworm. Due to the complexity of the reaction term, under certain conditions, these models admit both endemic and outbreak steady state solutions. We explore the reaction-diffusion-advection version of the Ludwig-Aronson-Weinberger model, where advective term is interpreted as biased movement due to prevailing wind. Such a model can also describe other ecological settings where a logistically growing population is subject to diffusion, advection and predation by a generalist. We use phase-plane analysis to determine conditions for the existence of the outbreak solutions. In particular, we observe that increasing advection can prevent outbreaks while allowing persistence in the form of an endemic state. We obtain upper and lower bounds for the critical advection for outbreak steady state solutions. This is a joint work with Abby Anderson.