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A comparison of two predator-prey models with a Holling type I functional response

I analyze and compare two models, a laissez-faire and a Leslie-type predator-prey model, with Holling type I functional responses. I show, numerically, that the two models can possess two limit cycles surrounding a stable equilibrium and that these cycles arise in global cyclic-fold bifurcations. The Leslie-type model may also exhibit super-critical and discontinuous Hopf bifurcations. I then present and analyze a new functional response, built around the arctan, that smoothes the sharp corner in a type I functional response. For this new functional response, both models undergo Hopf, cyclic-fold, and Bautin bifurcations.