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Pest Control by Generalist Parasitoids: A Bifurcation Approach

Magal, Cosner, and Ruan (Math. Med. Biol. 25,1-20; 2008) studied both spatial and non-spatial host-parasitoid models motivated by the need for biological control of horse-chestnut leafminers that have spread through Europe. In the non-spatial model, they considered control by predation of leafminers by a generalist parasitoid population with functional response modeled using a Holling type II (Monod) form. They showed that there can be at most six equilibrium points, and discussed their local stability. We revisit their model in the non-spatial case, and identify cases missed in their investigation and the ramifications for possible pest control strategies. Both the local stability of equilibria and global properties are considered. A bifurcation theoretical approach is used. We provide analytical expressions for fold and Hopf bifurcations. Numerical results show very interesting dynamics, e.g., multiple coexisting limit cycles, homoclinic orbits, codimension one bifurcations including: Hopf, fold, transcritical, cyclic-fold, and homoclinic bifurcations, as well as codimension two bifurcations including: Bautin and Bogdanov-Takens bifurcations.

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