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A Predator-Prey Model with a Holling Type I Functional Response Including a Predator Mutual Interference

The most widely used functional response in describing predator-prey relationships is the Holling type II functional response, where per capita predation is a smooth, increasing, and saturating function of prey density. Beddington and DeAngelis modified the Holling type II response to include interference of predators that increases with predator density. In this talk, I introduce a predator-interference term into a Holling type I functional response. I explain the ecological rationale for the response and note that the phase plane configuration of the predator and prey isoclines differs greatly from that of the Beddington-DeAngelis response; for example, in having three possible interior equilibria rather than one. In fact, this new functional response seems to be quite unique. I use analytical and numerical methods to show that the resulting system shows a much richer dynamical behavior than the Beddington-DeAngelis response, or other typically used functional responses. For example, cyclic-fold, saddle-fold, homoclinic saddle connection, and multiple crossing bifurcations can all occur. I then use a smooth approximation to the Holling type I functional response with predator mutual interference to show that these dynamical properties do not result from the lack of smoothness, but rather from subtle differences in the functional responses. This is joint work with Donald L. DeAngelis at the University of Miami.