Equations with State-Dependent Delay in Population Biology

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A novel class of state-dependent delay equations is derived from the balance laws of age-structured population dynamics, assuming that birth rates and death rates, as functions of age, are piece-wise constant and that the length of the juvenile phase depends on the total adult population size. The resulting class of equations includes also neutral delay equations.

These equations can be written as systems for two variables consisting of an ordinary differential equation (ODE) and a generalized shift, a form suitable for numerical calculations. It is shown that the neutral equation (and the corresponding ODE - shift system) is a limiting case of a system of two standard delay equations.

We provide results on existence, uniqueness of solutions and linearized stability of equilibria, as well as numerical simulations.

References

[1] M. V. Barbarossa, K. P. Hadeler and C. Kuttler, *State-dependent neutral delay equations from population dynamics* (submitted)