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On Nicholson's Blowflies and Other Models with a Distributed Delay

We consider the Nicholson's blowflies equation with a distributed delay

$$\dot{N}(t) = -\delta N(t) + p \int_{h(t)}^{t} N(s) e^{-aN(s)} \, d_s R(t,s), \quad t \geq 0,$$

and obtain existence, positiveness and permanence results for solutions with positive initial conditions. In the range of parameters p, δ, where the relevant equation with a constant delay is locally asymptotically stable (see the paper by Michael Li *et al.*, we prove that the solution is globally stable, as far as $h(t)$ tends to infinity for $t \to \infty$. We also consider the general equation with several distributed delays

$$\dot{x}(t) + \sum_{k=1}^{m} r_k(t) \int_{-\infty}^{t} f_k\big(x(s)\big) \, d_s R_k(t,s) = 0,$$

which includes equations with several delays and integrodifferential equations as special cases and obtain some additional results for this equation, like linearized oscillation theorems. The results are applied to logistic, Lasota–Wazewska and Nicholson's blowflies equations with a distributed delay.

In addition, the "Mean Value Theorem" is proved which claims that any solution of an equation with a distributed delay also satisfies the linear equation with a variable concentrated delay.