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An alternative formulation for a distributed delayed logistic equation

We study the alternative single species logistic distributed delay differential equation (DDE) with decay-consistent delay in growth. Population oscillation is rarely observed in nature, in contrast to the outcomes of the classical logistic DDE. In the alternative discrete delay model proposed by Arino et al. [J. Theor. Biol. 2006, pp109–119], oscillating behavior is excluded. This study adapts their idea of the decay-consistent delay and generalizes their model.

We establish a threshold for survival and extinction: in the former case, it is confirmed using Lyapunov functionals that the population approaches the delay modified carrying capacity; in the later case the extinction is proved by the fluctuation lemma. We further use the adaptive dynamics to conclude that the evolutionary trend is to make the mean delay in growth as short as possible. This confirms Hutchinson's conjecture and fits biological evidence.