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Existence and Asymptotic Behavior of Positive Solutions of a Non-Autonomous Food-Limited Model with Unbounded Delay

Consider the non-autonomous logistic model

$$\Delta x_n = p_n x_n \Big(\frac{1 - x_{n-k_n}}{1 + \lambda x_{n-k_n}} \Big)^r \qquad (n \geq 0)$$

where $\Delta x_n = x_{n+1} - x_n$, $\{p_n\}$ is a sequence of positive real numbers, $\{k_n\}$ is a sequence of non-negative integers such that $\{n - k_n\}$ is non-decreasing, $\lambda \in [0, 1]$, and r is the ratio of two odd integers. We obtain new sufficient conditions for the attractivity of the equilibrium $x = 1$ of the model and conditions that guarantee the solution to be positive, which improve and generalize some recent results established by Phios and by Zhou and Zhang.