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GLOBAL DYNAMICS IN PERIODIC HOLLING-TANNER MODELS WITH IMPULSES

Mirella Cappelletti Montano[1] and Benedetta Lisena[1]

[1]Dipartimento di Matematica
Università degli Studi di Bari "A. Moro", 70125 Bari, ITALY

Abstract. In this paper we establish sufficient conditions for the existence and the global asymptotic stability of the positive periodic solution to periodic Holling-Tanner systems with impulses. We carry on the investigation of the global attractivity by means of a piecewise continuous Lyapunov function. In the autonomous case, the general sufficient conditions for the global asymptotic stability lead to simple inequalities involving the system coefficients.

Keywords. Predator-prey. Periodic solution. Impulses. Global stability. Lyapunov function.

AMS (MOS) subject classification: 34C25, 34A37, 92D25.

1 Introduction

The increasing interest devoted to the investigation of mathematical models in ecology is due to their importance in understanding the dynamic relationship between interacting populations. A predator-prey model is a differential system in which the growth rate of one population is decreased and the other increased. The Lotka-Volterra model is one of the most known predator-prey models thanks to its simplicity and historical importance.

More recently, many authors have investigated the predator-prey relationship through the more realistic Leslie system

$$\begin{cases} x' = x(a - b\,x) - p(x)\,y \\ y' = y\left(d - e\,\dfrac{y}{x}\right), \end{cases} \tag{1.1}$$

where $x(t)$ and $y(t)$ are the density of the prey and the predator species, respectively, at time t and $p(x)$ is the so called predator functional response to the prey (see [20]). In (1.1) the prey has logistic growth, in absence of predators, the predator still grows logistically, but its carrying capacity $\dfrac{d}{e}x(t)$ depends on the prey $x(t)$; hence, the second equation in (1.1) has a certain singularity at $x = 0$.

To avoid such a singularity, in [2] the authors proposed a predator-prey model containing a modified Leslie-Gower term, that is the second equation