Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **23 (2016)** 91-112

COMPLEX DYNAMICS OF A FORCED DISCRETE LESLIE–GOWER TYPE THREE SPECIES FOOD CHAIN SYSTEM

A. Elhassanein[1,2]
[1]Department of Mathematics
Faculty of Sciences, University of Damanhour, Damanhour, Egypt
[2] Department of Mathematics
Faculty of Sciences and Arts, University of Bisha, Bisha, Saudi Arabia
E-mail address: el_hassanein@yahoo.com

Abstract. In this paper, a forced discrete chaotic Leslie–Gower type three species food chain model is presented. The chaotic behavior of the proposed model is investigated. The existence and stability of the equilibria of the skeleton are studied. Numerical simulations are employed to show the model's complex dynamics by means of the largest Lyapunov exponents, bifurcations, time series diagrams and phase portraits. Time series diagrams are used to follow the dynamics of the model and discuss the marginal distribution of the state variables. The effects of noise intensity on its dynamics and the intermittency phenomenon are also discussed via simulation.

Keywords. Ecosystems; Three species food chain; Intermittency; Skeleton; Time series; Bifurcations; Chaos.

AMS (MOS) subject classification: 34K60; 34K23; 37M10; 91B70; 93E03.

1 Introduction

The ecosystems have largely been studied, see [12, 28, 40, 44, 46, 48, 49, 53]. In recent years, there has been an increasing interest in predator-prey model in continuous time scale, see [17, 20, 29, 32-34, 43, 50-52]. The local and global stability for a predator–prey model of modified Leslie–Gower and Holling-type II with time-delay has been considered by Lin and Ho [35]. Bifurcation analysis of a Leslie–Gower prey–predator model with Holling-type III functional response has been studied by Li and Xiao [32]. The global stability of a Leslie–Gower prey–predator model with proportional harvesting in both prey and predator has been studied by Zhang et al. [54]. By defining a suitable Lyapunov function, the global stability of the unique interior equilibrium of the system was shown , which means that suitable harvesting has no influence on the persistent property of the harvesting system. Mena-Lorca et al. [39] studied the dynamics of the Leslie–Gower model subjected to the Allee effect with proportionate harvesting. The dynamical behavior