Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **27 (2020)** 375-396
 http://www.watam.org

EXTINCTION OR COEXISTENCE OF A PREDATOR-PREY MODEL WITH CONSTANT-YIELD HARVESTING

[1] Chunyan Zuo and Hongjun Cao[2]
[1] Department of Mathematics, School of Science
Hebei University of Science and Technology
Shijiazhuang, Hebei 050000, P. R. China
[2] Department of Mathematics, School of Science
Beijing Jiaotong University
Beijing 100044, P. R. China
email:hjcao@bjtu.edu.cn

Abstract. In this paper, we discuss a predator-prey model with the constant-yield prey harvesting. Using the qualitative theory and bifurcation theory, we prove that the model exists different types and numbers of equilibria such as saddle, node, focus and saddle-node, even a cusp in different parameter regions. When parameters of this model vary, the model exhibits saddle-node bifurcations and Hopf bifurcations. Numerical simulations, including phase portraits and limit cycles corresponding to different parameter regions are presented to support qualitative analyses. One of our results demonstrates that the parameter h plays an important part in the model. When $h > \frac{1}{4}$, this model has no any equilibrium, which means that the prey species becomes extinct, in turn drives predators to extinction, this is so-called over harvesting phenomenon. When $0 < h \leq \frac{1}{4}$, there exist various types and numbers of equilibria of this model in different parameter regions. Once the corresponding parameters and some special initial values are chosen, the prey species can persist regarding to different types and numbers of equilibria of the model, which in turn drives both species to coexist. These results demonstrate that nonlinear dynamical behaviors of the model are very sensitive on the constant-yield harvesting. Much attention should be paid on the constant-yield harvesting as far as the management of renewable resource and policies decision are concerned.

Keywords:Predator-prey model and constant-yield harvesting and extinction and coexistence and maximum sustainable yield and saddle-node and Hopf bifurcations

1 Introduction

In the last three decades, great attention has been paid to investigate the effect of harvesting on the dynamics of predator-prey systems and the role of harvesting in the management of renewable resources [1, 2, 5, 6, 7, 8, 9]. Two types of harvesting regimes, namely, constant-effort harvesting and constant-