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STABILITY, BIFURCATION AND LIMIT CYCLE FOR A PREDATOR-PREY MODEL WITH SOME FEEDBACK CONTROL

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Abstract. This paper is devoted to a predator-prey model with some feedback control. We prove that there exist a unique positive equilibrium or three positive equilibria for such model if the feedback control parameters satisfy some conditions. We also show that, under some additional assumptions, the positive equilibrium is asymptotically stable. Finally, we study the existence of limit cycles as well as bifurcations in this predator-Prey model. It is further shown that there exist infinite bifurcation points as long as the parameters of the model is in some area. Numerical simulations demonstrate this asymptotic behavior depending on parameters of the species.

Keywords. Stability, Limit cycle, Parameter domains of the Stability, Bifurcation, Feedback control

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1 Introduction

Mathematical biology is one of the most exciting modern applications of mathematics. Till now, ordinary differential equations, partial differential equations and numerical analysis and so on, have become fundamental tools in revealing the underlying mechanisms involved in the biological processes. The research [1, 3-6, 8-11] shows that the best mathematical biology model can show how a biological process works and then predict what may follow.

One of the most interesting topics in mathematical ecology concerns the protection of plants from insect pests. Of course, chemical insecticides can be used to exterminate pests, but the side effect of insecticides to the health of a human being and the possible insect adaptation to the insecticides (thus their population rapidly regains their sizes) force us to find better ways to resist pest. From the practice of plant protection, we find that combining natural enemies of insects with chemical insecticides may have better effect on resisting pest. In fact the natural enemy of insect pest can be bred in special incubators and released from the incubators to the environment to cut down the population of the insect pest. In order to clarify how many incubation predators should be released to reduce the pest population to a