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A Self-Diffusion Mathematical Model to Describe the Toxin Effect on the Zooplankton-Phytoplankton Dynamics

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Abstract: The main goal of this work is the mathematical formulation, the analysis and the numerical simulation of a prey-predator model by taking into account the toxin produced by the phytoplankton species. The mathematical study of the model leads us to have an idea on the existence of solution, the existence of equilibria and the stability of the stationary equilibria. These results are obtained through the principle of comparison. Finally, the numerical simulations in two-dimensional allowed us to establish the formation of spatial patterns and a threshold of release of the toxin, above which we talk about the phytoplankton blooms.

Keywords: *toxin effect; populations dynamics; predator-prey model; reaction-diffusion; pattern formation.*

Mathematics Subject Classification (2010): 65L12, 65M20, 65N40.

1 Introduction

Ecology and harmful toxic release in marine environment are major fields of study in their own right, but there are some common features of these systems. It is interesting and important from biological viewpoints to study ecological systems under the influence of the toxic substance release factors. However, this goal remains difficult to attain due to the complexity of natural systems, especially in the aquatic environment where many processes of all types interact with living organisms. The fundamental basis of all aquatic food chains is plankton, and phytoplankton in particular occupies the first trophic level and the fluctuations in its abundance determine the production of a whole marine

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