COEXISTENCE IN AN INTRAGUILD PREDATION MODEL WITH HOLLING FUNCTIONAL RESPONSES

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Abstract. An asymmetric intraguild predation model with three species (Prey (P), Meso-Predator (MP) and Super-Predator (SP)) is analyzed. For the interactions MP-P and SP-MP we have a Holling II functional response; and in SP-P interactions, the functional responses could be type II, III or IV. In all cases, sufficient conditions in the parameter spaces are given to guarantee the coexistence of the three species by means of the existence of stable equilibrium points or limit cycles. Particularly, in the Holling III and IV cases, there exist stable cycles generated by a supercritical Hopf bifurcation. In the Holling II case the dynamics are richer, since we have simultaneous Hopf bifurcations and the existence of two limit cycles generated by a Bautin bifurcation. These results imply that, independently, if predator spends time searching and handling the prey, or there exists defense from the prey, the coexistence of species takes place.

Keywords. Hopf bifurcation, Bautin bifurcation, IGP model, Holling functional responses.

AMS (MOS) subject classification: Pimary, 34C60, 34C23; Secondary, 92D25, 92D40.

1 Introduction

In the study of interactions among species that conform an ecosystem, it is important to consider that their coexistence depends both on intrinsic and external factors. For instance, in the interaction predator prey, the growth rate of the prey and the functional response play an important role in the coexistence of species [3], [18].

A particular interaction is the Intraguild Predation (IGP), which is a food web module that contains three species where two species that are involved in a predator prey relationship are also competing for a shared resource. In this kind of modules the interacting species are the prey or resource (P) in the lowest

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