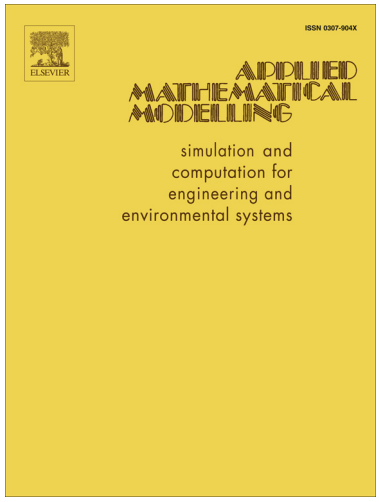

A fuzzy cellular prey-predator model for pest control under sustainable bio-economic equilibrium: A Formal description and simulation analysis study

Cecilia Leal-Ramírez, Oscar Castillo, Patricia Melin, Héctor Echavarria-Heras

PII: S0307-904X(14)00474-0
DOI: http://dx.doi.org/10.1016/j.apm.2014.09.037
Reference: APM 10154

To appear in: *Appl. Math. Modelling*

Received Date: 6 July 2012
Revised Date: 6 December 2013
Accepted Date: 29 September 2014

Please cite this article as: C. Leal-Ramírez, O. Castillo, P. Melin, H. Echavarria-Heras, A fuzzy cellular prey-predator model for pest control under sustainable bio-economic equilibrium: A Formal description and simulation analysis study, *Appl. Math. Modelling* (2014), doi: http://dx.doi.org/10.1016/j.apm.2014.09.037

A fuzzy cellular prey-predator model for pest control under sustainable bio-economic equilibrium: A Formal description and simulation analysis study

Cecilia Leal-Ramírez[1], Oscar Castillo[2], Patricia Melin[2] and Héctor Echavarria-Heras[1]

[1]Centro de Investigación Científica y Educación Superior de Ensenada. Carretera Ensenada-Tijuana 3918, Zona Playitas. Código Postal 22860, Apdo. Postal 360. Ensenada, B. C. México.

[2]Tijuana Institute of Technology, Tijuana Baja California, México.

Corresponding author: ocastillo@tectijuana.mx

Abstract

In the present work we have formulated a mathematical model for an aphid-predator-resource interaction system and studied its performance using simulation procedures. The proposed model integrates spatial heterogeneity using a cellular structure where environmental-favorability drives immigration and emigration processes. Environmental favorability is in our settings fundamental for the control of the dynamics of both populations. Therefore, uncertainty an imprecision in this variable paves the way to consider a fuzzy set framework. Parameter characterization is achieved through variation intervals defined as input and output variables, by using a criterion, in a fuzzy logic system. Simulations results show that the aphid population evolves toward an equilibrium level that depends on the initial values of both populations and the resources. A target bio economic equilibrium defined by the maximum economic benefit derived from the resource can be obtained by modifying the population levels and this can be achieved in an interactive way throughout the associated simulation program. On the basis of the numerical exploration of the performance of the model it is concluded that the model possesses the qualitative properties