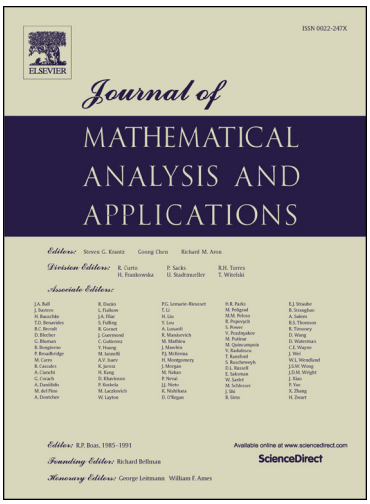
Accepted Manuscript



Bifurcations in a discrete predator–prey model with nonmonotonic functional response

Jicai Huang, Sanhong Liu, Shigui Ruan, Dongmei Xiao

PII: S0022-247X(18)30286-5
DOI: https://doi.org/10.1016/j.jmaa.2018.03.074
Reference: YJMAA 22150

To appear in: *Journal of Mathematical Analysis and Applications*

Received date: 4 July 2017

Please cite this article in press as: J. Huang et al., Bifurcations in a discrete predator–prey model with nonmonotonic functional response, *J. Math. Anal. Appl.* (2018), https://doi.org/10.1016/j.jmaa.2018.03.074

Bifurcations in a Discrete Predator-Prey Model with Nonmonotonic Functional Response

Jicai Huang[1,*], Sanhong Liu[2], Shigui Ruan[3,†] and Dongmei Xiao[4,‡]

[1] *School of Mathematics and Statistics, Central China Normal University, Wuhan, Hubei 430079, P. R. China*

[2] *School of Mathematics and Statistics, Hubei University of Science and Technology, Xianning, Hubei 437100, P. R. China*

[3] *Department of Mathematics, University of Miami, Coral Gables, FL 33146, USA*

[4] *School of Mathematical Sciences, Shanghai Jiao Tong University, Shanghai 200240, P. R. China*

April 6, 2018

Abstract

The predator-prey/consumer-resource interaction is the most fundamental and important process in population dynamics. Many species, such as monocarpic plants and semelparous animals, have discrete nonoverlapping generations and their births occur in regular breeding seasons. Their interactions are described by difference equations or formulated as discrete-time mappings. In this paper we study bifurcations in a discrete predator-prey model with nonmonotone functional response described by a simplified Holling IV function. It is shown that the model exhibits various bifurcations of codimension 1, including fold bifurcation, transcritical bifurcation, flip bifurcations and Neimark-Sacker bifurcation, as the values of parameters vary. Moreover, we establish the existence of Bogdanov-Takens bifurcation of codimension 2 and calculate the approximate expressions of bifurcation curves. Numerical simulations are also presented to illustrate the theoretical analysis. These results demonstrate that the Bogdanov-Takens bifurcation of codimension 2 at the degenerate singularity persists in all three versions of the predator-prey model with nonmonotone functional response: continuous-time, time-delayed, and discrete-time.

Keywords: Discrete predator-prey model; fold bifurcation; transcritical bifurcation; flip bifurcations; Neimark-Sacker bifurcation; Bogdanov-Takens bifurcation.

AMS Subject Classifications: 92D25, 39A11, 37G15.

[*] Research was partially supported by NSFC grants (No.11471133), and Self-determined Research Funds of CCNU from the Colleges Basic Research and Operation of MOE (CCNU16A02009).

[†] Research was partially supported by NSF (DMS-1412454). E-mail address: ruan@math.miami.edu.

[‡] Research was partially supported by NSFC grants (No.11431108, No. 11371248).