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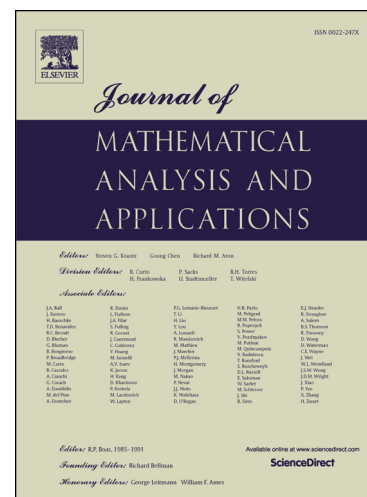
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Bifurcations in a Discrete Predator-Prey Model with Nonmonotonic Functional Response

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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.

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