Dynamical Analysis of a Fractional Order Leslie-Gower Model with Additive Allee Effect

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Abstract

One of well-known mathematical models which describe the dynamics of prey-predator interaction is the modified Leslie-Gower model. In this model, the growth rate of predator is in the form of logistics-type where its carrying capacity is proportional to the prey number and environment protection for predator. In this paper we analyze the dynamics of a fractional order modified Leslie-Gower model with Beddington-DeAngelis functional response and additive Allee effect by means of local stability. In this respect, all possible equilibria and their existence conditions are determined and their stability properties are analyzed. We also construct nonstandard numerical schemes based on Euler scheme as well as on Grünwald-Letnikov approximation. The constructed schemes are explicit and maintain the positivity of solutions. Using these schemes, we perform some numerical simulations to illustrate the dynamical behaviors of the model. It is noticed that the nonstandard schemes preserve the dynamical properties of the continuous model, while the classical schemes may fail to maintain those dynamical properties.