Influence of the Rosenzweig functional response on the dynamics of the Leslie-Gower model

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Abstract

After the well-known classification formulated by Crawford S. Holling in 1959 of the functional responses dependent only of the prey populations, various other have been proposed. In this work a simple Leslie-Gower type predator-prey model is analyzed, incorporating the Rosenzweig functional response described by $h\left(x\right) =qx^{\alpha }$, with $0<\alpha <1$. This function does not conform to the types proposed by Holling, since is not bounded. Although this functional response is non-differentiable for $x=0 $, it is proved that the obtained system is Lipschitzian. However, the existence of a separatrix curve $\Sigma $ in the phase plane it is proven, which divides the phase plane en two complemntary sectors. According to the relative position of the initial conditions respect to the curve $\Sigma $, the trajectories can have differents $\omega $-$limit$, which can be the equilibrium $\left(0,0\right) $, or else, a positive equilibrium point, or a limit cycle or a heteroclinic curve. These properties show the great diffference of this model with the original and well-known Leslie-Gower model (when $\alpha =1$), since this last has only a unique positive equilibrium, which is globally asymptotically stable. Then, it can concluded that i) a small change in the mathematical expression for the functional response, it produces a strong change on the dynamics of model. ii) \ a slightest deviation in the initial population sizes, respect to the curve $\Sigma $, it can signify the coexistence of populations or the extinction of both. Numerical simulations are given to endorse our analytical results.

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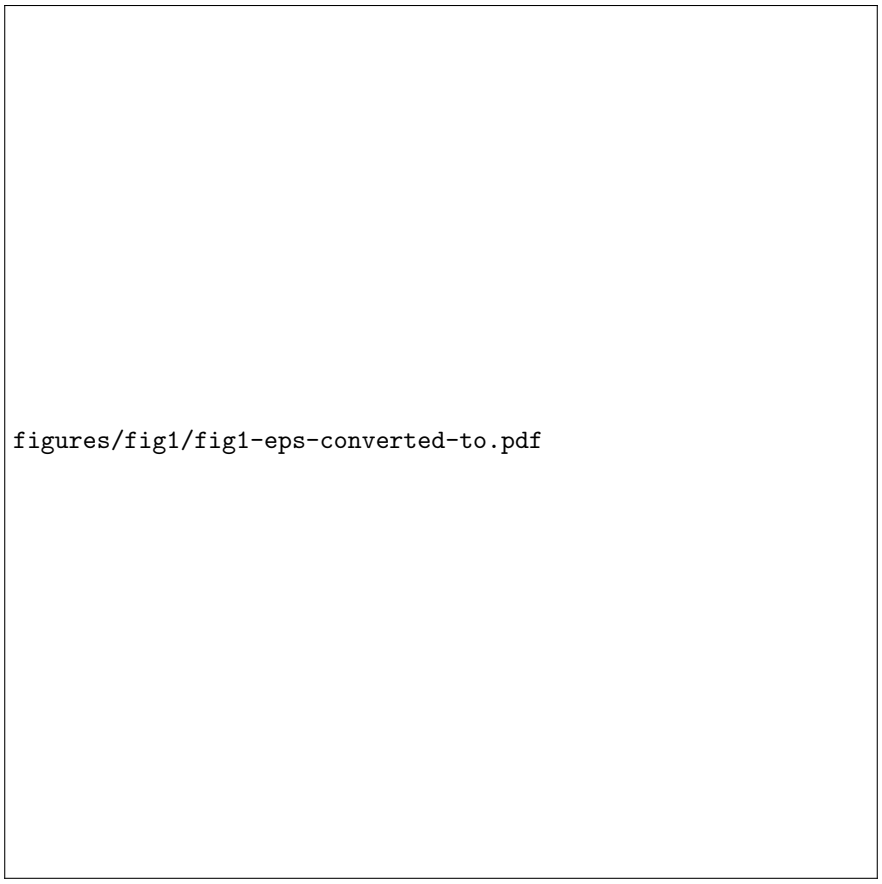

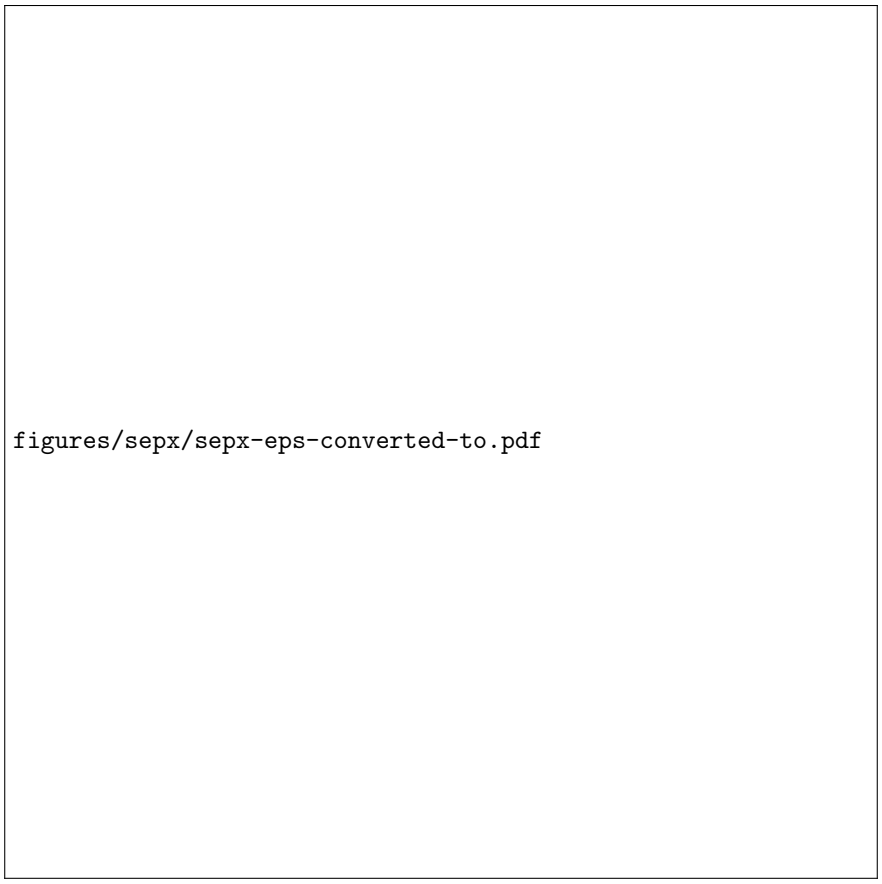

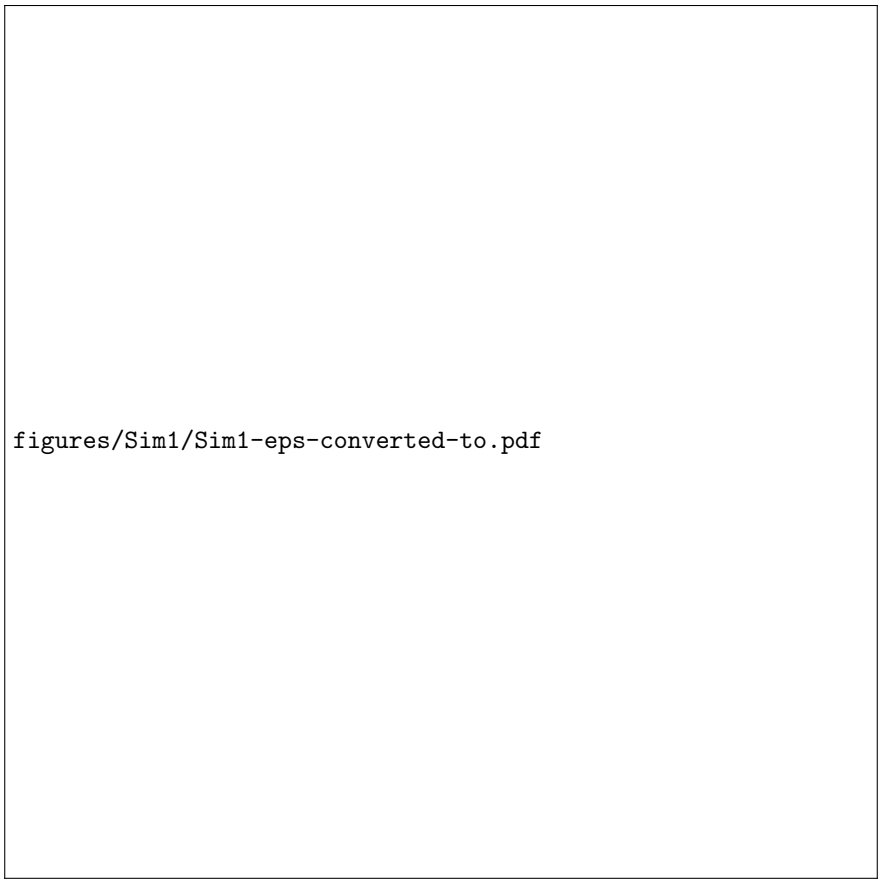

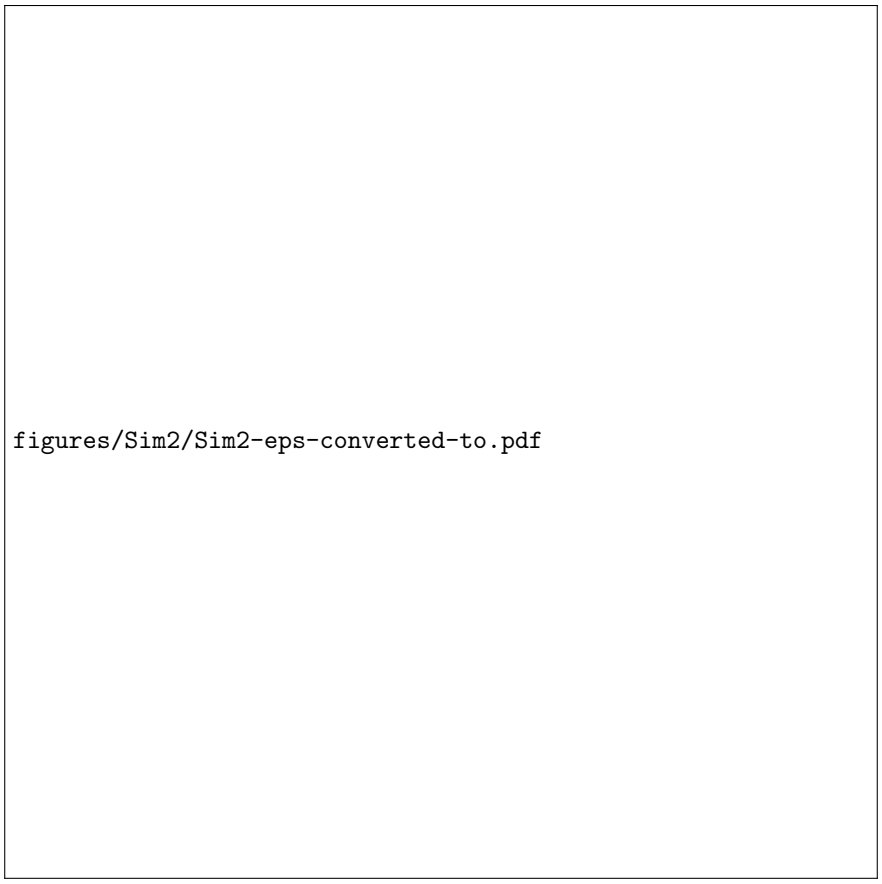

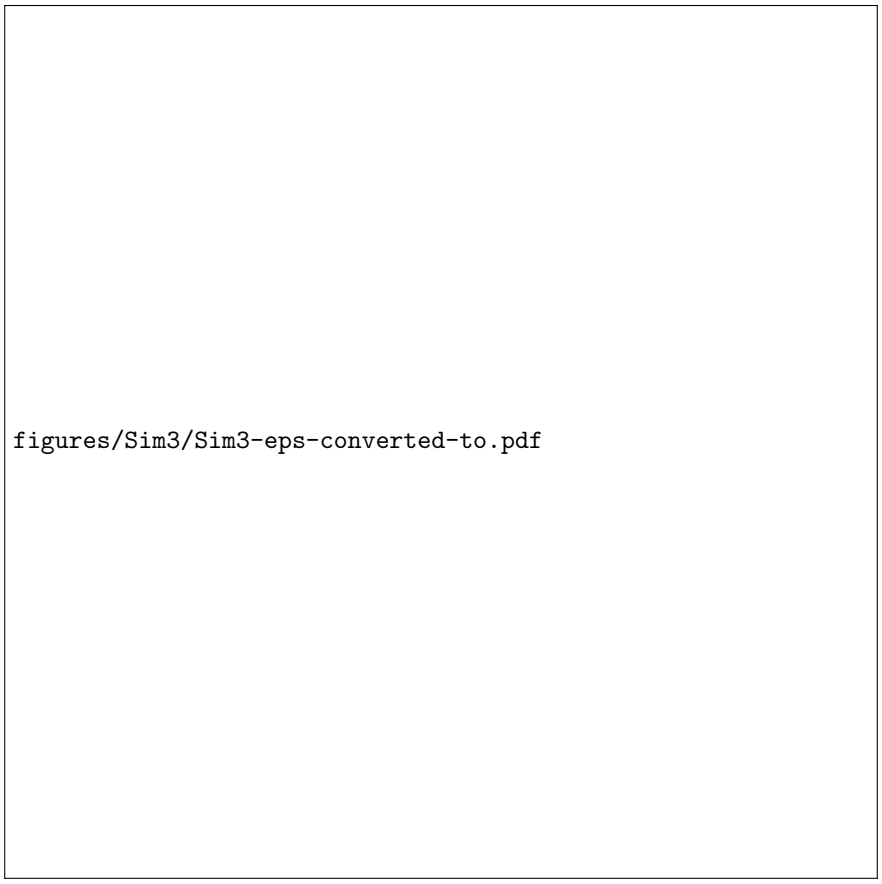

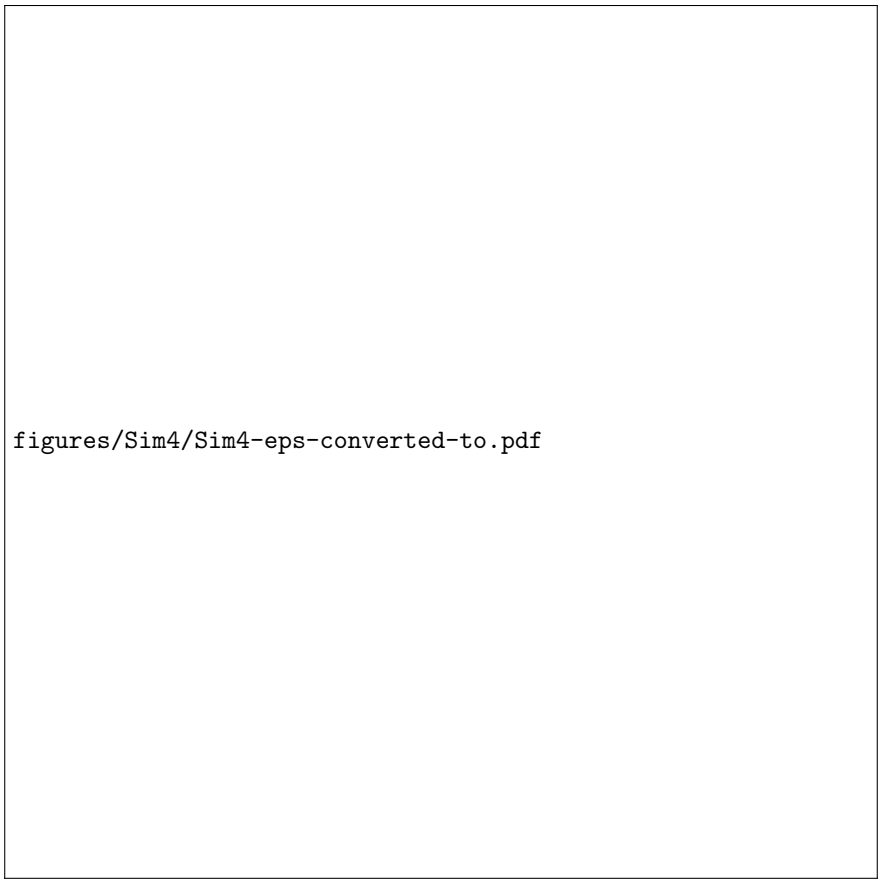

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