

Title: Strong and weak Allee effects and chaotic dynamics in Richards' growths

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Abstract: In this paper we define and investigate generalized Richards' growth models with strong and weak Allee effects and no Allee effect. We prove the transition from strong Allee effect to no Allee effect, passing through the weak Allee effect, depending on the implicit conditions, which involve the several parameters considered in the models. New classes of functions describing the existence or not of Allee effect are introduced, a new dynamical approach to Richards' populational growth equation is established. These families of generalized Richards' functions are proportional to the right hand side of the generalized Richards' growth models proposed. Subclasses of strong and weak Allee functions and functions with no Allee effect are characterized. The study of their bifurcation structure is presented in detail, this analysis is done based on the configurations of bifurcation curves and symbolic dynamics techniques. Generically, the dynamics of these functions are classified in the following types: extinction, semi-stability, stability, period doubling, chaos, chaotic semistability and essential extinction. We obtain conditions on the parameter plane for the existence of a weak Allee effect region related to the appearance of cusp points. To support our results, we present fold and flip bifurcations curves and numerical simulations of several bifurcation diagrams.

Author Keywords: Population dynamics; Strong and weak Allee effects; Richards' equation; Fold and flip bifurcations; Symbolic dynamics

KeyWords Plus: Models; Extinction; Metapopulation; Bifurcation; Densities

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