Title: On chaos, transient chaos and ghosts in single population models with Allee effects

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Source: Nonlinear Analysis-Real World Applications

Volume: 13 **Issue:** 4 **Pages:** 1647-1661 **DOI:** 10.1016/j.nonrwa.2011.11.022 **Published:** Aug 2012

Document Type: Article

Language: English

Abstract: Density-dependent effects, both positive or negative, can have an important impact on the population dynamics of species by modifying their population per-capita growth rates. An important type of such density-dependent factors is given by the so-called Allee effects, widely studied in theoretical and field population biology. In this study, we analyze two discrete single population models with overcompensating density-dependence and Allee effects due to predator saturation and mating limitation using symbolic dynamics theory. We focus on the scenarios of persistence and bistability, in which the species dynamics can be chaotic. For the chaotic regimes, we compute the topological entropy as well as the Lyapunov exponent under ecological key parameters and different initial conditions. We also provide co-dimension two bifurcation diagrams for both systems computing the periods of the orbits, also characterizing the period-ordering routes toward the boundary crisis responsible for species extinction via transient chaos. Our results show that the topological entropy increases as we approach to the parametric regions involving transient chaos, being maximum when the full shift R(L)(infinity) occurs, and the system enters into the essential extinction regime. Finally, we characterize analytically, using a complex variable approach, and numerically the inverse square-root scaling law arising in the vicinity of a saddle-node bifurcation responsible for the extinction scenario in the two studied models. The results are discussed in the context of species fragility under differential Allee effects.

Author Keywords: Allee Effects; Chaos; Extinction Transients; Scaling Laws; Single Species Dynamics; Theoretical Ecology; Topological Entropy

KeyWords Plus: Predator-Prey System; Nonlinear Dynamics; Periodic-Solutions; Bifurcation; Attractors; Disappearances; Satiation; Community; Ecology; Size

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Funding:

Funding Agency	Grant Number
Fundacao para a Ciencia e a Tecnologia	
Human Frontier Science Program Organization	RGP12/2008
National Science Foundation	NSF PHY05-51164

Publisher: Pergamon-Elsevier Science LTD

Publisher Address: The Boulevard, Langford Lane, Kidlington, Oxford OX5 1GB, England

ISSN: 1468-1218

Citation: Duarte J, Januário C, Martins N, Sardanyes J. On chaos, transient chaos and ghosts in single population models with Allee effects. Nonlinear Analysis-Real World Applications. 2012; 4 (13): 1674-1661.