
THE ALLEE EFFECT: ITS INFLUENCE ON A HOLLING-TANNER MODEL WITH GENERALIST PREDATORS

Francisco Javier Reyes-Bahamón^{1,*}, Eduardo González-Olivares², Alejandro Rojas-Palma³

¹Universidad Surcolombiana, Neiva, Huila, Colombia

²Pontificia Universidad Católica de Valparaíso, Chile

³Departamento de Matemática, Física y Estadística, Facultad de Ciencias Básicas, Universidad Católica del Maule, Talca, Chile

ABSTRACT

The study of interactions between prey and predators is fundamental to mathematical ecology. Factors such as the Allee effect in prey and the availability of alternative food sources for predators significantly influence these dynamics. In this article, we analyze a Holling-Tanner model with an double Allee effect in prey and generalist predators, which is described by the autonomous ordinary differential equation system of Kolmogorov type. To simplify the calculations, a change of variables and a time rescaling were applied, resulting in a system topologically equivalent to the original, which allowed for a more detailed analysis. We establish the existence of a positively invariant region and show that the solutions are permanent. Moreover, we prove that the solutions are uniformly bounded. The conditions for the existence and stability of equilibrium points in the phase plane are established.

Keywords Allee effect · Bifurcation · Holling-Tanner model · Stability

References

- [1] Sáez E., González-Olivares E., Dynamics of a predator-prey model, *SIAM Journal on Applied Mathematics* 59 (5): 1867–1878, 1999.
- [2] Perko, L. *Differential Equations and Dynamical Systems*, 3rd ed., vol. 7, Springer Science & Business Media, 2013.
- [3] Arancibia-Ibarra C., Flores J., Dynamics of a Leslie–Gower predator–prey model with Holling type II functional response, Allee effect and a generalist predator, *Mathematics and Computers in Simulation*, 188: 1–22, 2021.
- [4] Liu Y., Li Z., He M., Bifurcation analysis in a Holling-Tanner predator-prey model with strong Allee effect, *Mathematical Biosciences and Engineering*, 20 (5): 8632–8665, 2023.
- [5] Chicone C., *Ordinary differential equations with applications*, Third edition, *Texts in Applied Mathematics* 34, Springer, 2024.

*Corresponding Author's E-mail: francisco.reyes@usco.edu.co