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## IF NATURE REMEMBERS THE PAST, WHY SHOULD OUR MATHEMATICAL MODELS BE FORGETFUL?

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Nilay Akgönüllü Pirim<sup>1,\*</sup>,

<sup>1</sup>*Baskent University, Kahramankazan Vocational School Kahramankazan 06980, Ankara, Turkey*

### ABSTRACT

Fractional-order differential equations have emerged as powerful tools for modeling real world phenomena due to their inherent ability to capture memory and hereditary properties. In contrast to classical integer-order models, fractional systems provide a more realistic framework for describing biological interactions, particularly in ecological dynamics such as prey–predator systems.

In this study, a fractional-order prey–predator model is considered to better represent the memory-dependent behavior observed in natural ecosystems. The system is formulated using Caputo fractional derivatives, which are widely preferred for their compatibility with initial conditions in physical problems. To obtain approximate solutions of the proposed system, the Hermite Collocation Method is employed due to its efficiency and high accuracy in handling nonlinear fractional differential equations.

This study highlights the importance of incorporating memory effects into mathematical models and confirms that fractional-order approaches, combined with efficient numerical techniques, offer significant advantages over classical models in representing complex biological systems.

**Keywords** : Fractional-order differential equations · Prey–predator model · Hermite collocation methods · Memory effect ·

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\*Corresponding Author's E-mail: [napirim@baskent.edu.tr](mailto:napirim@baskent.edu.tr)