

Stability Analysis and Maximum Profit of Predator – Prey Population Model with Time Delay and Constant Effort of Harvesting

**¹Syamsuddin Toaha, ²Malik Hj. Abu Hassan,
³Fudziah Ismail and ⁴Leong Wah June**

*¹Department of Mathematics, Hasanuddin University,
90245, Makassar, Indonesia*

*^{1,2,3,4}Department of Mathematics, Universiti Putra Malaysia,
43400, UPM, Serdang, Selangor Darul Ehsan, Malaysia
E-mail:¹syamsuddint@yahoo.com*

ABSTRACT

In this paper we present a deterministic and continuous model for predator - prey population model based on Lotka-Volterra model. The model is then developed by considering time delay and the two populations are subjected to constant effort of harvesting. We study analytically the necessary conditions of harvesting to ensure the existence of the equilibrium points and their stabilities. The methods used to analyze the stability are linearization and by investigation the eigenvalues of the Jacobian matrix. The results show that there exists a globally asymptotically stable equilibrium point in the positive quadrant for the model with and without harvesting. The time delay can induce instability and a Hopf bifurcation can occur. The stable equilibrium point for the model with harvesting is then related to profit function problem. We found that there exists a critical value of the effort that maximizes the profit and the equilibrium point also remains stable. This means that the predator and prey populations can live in coexistence and give maximum profit although the two populations are harvested with constant effort of harvesting.

Keywords: Predator-Prey, Time Delay, Jacobian Matrix, Eigenvalues, Effort of Harvesting, Profit.