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Global Stability and Optimal Harvesting of Predator-Prey Model with Holling Response Function of Type II and Harvesting in Free Area of Capture

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Abstract

This paper analyzes the dynamical behavior of predator and prey in free and forbidden areas of capture. The dynamics of the populations are expressed in the form of equations system. The predator and prey in the free area are exploited with fixed efforts. The presence of an interior fixed point and its stability is studied. Harvesting efforts as control variables in the model are discussed. The interior fixed point is connected to the problems of maximizing the profit and present value. Local stability of the fixed point is analyzed via linearization and global stability in terms of the Lyapunov function. A critical value of fixed efforts is found, maximizing the profit function and the fixed point remains stable. According to Pontryagin's maximum principle, there exists an optimal path for the harvesting efforts that maximizes the present value of revenues. The predator and prey populations are possibly living together for a certain span of time even though the predator and prey populations are harvested with efforts as control variables. From simulation, the control variables can reduce the predator population and increase the prey population.

http://www.e-ndst.kiev.ua/v22n1/9(81).pdf