Optimal Impulsive Sustainable Harvesting

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Abstract

The optimal management of renewable resources has important consequences to the sustainability of the population in the long term. The strategies used to exploit populations can vary from constant, continuous, seasonal and pulse harvest. Fishermen cannot harvest 24 hours a day and so considering harvesting which occurs in pulses is more realistic. Impulsive harvesting is considered in literature where the impulsive harvesting strategy is constant, that is we remove a certain amount of fish every time T, independent of stock abundance or can occur where fish are removed once every time T in proportion to their abundance. In these cases, it was found that the continuous strategy is optimal or that the results of impulsive harvesting nearly produce the same results as impulse time tends to zero.

In this thesis, we consider a single population that obeys logistic or Gompertz growth in the absence of any harvesting with exploitation using an proportional impulsive harvesting strategy. In addition, we incorporate a constant or proportional harm associated with fishing each time harvesting occurs which makes continuous sustainable harvesting impossible. We obtain existence and global attractiveness of the positive impulsive periodic solutions. We choose the maximum sustainable yield as a management objective and investigate optimal harvest policies. We optimize this yield as a function of both the effort applied and the impulse time and find explicit expressions where possible for the optimal effort, fishing time and population level and the maximum sustainable yield per unit time. Under certain assumptions

on the effort and the disturbance, the impulsive harvesting strategy is optimal and in fact is the only possible strategy to sustain the population while harvesting occurs.