

Profit optimization of stochastically fluctuating populations: the effects of Allee effects

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ABSTRACT

The main goal of this work is to assess and compare the influence of Allee effects in profit optimization of stochastically fluctuating harvested populations considering several harvesting policies. The policies to compare are based on constant, variable, and stepwise harvesting efforts. For application purposes, the population growth models considered are the logistic model and a logistic-like model with weak Allee effects. In recent work, we have shown that the optimal harvesting policy with variable effort is inapplicable whereas the optimal harvesting policy with constant effort is easily applicable and leads to population sustainability. However, the latter implies profit losses, comparing to the first one. So, we consider a stepwise policy which is applicable but shares some of the problems with the optimal policy based on variable effort. We also show that some of the disadvantages of the optimal policy are eliminated by considering a penalized profit with an artificial running energy cost on the effort. However, the applicability problems remain. Finally, in terms of optimal profit, we study the influence of Allee effects on all policies and check whether Allee effects should or should not be taken into account when designing harvesting policies.

KEYWORDS

Optimal control; profit optimization, stochastic differential equations; Allee effects; logistic growth.