

## TIME-LIMITED MANAGEMENT STRATEGIES OF A SINGLE-SPECIES WITH ALLEE EFFECT

HONGJIAN GUO, LANSUN CHEN AND XINYU SONG

**ABSTRACT.** Two kinds of time-limited management strategies of a single-species with Allee effect, described by the impulsive differential equation with initial and boundary value conditions, are presented according to the initial density of the species. By means of the comparison principle and the methods of upper and lower solutions, boundary value problems of impulsive management models are discussed. According to the initial density of the species, there are two kinds of models: the model with impulsive release and the model with impulsive harvesting. The corresponding sufficient conditions under which the corresponding model has a solution or no solution are obtained. If the models have a solution, the corresponding management strategy can be performed successfully. For the model with impulsive release, if other parameters are given, the population of release can be estimated. For the model with impulsive harvesting, the times of impulsive harvesting can also be estimated. Finally, some discussions and corresponding numerical simulations about the results obtained in this paper are given.

**1. Introduction.** Many biological and mathematical models suppose that the density of a species always increases if the density doesn't reach the carrying capacity of environment no matter how exiguous it is. But it isn't true for some cases because, for a lot of species (such as white-flag dolphin (*Lipotes vexillifer*) and Chinese sturgeon (*Acipenser Sinensis Grdy*)), the population density of species will decrease and tend to zero when the density reaches a very low level. The causations from outside are usually attributed to the over-exploitation of biological resources (especially to those with great economic value) and the destruction of the natural habitats of rare

---

2000 AMS *Mathematics subject classification.* Primary 54B20, 54F15.

*Keywords and phrases.* Impulsive effect, boundary value problem, impulsive differential equation, single species, Allee effect.

This work is supported by the National Natural Science Foundation of China (No. 10771179) and the Natural Science Foundation of the Education Department of Henan Province (No. 2007110028).

The first author is the corresponding author.

Received by the editors on July 14, 2007, and in revised form on November 1, 2007.

DOI:10.1216/RMJ-2008-38-5-1403 Copyright ©2008 Rocky Mountain Mathematics Consortium