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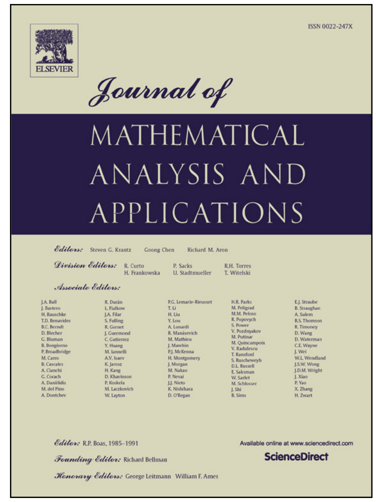

A weak competition system with advection and free boundaries

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A weak competition system with advection and free boundaries☆

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Abstract

In order to study the influence of advection speed on the competitive outcomes of two invading species, a reaction-diffusion-advection weak competition system with four free boundaries in one dimensional space is proposed and investigated. In the case of small advection speed, the explicit classification of the competitive outcomes, the estimation of the spreading speed, the long time behavior of the solutions and the minimal habitat size which determines whether the species can always spread or not are obtained. The results are similar as the case with no advection. In the case of large advection speed, both two species cannot spread successfully, but may virtual spread downstream. In the case of medium-sized advection speed, some competitive outcomes and the long time behaviors of the solutions are also obtained. Mathematical results suggest that the competitive outcomes, which depend on the advection speed and moving parameters, are very complicated. Some criteria for spreading, vanishing and virtual spreading are also established in all cases.

Keywords: Reaction-diffusion-advection; Free boundary; Spreading speed; Competition; Minimal habitat size

1. Introduction

Many investigations about the invasion of new or invasive species assume that the boundary is fixed or unbounded for the persistence or spreading speed problems. There is a different method arising in [5] and forming a free boundary problem. In [5, 6, 8], the authors assumed that the species' density near the wave front is close to zero, the species face a press to invade the new environment and the diffusion press is flux. When species invades a new habitat, they may suffer from Allee effect because their density is too low. Hence, the random movement of the individuals of the species at the front is affected by a tendency to stay close to the population range, as the free boundary problem derived by [2, 4]. From these studies, we can find that the invasive outcomes also depend on the initial data, the

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