

# Accepted Manuscript

Effect of cross-diffusion in the diffusion prey-predator model with a protection zone II

Shanbing Li, Yoshio Yamada

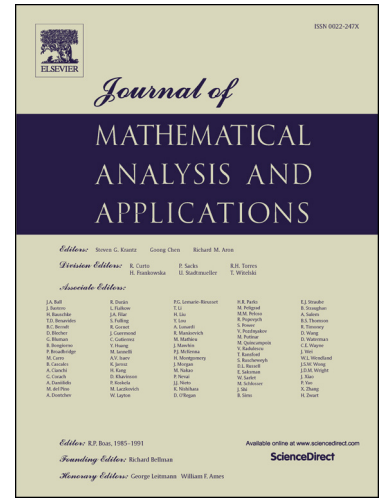
PII: S0022-247X(17)31107-1  
DOI: <https://doi.org/10.1016/j.jmaa.2017.12.029>  
Reference: YJMAA 21890

To appear in: *Journal of Mathematical Analysis and Applications*

Received date: 5 December 2017

Please cite this article in press as: S. Li, Y. Yamada, Effect of cross-diffusion in the diffusion prey-predator model with a protection zone II, *J. Math. Anal. Appl.* (2018), <https://doi.org/10.1016/j.jmaa.2017.12.029>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



# Effect of cross-diffusion in the diffusion prey-predator model with a protection zone II \*

Shanbing Li<sup>1, †</sup> Yoshio Yamada<sup>2</sup>

<sup>1</sup> School of Mathematics and Statistics, Xidian University, Xi'an, 710071, PR China

<sup>2</sup> Department of Mathematical Sciences, Waseda University, Tokyo, 169-8555, Japan

**Abstract**—In the current paper, we continue the mathematical analysis studied in [S. Li et al., *Discrete Contin. Dynam. Syst.* 37 (2017) 411-430, K. Oeda, *J. Differential Equations* 250 (2011) 3988-4009], and further study the effect of cross-diffusion for the predator on the stationary problem. The existence of positive solutions is first established by the bifurcation theory. We next discuss the limiting behavior of positive solutions when the intrinsic growth rate of the predator species tends to infinity. Moreover, as the prevention coefficient tends to infinity, we obtain two *shadow systems* and give the complete limiting characterization of positive solutions.

**Keywords**—Cross-diffusion, Protection zone, Coexistence solution, Limiting behavior, Shadow system.

MSC—35J65, 35B32, 35B35, 92D25.

## 1 Introduction

This paper is devoted to studying the following prey-predator model with a protection zone and nonlinear diffusions:

$$\begin{cases} u_t = \Delta[(1 + k\rho(x)v)u] + u(\lambda - u - b(x)v), & (x, t) \in \Omega \times (0, \infty), \\ v_t = \Delta \left[ \left(1 + \frac{\alpha}{1 + \beta u}\right) v \right] + v(\mu - v + cu), & (x, t) \in \Omega \setminus \bar{\Omega}_0 \times (0, \infty), \\ \partial_n u = 0, & (x, t) \in \partial\Omega \times (0, \infty), \\ \partial_n v = 0, & (x, t) \in \partial(\Omega \setminus \bar{\Omega}_0) \times (0, \infty), \\ u(x, 0) = u_0(x) \geq 0, & x \in \Omega, \\ v(x, 0) = v_0(x) \geq 0, & x \in \Omega \setminus \bar{\Omega}_0, \end{cases} \quad (1.1)$$

where  $\Omega$  is a bounded domain in  $\mathbb{R}^N$  with smooth boundary  $\partial\Omega$ ,  $\Omega_0$  is a subdomain of  $\Omega$  with smooth boundary  $\partial\Omega_0$  such that  $\bar{\Omega}_0 \subset \Omega$ , the parameters  $k, \alpha, \beta, \lambda, \mu, c$  are constants with  $\lambda, c$  positive and  $k, \alpha, \beta$  nonnegative,  $\mu$  may change sign,  $b(x)$  and  $\rho(x)$  are smooth functions in  $\bar{\Omega}$  with  $\rho(x) = b(x) = 0$  in  $\Omega_0$  and  $\rho(x) > 0$  and  $b(x) > 0$  in  $\Omega \setminus \bar{\Omega}_0$ . For more details on the protection zone see references [3, 8–11, 15, 17, 22, 23, 25] and references therein. For more details on the cross-diffusion see references [2, 5, 12–14, 16, 19–21, 26, 29] and references therein.

In (1.1), **when cross-diffusion is absent, i.e.,  $k = \alpha = 0$** , Du et al. have studied the effects of protection zone for the prey on Holling type II prey-predator model [8], and they have obtained

\*The first author was partially supported by the Postdoctoral Science Foundation of China (2016M602767), the Fundamental Research Funds for the Central Universities (JBX170707). The second author was partially supported by Grant-in-Aid for Scientific Research (C-24540220), Japan Society for the Promotion of Science.

†The correspondence author. E-mail address: lishanbing@xidian.edu.cn (S. Li)

Download English Version:

<https://daneshyari.com/en/article/8900090>

Download Persian Version:

<https://daneshyari.com/article/8900090>

[Daneshyari.com](https://daneshyari.com)