A NONLOCAL REACTION-DIFFUSION POPULATION MODEL WITH STAGE STRUCTURE

Dedicated to Professor Paul Waltman on the occasion of his retirement

DASHUN XU AND XIAO-QIANG ZHAO

ABSTRACT. A threshold dynamics and global attractivity of positive steady state are established in terms of principal eigenvalues for a nonlocal reaction-diffusion population model with stage structure, and the effects of spatial dispersal and maturation period on the evolutionary behavior are also discussed in two specific cases.

1 Introduction Recently, an increasing attention has been paid to nonlocal and time-delayed population models in order to study the effects of spatial diffusion and time delay on the evolutionary behavior of biological systems (see, e.g., [**16, 13, 3, 1, 19, 17**]). In the reality, species may drift from one spatial point at a time to another spatial point at another time, and may disperse from a domain to a larger domain. Moreover, the environment is often spatially heterogeneous. To describe the growth of a single species in a multi-patchy environment, certain delay differential equation models were proposed and analyzed in [**12, 14, 20**]. [**13, 1, 3**] also formulated the nonlocal and delayed reaction-diffusion models for a single species with stage structure, and established the existence of a family of traveling wave fronts for these models.

In order to obtain a general nonlocal and time delayed model for a single species in a bounded domain, we let $u(t, a, x)$ be the density of individuals with age a at a point x at time t, τ be the length of the juvenile period. Denote by $u_m(t, x)$ the density of mature adults. Then