VACANCIES IN HABITAT MAY PROMOTE THE EVOLUTION OF COOPERATION

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We consider a stochastic evolutionary game on one-dimensional lattice with vacancies created by fitness-dependent death processes. Interactions between neighbors are mimicked by a prisoner's dilemma game which has two strategies, cooperation and defection. Fitness, f of an individual is given by an increasing function of its payoff, p in the form of $f = A/[1+\exp(-wp)]$ where w is the selection strength and A is the parameter to control the growth rate of the population. We choose the site randomly and its habitant dies with probability of $d = 1 - f$ if it is occupied. Otherwise, the chosen empty site is occupied by an offspring of its neighbors. We study the population growth from the seed of a single individual and find a phase transition to the absorbing state of empty population as A decreases. This dynamical transition is a directed-percolation class regardless of the type of the initial seed but the transition points, A_c of the cooperators is small than that of the defectors, A_d providing rooms for cooperators proliferate while defectors diminish. We find more cooperators than defectors even when A is moderately larger than A_d since the abundant vacancies around defectors prevent them from invading communities of cooperators.