[Talk 18] Evolution of social behaviors in a growing habitat with vacancies

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We consider a stochastic evolutionary game in a growing habitat embedded in a regular lattice. Interactions between neighbors are mimicked by a prisoner's dilemma game. Fitness, f of an individual is given by an increasing function of its payoff, p in the form of $f = 1 + A\exp(wp)$. When a randomly chosen site is occupied, its inhabitant dies with probability of $d = 1/f$. Otherwise, the chosen empty site is taken by an offspring of its neighbors. We study growth of population from a single seed and find that its dynamics critically depends on the parameter~A. As A decreases, absorbing transitions from growing population phases to empty population phases occur for both types of seeds, cooperator and defector. The transition points, A_{C} of the cooperators is smaller than that of the defectors, A_{D} implying the existence of a parameter range $A_{C} < A < A_{D}$ in which only cooperative populations can exist. Our observation shows that vacancies, introduced by fitness dependent death processes, provide a natural way to develop cooperative communities in a growing population.