

Epigenetic transitions and the stability of cooperation

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Microorganism populations can engage in cooperative behavior with respect to public goods. An example of such behavior is the secretion of extracellular enzymes to extract a growth-limiting resource from the environment: expression and secretion of enzymes has an individual metabolic cost while conferring a collective benefit. How is such cooperative behavior stabilized against invasion by non-cooperative individuals? In this work we study theoretically the secretion of a yeast exoenzyme that hydrolyzes sucrose, in the context of this question. Using a dynamical systems approach we show that stabilization of cooperative-defective coexistence can be maintained by epigenetic transitions between active and silent states of the gene, a known property of this enzyme. Our approach highlights dynamic aspects of the interaction between population members and between population and environment. The results illustrate the fundamental effect that epigenetic transitions can have on the long-term population dynamics and on the nature of evolutionary stable states in an interacting population under constraints.