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Anticipating Changing in Environments: Adaptation in Fluctuating Environments in A Heterogeneous Microbial Communities

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The environments in which micro-organisms grow often fluctuate. To survive in temporally changing environments, cells have evolved mechanisms to survive environmental changes. One survival mechanism is generating phenotypic differences among identical cells in a given environment, with cells randomly switching between phenotypes. Such cells form subpopulations that proliferate at different rates. Optimal population fitness was attributed before to matching cellular and environmental switching rates. However, the conditions for this optimum are not well understood. In particular, it is unknown how the growth rates of the phenotypes affect the optimum. We use mathematical models to address this question. We find that the existence of the predicted optimum depends on cell growth rates in each phenotype. The predicted optimum exists for wider parameter regimes if the environmental durations are long. In addition, we study how mutants arising among such phenotypically heterogeneous cells spread in the population.

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