Adaptative peak shifts with stress-induced mutagenesis

Population genetics of adaptation with stress-induced mutagenesis

Stress-induced mutagenesis on rugged adaptive landscapes

Stress-induced mutagenesis on rugged fitness landscapes

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In 1931 Sewall Wright presented a classic problem: how can a population cross a fitness valley and shift from a one adaptive peak to a higher one? Wright’s problem is still an open question in evolutionary biology despite his own “shifting-balance theory” and other attempts to resolve it.

Stress-induced mutagenesis, the process in which maladapted individuals increase their mutation rate, has been evidenced in numerous species, both prokaryote and eukaryote. In addition, we have previously demonstrated that stress-induced mutagenesis should evolve by natural selection and that it increases the mean fitness of populations.

Here we analyze a population genetic model of a rugged adaptive landscape. We derive analytical expressions that show that stress-induced mutagenesis increases the adaptation rate and present the results of stochastic simulations that validate our analysis. Our results suggest that stress-induced mutagenesis can resolve the problem of adaptive peak shifts and that it increases the capacity populations to adapt.