Stress-induced mutagenesis and the evolution of complex traits

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The evolution of complex traits, coded by multiple genes, presents an open evolutionary question, first described by Sewall Wright in 1931: if different alleles are separately deleterious but jointly advantageous, how can a population evolve from one co-adapted gene complex to a better one?

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 by increasing the capacity of populations to adapt, in particular in the case of complex adaptation.