

Stress-induced mutagenesis and the evolution of complex traits

Yoav Ram and Lilach Hadany

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 fitness 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.