Modeling Evolution by Natural Selection Utilizing the Drosophila melanogaster White Mutant

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Hardy-Weinberg Equilibrium (HWE), which defines genetic equilibrium in a population, is fundamental for studies in population genetics. Deviations from HWE, or changes in allele frequency in a population, define evolution. Our study utilized HWE to investigate evolution in Drosophila at the white gene locus in a laboratory environment. The white mutant inactivates the ABC transporter protein, resulting in loss of eye pigmentation, white eyes and impaired vision. This mutation is an X-linked recessive, allowing direct determination of allele frequencies in males. Classical genetics were utilized to generate a large initial population comprised of equal frequencies of mutant and wild-type alleles. Changes in allele frequencies were measured over eight generations by scoring male eye phenotypes. Chi-square analysis revealed a significant decrease of 21% in the white allele, demonstrating deviation from HWE. An equation derived from the HWE incorporating consideration of selection was utilized to determine selection coefficients over eight generations. An average selection coefficient of 0.057 indicated a 5% disadvantage of the mutant phenotype. The same equation was utilized to model evolution for 100 generations. The predictive model was inconsistent with the experimental data. We initially hypothesized that observed changes in allele frequency would result from simple selection against the deleterious allele. Comparison to our model suggests that the large deviation from HWE in our experimental data could be due to sexual selection. Modeling is a useful tool to study adaptation and could have applications in conservation biology assessing populations' ability to adapt to rapidly changing ecosystems.

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