LAB 10: SIMULATING DRIFT, MIGRATION & MUTATION

Now that you have had experience with using PopG to study selection and experimental design, you will have a chance to look at other evolutionary forces and continue gaining experience with experimental design.

GET FAMILIAR WITH GENETIC DRIFT

Try running PopG several times with the parameters in Table 1, then try other population sizes to get a feel for pure genetic drift. You will also have to change the number of generations. Be prepared to summarize your conclusions.

Table 1. PopG parameters for genetic drift

Population size:	100
Fitness of each genotype:	1 for all
Mutation rates:	0 for both
Migration rate:	0
Initial frequency of A:	0.5
Generations to run:	100
Number of populations:	10

Consider how you might measure — quantify — the amount of genetic drift for different population sizes. Be sure to bounce your ideas off other teams and your instructor. We'll discuss strategies for collecting data on drift.

Afterwards, you will have a chance to design experiments to address the problems below, collect data in a new Excel notebook and report to the class. Be sure to discuss your experimental designs and data you will collect with your instructor *before* investing a lot of time in one experiment. You will need to revise your experimental design several times.

TEAM PROJECTS

DRIFT AND SELECTION

Try running the experiments with selection for a dominant phenotype, a recessive phenotype, incomplete dominance and heterosis at large and small population sizes. How does drift affect selection?

MIGRATION/GENE FLOW & SELECTION & DRIFT

Repeat one of the scenarios you ran in the *Drift and Selection* section that exhibited a moderate amount of drift and try several different amounts of gene flow. How does gene flow affect the result?

MUTATION

Setup an experiment with no selection and no gene flow, an initial P[A] of 0.0. Use high values of forward and backward mutation rates — try several values between 0.01 (1/100) and 0.001 (1/1,000); e.g., 0.03 & 0.005.

Reverse the initial P[A] to 1.0 and rerun the same experiments; do the end results differ, if so how?

Now try several of the *relative* mutation rates, but more realistic values between 0.000001 (1/100,000 = $1\text{x}10^{-6}$ — a more realistic, but still high mutation rate) and 0.000000001 (1/1,000,000,000 = $1\text{x}10^{-9}$); e.g., 0.000003 & 0.0000005. You will need to run for large numbers of generations. Try several different mutation rate combinations.

Summarize the effect of pure mutation (no selection, drift or flow) on evolution.

MUTATION, POPULATION SIZE & SELECTION

What is the effect of population size on the evolution of drug resistance? Consider a population of some pest that initially has little resistance to a pesticide/antibiotic, a relative fitness = 0.001 ("*kills 99.9% of harmful bacteria)*. A mutation ($\mu = 1 \times 10^{-6}$) occurs that has an RF of 1. Set up such a simulation and vary the population size. What can you say about the evolution of resistance? Does the pattern of inheritance matter?

Try adding some gene flow; how does it affect the result?

Would You Like to Try Something Else?

If another question occurs to you, feel free to explore and report on it. Ask your instructor first.