**Problem Set # 5 – Due Fri., Nov. 15**

**Instructions**

This is the fifth of six problem sets that will count towards your final grade. The problem set is due **in lecture** on Friday, Nov. 15. You may work in groups of up to three people (and are encouraged to do so). Please hand in one assignment per group with up to three names listed. Late assignments will be penalized 20% per day or part thereof. **Staple multiple pages together** –no paper clips or folded corners as sheets inevitably get lost. **Show your work.** Incorrect answers with some correct work will receive part marks; correct answers with no work might not receive full marks.

1. A rancher is concerned about the loss of genetic variation in their herd over time because it may compromise their breeding program. If the current heterozygosity in their herd is 0.50, estimate the heterozygosity 10 generations later if the population size fluctuates across these generations as follows: 200, 180, 160, 150, 165, 168, 177, 180, 191, and 204 individuals. You can assume the sex ratio is always equal.

2. A dam that previously isolated two equal sized populations of fish on either side was removed, allowing migration between the subpopulations to be reestablished. If the initial allele frequency at a locus in the two subpopulations was 0.4 and 0.6, and after 15 generations the allele frequency in the first population was now 0.45, estimate the migration rate between these populations assuming the rate is equal in both directions. (Recall, $\sqrt[a]{x}=x^{1/a}$)

3. Consider an allele, present at very low frequency in a population, that causes individuals carrying it to have a higher fitness than the common (i.e. wild-type) allele at that locus (i.e. there is directional selection favouring this allele). Will this beneficial allele rise in frequency faster if it is dominant or if it is recessive? Explain your answer in **three sentences or less**.

4. Imagine a population of size *Ne* = 500 individuals that receives migrants at the rate *m* = 0.001. What is the Pr(IBD) in this population at equilibrium between drift and migration? How does this compare to the Pr(IBD) in a population of size *Ne* = 500 individuals at mutation-drift equilibrium if *μ* = 1 × 10-8? In one sentence, explain why these are so different.

5. The table below shows the viability and number of offspring produced by grasshoppers in the presence of a trial insecticide.

a) Complete the table:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **SS** | **SR** | **RR** |
| Number of zygotes in *t* | 100 | 100 | 100 |
| Probability of survival | 0.4 | 0.6 | 0.8 |
| Number of adults (*t*) |  |  |  |
| Number of offspring produced per adult | 5 | 3 | 2 |
| Number of offspring in *t*+1 |  |  |  |
| Absolute fitness (*W*) |  |  |  |
| Relative fitness (*w*) |  |  |  |

b) Using the data identify find all equilibrium values for the frequency of the S allele and their stability. What type of selection is this?

c) If the frequency of the S allele in a given generation is 0.6, what would it be in the next generation?

6. If the mutation rate from *B* to *b* is 1 × 10-4, and the mutation rate from *b* to *B* is 6.2 × 10-4, what would the frequency of the *B* allele be in the next generation if it is currently 0.8? What is the equilibrium frequency of *B* if mutation is the only factor affecting it? Is your equilibrium value greater than, or less than, 0.5? Explain in one sentence why your answer to this question makes sense biologically.