Genetic variation and natural selection

How does a population evolve?

Outline

1. Natural Selection
2. How is genetic variation measured?
3. Directional selection
4. Stabilizing selection
5. Disruptive selection
6. Sexual selection
7. Key terms
8. Conclusions

Natural selection

- Natural selection is the primary mechanism of adaptive evolution
- Natural selection accumulates and maintains favorable genotypes in a population
- Natural selection increases the frequencies of certain genotypes, fitting organisms to their environment over generations
How is genetic variation measured?

- Population geneticists measure genetic variation both at the level of whole genes and at the molecular level of DNA.
- **Gene diversity** measures the average percent of gene loci that are heterozygous.
- Humans genetic variation:
  - Gene diversity is about 14% in humans.
  - Nucleotide diversity is only 0.1%.
  - You and your neighbor have the same nucleotide at 999 out of every 1,000 nucleotide sites in your DNA.

Directional Change in the Range of Variation

- **Directional Selection**
  - Shift in allele frequency in a consistent direction
- **Phenotypic Variation in a population of butterflies**

The Case of the Peppered Moths

- **Industrial revolution**
  - Soot on trees
- **Camouflage of moths increases survival from predators**
- **Directional Selection from light colored to dark moths**
**Directional Selection**
- Pesticide Resistance
  - Pesticides kill susceptible insects
  - Resistant insects survive and reproduce
  - If resistance has heritable basis, it becomes more common with each generation
- Antibiotic Resistance
- With directional selection, allele frequencies tend to shift in response to directional changes in the environment

**Stabilizing Selection**
- Intermediate forms are favored and extremes are eliminated
- Alleles that specify extreme forms are eliminated from a population

**Selection Against or in Favor of Extreme Phenotypes**
- Disruptive Selection
  - Both forms at extreme ends are favored
  - Intermediate forms are eliminated
**In Conclusion**

- Individuals of a population have the same number and kind of genes.
- A population is evolving when a trait is becoming more or less common.
- Genetic equilibrium is used as a baseline to measure change.
- Gene mutations are the only source of new alleles.

**In Conclusion**

- Natural selection is an outcome of differences in survival and reproduction among individuals.
- Selection pressure may drift the range of variation for a trait.
- Gene flow is a change in allele frequencies.
- Genetic drift is a change in allele frequencies over the generations due to chance events.