Selection

Directional
Stabilizing
Disruptive
Selection lingo

• **Diversity**: The number of different states of a character and the relative abundance of each state
  - # of different alleles of a gene
  - # of different polymorphisms of a trait

• **Frequency**: Percentage of states that are of a given type
  - If 75 of 100 humans have blue eyes, then the blue eye phenotype occurs at a frequency of 75%
Genetic Diversity: alleles for color

N = 4
\[ \frac{1}{4} = \text{green} \]
\[ \frac{1}{4} = \text{blue} \]
\[ \frac{1}{4} = \text{orange} \]
\[ \frac{1}{4} = \text{purple} \]

N = 2
\[ \frac{3}{4} = \text{green} \]
\[ \frac{1}{4} = \text{purple} \]
Selection

- **Natural**: Increase in the frequency of alleles that increase **reproductive success**
  - "Bout" of selection: An event that alters allele frequencies
- **Sexual**: A specific *type* of natural selection; increase in the frequency of alleles that enhance one’s ability to obtain mates
Selection modifies genetic variation

- Number & relative frequency of different alleles present in a population
- Some types of selection increase variation, other types reduce it
- To the extent that phenotype is determined by genotype, a reduction in phenotypic diversity will reduce genetic diversity
Directional Selection

- Allele frequencies change in one direction
- Variation is reduced
- \textit{Mean value} of trait increases or decreases
What probably best describes the inheritance of this trait?

1. Pleiotropic
2. Polygenic
3. Codominant
Great Plains Cliff Swallows

• Population endures extended cold weather
• Food source dies
• Swallows die
• Who’s left? Why?
  - Body fat stores helped carry them through thin times
Directional Selection & allele frequency

- Imagine that one gene is very important for determining body size (unrealistic); complete dominance.
  - \( aa \) = small
  - \( Aa \) = medium
  - \( AA \) = large

- What should happen if \( a \) is very common (.9)?

For example, directional selection caused average body size to increase in a cliff swallow population.
Stabilizing Selection

- Extreme phenotypes are lost (tails of dist. reduced)
  - Reduces variation
- *Mean* value of a trait remains unchanged
Stabilizing Selection

- Birth weight in humans
- High mortality rates for very large and for very small*
- Nutrition influenced?

For example, very small and very large babies are the most likely to die, leaving a narrower distribution of birth weights.
Stabilizing Selection

- If this trait is mainly influenced by 2 alleles showing incomplete dominance at a single gene locus, (dominant allele produces large size; recessive produces small), then what is the genotype of infants with LOW mortality?

1. Homozygous dominant
2. Heterozygous
3. Homozygous recessive
Disruptive Selection

• Extreme phenotypes are favored; Phenotypes near mean value are eliminated
• Mean does not change
• Distributions becomes bimodal
  - Variation increased
Disruptive Selection

- Black-bellied seed-crackers
- Long-beaked individuals specialize on large seeds, short-beaked on small seeds
- Intermediate sizes handle seeds inefficiently*

*For example, only juvenile black-bellied seed-crackers that had very long or very short beaks survived long enough to breed.
Disruptive Selection

- If bill size is determined by 2 alleles ($A$ & $a$) displaying **incomplete dominance** at one gene locus, how will allele frequencies change if initial frequencies are equal ($A = 0.5$)?
  1. Increase in $A$
  2. Decrease in $A$
  3. No change in allele frequencies

For example, only juvenile black-bellied seed-crackers that had very long or very short beaks survived long enough to breed.

![Histogram showing beak length distribution](image)
Disruptive Selection

- If initial $A$ allele frequency is 0.49, how will allele frequencies change?
  1. Increase in $A$
  2. Decrease in $A$
  3. No change in allele frequencies

For example, only juvenile black-bellied seed-crackers that had very long or very short beaks survived long enough to breed.
Selection and Population size

• The behavior of allele frequencies is consistent & predictable when population size is large (infinite). They basically behave deterministically.
• When population sizes are small, allele frequencies begin to behave stochastically (based on probabilities).