Chapter 20

The Evolution of Populations
HETEROZYGOATS

Just allele uneven.
Population genetics

- Population: *a localized group of individuals belonging to the same species*
- Species: *a group of populations whose individuals have the potential to interbreed and produce fertile offspring*
- Gene pool: *the total aggregate of genes in a population at any one time*
- Population genetics: *the study of genetic changes in populations*
- Modern synthesis/neo-Darwinism

- “Individuals are selected, but populations evolve.”
Hardy-Weinberg Theorem

• **Serves as a model for the genetic structure of a nonevolving population (equilibrium)**

• **5 conditions:**
  • 1- Very large population size;
  • 2- No migration;
  • 3- No net mutations;
  • 4- Random mating;
  • 5- No natural selection
Hardy-Weinberg Equation

\( p = \text{frequency of one allele (A)}; \quad q = \text{frequency of the other allele (a)}; \)
\( p + q = 1.0 \)
\( (p = 1-q \quad \& \quad q = 1-p) \)

\( P^2 = \text{frequency of AA genotype}; \quad 2pq = \text{frequency of Aa plus aA genotype}; \quad q^2 = \text{frequency of aa genotype}; \)

\[ p^2 + 2pq + q^2 = 1.0 \]
Microevolution, I

• A change in the gene pool of a population over a succession of generations

• 1- Genetic drift: changes in the gene pool of a small population due to chance (usually reduces genetic variability)
Microevolution, II

• **The Bottleneck Effect:** type of genetic drift resulting from a reduction in population (natural disaster) such that the surviving population is no longer genetically representative of the original population
Microevolution, III

• **Founder Effect:**
  a cause of genetic drift attributable to colonization by a limited number of individuals from a parent population
Microevolution, IV

• 2- **Gene Flow**: genetic exchange due to the migration of fertile individuals or gametes between populations (reduces differences between populations)
Microevolution, V

3- **Mutations**: a change in an organism’s DNA (gametes; many generations); original source of genetic variation (raw material for natural selection)
Microevolution, VI

• 4- **Nonrandom mating**: inbreeding and assortive mating (both shift frequencies of different genotypes)
Microevolution, VII

• 5- Natural Selection: differential success in reproduction; only form of microevolution that adapts a population to its environment
Population variation

• **Polymorphism:** coexistence of 2 or more distinct forms of individuals (morphs) within the same population

• **Geographical variation:** differences in genetic structure between populations (cline)
Variation preservation

- Prevention of natural selection’s reduction of variation
- **Diploidy**
  2nd set of chromosomes hides variation in the heterozygote
- **Balanced polymorphism**
  1- heterozygote advantage (hybrid vigor; i.e., malaria/sickle-cell anemia);
  2- frequency dependent selection (survival & reproduction of any 1 morph declines if it becomes too common; i.e., parasite/host)
Natural selection

• Fitness: *contribution an individual makes to the gene pool of the next generation*

• **3 types:**
  • A. Directional
  • B. Divergent
  • C. Stabilizing
Sexual selection

- **Sexual dimorphism**: secondary sex characteristic distinction

- **Sexual selection**: selection towards secondary sex characteristics that leads to sexual dimorphism