Vascular Plant Systematics - Fall 2001
Lecture #12 - Evolution, Variation & Biosystematics Cont.

Cross Fertilization promotes heterozygosity and thus diversity among organisms; **Self fertilization** promotes homozygosity - yielding more uniform populations with less variation.

Natural Selection - for evolution to occur, there must be variation and a driving force such that some of the variants are at an adpative advantage (an adaptation is any trait, whether it be physiological, morphological, anatomical, or behavioral, that results in an enhanced ability to survive and reproduce). An adaptation may also be looked at as a characteristic that confers higher inclusive fitness to individuals over any other existing alternatives exhibited by others in the population ..... such adaptive traits are spread via natural selection.

Fitness is the measure of the reproductive success of an individual.

Natural Selection - there are 3 types:

(A) Stabilizing Selection - selection away from the extremes in a population and in favor of the norm. This type of selection tends to reduce variation in the population by eliminating (or making rare) the extremes in the population. Examples among plants might include magnolia, ginkgo, horse tails, conifers.

(B) Directional Selection - operates in a unidirectional changing environment and results in a shift in the gene frequency of the population in one direction only (peppered moths in England)

(C) Disruptive Selection - occurs in a heterogeneous, capricious environment and results in a shift toward both extremes in the population and away from the norm.

Hardy-Weinberg Theory Developed in 1908 suggesting that if the following would cease in a population: **mutations, gene flow, genetic drift, non-random mating and natural selection**

.... then the frequency of genes in the population would remain the same generation after generation (e.g., evolution would cease). Hardy and Weinberg proposed the following equation:

p + q = 1 in which p represents the dominant allele for a particular trait and q represents the recessive allele for a particular trait (say height in plants in which Tall is dominant (T) and short is recessive (t)).

This equation can be expanded such that: $(p + q)2 = 1$ or **p2 + 2pq + q2 = 1**. In this expanded equation, p2 represents the **homozygous dominant** genotype, 2pq represents the **heterozygous** genotype and q2 represents the **homozygous recessive** genotype. In the absence of the driving forces of evolution, it (changes in gene and/or allele frequencies) will cease. Would you expect to find many Hardy-Weinberg plant populations in the wild??? That is, plant populations that were not evolving in terms of gene pool change??

The other Driving Forces in Addition to Natural Selection:

- **Gene Flow**
- **Genetic Drift**
- **Mutations**
- **Non-Random Mating**

***** But remember that natural selection is the only driving force of evolution that results in adaptation to the environment.**

Genetic Drift - significant changes in gene frequencies in small populations due to chance alone. Two subcomponents: (a) Founder Principle and (b) The Bottleneck Effect

Founder Principle the founding population is so small that it is susceptible to inbreeding and changes in the frequency of the gene pool as a result of chance events.

Bottleneck Effect - associated with endangered or threatened populations whose numbers become so small that the population is then again affected by inbreeding and chance events that might alter the frequency of the gene pool.

Ecotype - local population or a series of populations adapted to particular ecological conditions often found along an ecological gradient (which may coincide with a latitudinal or altitudinal gradient).

In fact, in plants, populational variation may be considered: (a) clinal (essentially latitudinal or longitudinal variation), (b) mosaic variation (associated with soil moisture or mineral conditions), or (c) altitudinal.

** Where the habitats of ecotypes are not distinct but form an environmental continuum, ecologically adapted species exhibit a continuous range of variation called a **cline** ..... such as those found in forests, prairie grasses etc... found over large areas.

** An **ecocline** is formed along an ecological gradient such as from sea coast to an inland area or from a forest to a grassland; a **topocline** is formed along a latitudinal or longitudinal gradient (from north to south or east to west).