

**Exam 2 Study Guide (some supporting lecture materials online at:  
<http://herbarium.millersville.edu/class-web/325.htm>, others, such as articles, at library)**

**Topic 08 – Species & Speciation**

I. Species as units

II. Speciation

A. Defined

1. Ernst Mayr (1940's-2000s), Theodosius Dobzhansky (1937), Verne Grant (1960s).
2. Hennig.

B. How does this happen?

1. Geographic barriers
2. Non-geographic barriers
3. Ecological factors

III. Species Concepts

A. Species as category vs. species as concept vs. species as entity

B. Species concepts

1. Morphological & Phenetic species concepts (pre-20<sup>th</sup> century)
  - a. Criterion
  - b. Ads
  - c. Cons
2. Biological Species Concept
  - a. Criterion
  - b. Ads
  - c. Cons
    - 1) *Platanus occidentalis* and *P. orientalis*)
    - 2) *Ophrys*
3. Modified Cladistic Species Concept (Phylogenetic Species Concept)
  - a. Theoretical Criterion
  - b. Operational Criterion
  - c. Ads
  - d. Cons
4. Ecological Species Concept:  
Van Valen (1976)
  - 1) *Taraxacum*

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Reading:

Lecture material on species:

1. Miller W. 2001. The structure of species, outcomes of speciation and the 'species problem': ideas for paleobiology. *Palaeogeography, Palaeoclimatology, Palaeoecology* 176: 1-10.
2. Dodd D. 1989. Reproductive isolation as a consequence of adaptive divergence in *Drosophila pseudoobscura*. *Evolution* 43 (6): 1308-1311.

**Topic 09 – History of Plant Systematics & Classification**

- I. The early days.
  - A. Folk taxonomy.
  - B. Theophrastus (ca. 371-286 BC).
- II. Herbalists.
  - A. Herbals.
  - B. Doctrine of Signatures.
  - C. Dioscorides (1<sup>st</sup> C. AD). *De Materia Medica*.
  - D. Others (15<sup>th</sup>-17<sup>th</sup> C. AD).
  - E. The Badianus Manuscript (1552).
- III. Early Pre-Linnaean Taxonomists.
  - A. Caesalpino (1519-1603). *De Plantis Libri*.
  - B. de Tournefort (1656-1708). *Institutiones Rei Herbariae*.
  - C. Ray (1628-1705). *Synopsis Methodica Stirpium Britannicarum & Historia Plantarum*.
- IV. Linnaeus.
  - A. Carl von Linné (a.k.a. Carolus Linnaeus; 1707-1778). *Species Plantarum* (1753).
- V. The French and their ‘natural’ systems.
  - A. Adanson (1727-1806). *Familles des Plantes*.
  - B. de Jussieu (1748-1836). *Genera Plantarum*.
  - C. Lamarck (1744-1829). *Flora Francoise*.
  - D. de Candolle (1778-1841). *Prodromus Systematis*.
- VI. Evolutionary taxonomy.
  - A. Darwin (1809-1882). *On the Origin of Species by Means of Natural Selection* (1859).
  - B. Engler (1844-1930) and Prantl (1849-1893). *Die Natürlichen Pflanzenfamilien*.
  - C. Bessey (1845-1915). Bessey’s Dicta. *The Phylogenetic Taxonomy of Flowering Plants*.
  - D. Takhtajan (1910-). *Diversity and Classification of Flowering Plants* (1997).
  - E. Cronquist (1919-1991). *An integrated system of classification of flowering plants* (1981, 1988).
- VII. Phenetics.
  - A. Michel Adanson (1750s).
  - B. Sneath & Sokal (1950s-1970s).  
Sneath & Sokal. 1973. *Numerical Taxonomy: The Principles and Practice of Numerical Classification*.
  - C. Phenetics Defined.
  - D. Pros & Cons.
- VIII. Cladistics.
  - A. Willi Hennig (1913-1976)  
*Grundzüge einer Theorie der Phylogenetischen Systematik* (Hennig, 1950).  
*Phylogenetic Systematics* (Hennig, 1966).
  - B. Hennigian Principles.

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Readings for this topic:

*Artificial and Phenetic Systems of Classification*. Pp. 461-467,

*Traditional Phylogenetic Classification.* Pp. 469-485,  
all in Vascular Plant Taxonomy, 4<sup>th</sup> ed. Walters, DR, and Keil, DJ. Kendall/Hunt  
Publishing Co., Dubuque, Iowa.

## Topic 10—Cladistics in Theory and Practice

### **I. Phylogenetic terms and concepts.**

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#### A. Phylogeny

1. Defined
2. Clade and monophyletic group
4. Sister groups

#### B. Cladogram

1. Defined
2. Styles
3. Branches and nodes

#### C. Characters and homology

1. Cladogram provides framework for understanding evolution
2. Characters/states evolve over course of phylogenesis/cladogenesis
3. Apomorphies vs. Plesiomorphies
  - a. Ingroup vs. outgroup sets this context.
  - b. Autapomorphy vs. synapomorphy
  - c. Synapomorphy vs. symplesiomorphy
4. Hashmarks
5. Homology, analogy, and homoplasy

### **II. Cladistics (methodology of phylogenetic inference) basics**

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#### A. The taxon-by-character matrix

#### B. Synapomorphies as evidence of recency of common ancestry

1. Ingroup vs. outgroup
2. Parsimony and Ockham's Razor
3. Parsimony the optimality criterion

#### C. Fitch Optimization

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*Cladistic classification systems.* Pp. 489-503,  
in Vascular Plant Taxonomy, 4<sup>th</sup> ed. Walters, DR, and Keil, DJ. Kendall/Hunt  
Publishing Co., Dubuque, Iowa.

**Topic 11: Ethnobotany, Origins of Cultivated Plants, & Molecular Systematics: The Origin of Breadfruit in the Pacific**

I. Noteworthy bits for introduction

Hawaii, California, Bering Straight  
Bounty-hunting  
Pandora's Box

II. *Artocarpus*, the genus & *Artocarpus altilis*

III. Nyree Zerega, Diane Ragone, and Tim Motely (2004); summarized by Zerega (2004)

- A. Closest relatives of breadfruit
  - phylogenetic (cladistic) evidence
- B. Origins of breadfruit
  - AFLP & Isozyme evidence
  - Biogeographic pattern to variation in AFLPs and Isozymes.
- C. Lapita migrations into Oceania.
- D. Connect human biogeography with breadfruit biogeography.

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Readings for this topic:

Zerega, NJC. 2003. The breadfruit trail. *Natural History* 112(10): 46-51.

Zerega, NJC, D Ragone, TJ Motley. 2004. Complex origins of breadfruit (*Artocarpus altilis*, Moraceae): Implications for human migrations in Oceania. *American Journal of Botany* 91(5): 760-766.