PLANT CLASSIFICATION – APPROACHES AND CHALLENGES BIO 3520 08

Assignment: Text, Murrell Ch. 4, p. 65-77 look for big ideas; Ch. 6, p. 97-102

I. DEVELOPMENT OF CLASSIFICATION

A. TRANSITION FROM CREATIONIST VIEW

1. Taxonomic classification in the 1700's and 1800's – See Chapter 6, p. 97-ff.

a. The emphasis of classification of this period? _____

_____

b. The aim of early *natural systems*? _____

2. Linnaeus – part of this effort as a "creationist" – author avoids calling him "creationist"

3. Your authors' allude (p 515) and other taxonomists see creationists believing that "each species was created individually by God and remained unchanged through time"[1]
   a. Is this a view held by most Creationists today?

   b. If not, what is the most common creationist view of "species?" _____

   _____

B. Effect of Darwin on classification – EVOLUTION PRESUPPOSITIONS

1. One Origin – the belief in common descent from one ancestor through gradual change
2. Closer morphology, chemical makeup, etc.→ closer phylogenetic relationship
3. PRINCIPLE: "[Darwinism] did not radically alter previous classifications" [1]
   >> Explain why? _____

II. TWO BROAD TYPES OF CLASSIFICATION:

A. ARTIFICIAL CLASSIFICATION – based upon easily recognized characters selected in an *a priori* manner, often for convenience in classifying

1. LINNAEUS (1753) – used number of_____(regardless of other differences)

   a. Class Monandria, or Diandria, Triandria, Tetrandria, etc.
   b. Orders formed within classes according to number of _____

2. WILDFLOWER GUIDES -- based on flower color or number of parts

3. Benefits of "artificial classification" – _____

[1] Jones, S.B. and A.E. Luchsinger. 1986. *Plant Systematics*, 2nd ed. McGraw-Hill, Inc. New York.

B. NATURAL CLASSIFICATION -- grouping according to "_____ _____"

1. Worldview-dependent – reflects the "ORIGINS" view of the taxonomist
2. Approach is to compare taxa based on a large number of traits and groups are recognized only after observed similarities become evident – *i.e. a posteriori*).
3. Early taxonomists – formed classification system based upon "morphological similarity"
4. RESULT: classification revealed pattern of similarity ==> began to doubt creation
5. TEMPTATION – "DID GOD REALLY SAY HE CREATED...?"

III. MODERN APPROACHES TO CLASSIFICATION – i.e. Synthesis and Experimental phases

A. Twentieth Century Advances – See Chapter 4, p. 65

1. Synthesis: Classic Darwinism + Mendelian Genetics + Population Genetics
2. Mechanisms (for Neo-Darwinism) : Mutation + Natural Selection —> Speciation
3. Result: Traditional taxonomy viewed as subjective, lacking credibility, "old school"
4. Response: Old phylogenetic approach replaced by phenetic and phylogenetic/cladistic

B. PHYLOGENETIC SYSTEMS – attempt to classify according to evolutionary relationships

1. MONOPHYLETIC REQUIREMENT of categories – pages 66,72 and Figure 4-5, p 74

   a. Monophyletic groupings reflect _____
   i.e. No taxon can have species (or higher taxa) that are believed to have descended from two different ancestoral lines (polyphyletic; see p. 73)

   b. Each taxon (e.g. genus, family, etc.) if monophyletic = from one common ancestor

2. DEVELOPING THE PHYLOGENETIC TREE based on objective methodology

   a. EVOLUTIONARY CLAIM: Fossil record reveals evidence of gradual evolution

   PROBLEM – Limited fossil record (p. 67, 102)
   "Without a complete fossil record (and even if we had one, how would we know it was complete?), we must rely on the evidence provided by the organisms themselves. Ths evidence comes in the form of measurable attributes (*characters*) of the plants."

   b. PRESUPPOSITION: the more characters shared the closer the phylogeny (p. 68)

   PROBLEM – being objective in choice of characters (e.g. choosing characters that "worked" to make groupings; created conflicting groupings

   c. DISTINGUISHING AMONG CHARACTER STATES – e.g. distinguishing between
      I. Plesiomorphies – "primitive" (ancestoral) character states; simply passed along
      II. Apomorphies – "derived" character states resulting from evolutionary change

   PROBLEM – w/o fossils, how can we distinguish ancestoral from derived states?
   SOLUTION – compare group in question (*in group*) with closely related group (*out group*). Shared character state are assumed plesiomorphic and not useful in phylogenetic analysis, while apomorphic character states are useful in analysis. (p. 69, and Fig. 4-2))

d, CLADOGRAMS or TREES (branched diagrams, Fig. 4.1) show groupings of taxa representing inferred historical connections based on synapomorphies (shared derived characters relative to symplesiomorphies (shared primitive states).

e. CONFLICTING TREES – what happens when phylogenetic trees contradict? (p. 69) SOLUTION – use *parsimony* analysis to develop simplest explanation (fewest steps or shortest tree); and if similar trees result, develop a *consensus tree* resulting from introduction of elements of equally parsimonious trees that cause least change.

3. HOW "SOLID" ARE THE GROUPINGS IN THE HIERARCHY?

   a. SPECIES – problems with hybridization –> hard to use the biological species definition of "interbreeding groups"

   b. GENERA = aggregates of closely related species — presumably one ancestor

   c. FAMILIES – some (*e.g*. Asteraceae) are well defined; others, very diverse genera

   d. ORDERS – "largely a matter of speculation" – Benson, Plant Classification (1979)

4. CONCLUSION:

   a. Due to the subjectivity of phylogenetic classifications, many taxonomists have long sought more objective approaches to identification and schematic representation of "natural affinities" among species

   b. Three alternative classification systems will be discussed below

C. PHENETIC SYSTEMS – (first by de Jussieu, 1789; revived in 1960's with computers)

1. Classification based on large numbers of phenotypic characters – observable traits
2. "O_____ T_____ U_____ (OTU) x Character Tables" to compare large numbers of character states (assigned numerical values or presence/absence)
3. Identify taxa based on "cluster analysis" to sort out groups based on greater overall similarity within "clusters" of species
4. Dendrogram (Phenogram) – diagram showing relative closeness of groups (Figure 6-2)
5. Pheneticists seek objectivity that is lacking in phylogenetic systems. The latter have been more subjective because of the incompleteness of the fossil record (page 102). Emphasize: "The dendrogram is **not** a phylogenetic tree (See p. 102)."

D. CLADISTIC SYSTEMS – (Willi Hennig, 1950) – based on pursuit of monophyletic groups

1. Monophyletic group = _____
2. Shared-derived characters = "those which changed states when the ancestor to the monophyletic group evolved (p. 66)." Group members would all share these characters.
3. Cladograms (branching diagrams) are used to portray closeness of species (Fig 4-1, 4-2)

Note: Both Phenetic and Cladistic approaches have been adapted to evolutionary theorizing For example: Cladogram nodes need not imply existence of a common ancestor, but phylogeneticists will attempt to "force" this interpretation in absence of fossil transitional forms

E. DISCONTINUITY SYSTEMATICS

1. BASIS – the belief that discontinuities exist in nature – i.e. typological approach using phenetic analysis with statistics to validate the amount of "distance" between taxa

2. RATIONALE – discontinuities between and among created forms reflect their origin

3. TYPOLOGY = grouping according to an array of distinct characters forming a TYPE
> Note: Broader attention to "form"; like phenetics, many morphol. features considered

4. BARAMINOLOGY – discontinuity systematics when combined with Biblical Revelation

   a. QUEST – to develop a classification system to reflect the origin of created "kinds"

   b. Leaders – Kurt Wyse and Todd Wood (Bryan College), Wayne Frair, and others.

IV. PROBLEMS WITH THE HIERARCHICAL APPROACH:

A. Accommodating new species both extinct and extant is flooding the Linnaean system

B. When new data requires name or rank changes at the species or genus level, the suffixes that indicate rank make it necessary to change names in multiple ranks

e.g. If *Acer* was displaced as the type genus of Aceraceae, the family name must change

C. Current changes in taxonomic classification – reflected in the fact that the 4th ed. of this text used the Cronquist system whereas Murrell is shifting to the Angiosperm Plant Group (APG) system (see Murrell, page 117-119, and http://www.mobot.org/MOBOT/research/APweb)