BIOLOGY 2404a
FLORA AND VEGETATION OF ONTARIO
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Lecture 3

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TODAY'S OUTLINE

- Taxonomy, systematics and phylogenetics
- New views of the evolutionary relationships of photosynthetic organisms

TAXONOMY & SYSTEMATICS

- Both have to do with classifying and naming organisms
- Taxonomy is now often regarded as the poor cousin or antiquated version of systematics – you won't find many university departments of Plant Taxonomy, but you might find a few university courses with that name
- Folk taxonomies – all around the world, people have recognized and named the organisms that are considered useful or dangerous, and often grouped them in some way

TAXONOMY

- Gk *taxis* – arrangement + *nomos* – management/law
- Webster: the science of classification of objects
- Raven et al: the science of the classification of organisms
- Judd et al: Theory and practice of grouping individuals into species, arranging species into larger groups, and giving these groups names, thus producing a classification

SYSTEMATICS

- Gk *systema* – system + *atikos* – about
- Webster: the science or method of classifying, especially taxonomy
- Raven: Scientific study of the kinds of organisms and the relationships between them
- Judd: The science of organismal diversity, frequently used in a sense roughly equivalent to taxonomy

TAXONOMY vs SYSTEMATICS

- If there <u>is</u> any difference, it is that systematics (post-Darwin) is concerned with creating a classification that reflects evolutionary relationships. Taxonomists have in the past frequently created classifications of convenience, consisting of easy-to-recognize groups based on patterns of overall similarity
- Since ~no taxonomists now classify in the absence of evolutionary evidence, the two terms are essentially equal

Why base classification on evolution?

- Knowing the identity of something (or someone) – its name – is potentially informative of what it does, where it lives, etc., as well as what it looks like
- Because related organisms share many traits (e.g., biochemical pathways, structure, morphology), a classification that is based on evolutionary relationships has potential to be more <u>predictive</u> than one that is not

Naming systems

- Folk taxonomies: names range from single words to phrases – e.g., "the plant with leaves used for poison arrows"
- Early European classifications – e.g., herbals of 15th to 18th C – used polynomials
- *Polyporus esculentus, ex ingenti, perenni, & tuberosa radice in singulos menses plerumque nascens ....* (Micheli 1729)
- Fries (1821) changed and shortened this to *Polyporus tuberaster* (now the **type species** of the genus *Polyporus*)

Karl von Linné (aka Carolus Linnaeus)

- Linnaeus 1753, borrowing from Casper Bauhin 150 years earlier, used <u>binomials</u> in his *Species Plantarum*
- Linnaeus did <u>not</u> come up with either binomials or the complete "Linnaean hierarchy" that we use today, <u>but</u> he did systematically apply binomial nomenclature and a consistent hierarchy to encyclopedic compendia of known organisms (not much on Fungi)
- The compleat naturalist: a life of Linnaeus (QH44.B54 1971)

The Linnaean Hierarchy

- Dumb kings play chess on fine green sods [or make up your own memory device]
- Domain, Kingdom, Phylum, Class, Order, Family, <u>Genus</u>, <u>species</u>* [<u>subspecies</u>/<u>variety</u>, f.sp.]
- The singular of species is species
- The plural of genus is genera
- The plural of phylum is phyla

* The new guideline is to write ALL Latin names (i.e., all ranks) in *italics* or <u>underlined</u>

Taxon Names

The names of many groups above genera have common (diagnostic) endings, depending on the group of organisms

Taxon/Suffix	Fungi	Algae	Plants
Phylum	-mycota	-phyta	-phyta
Class	-mycetes	-phyceae	-opsida
Order	-ales	-ales	-ales
Family	-aceae	-aceae	-aceae

HOW do you create a classification?

- Traditional taxonomy: "expert" studies group, usually based on morphology, and uses personal judgement to assign individuals to species, species to genera, genera to families, etc. (criteria are not necessarily explicit)
- Numerical taxonomy or phenetics: character states of individuals are codified or quantified, and similarity is used as criterion of relatedness
- Phylogenetic systematics or cladistics: relatedness is based on patterns of shared derived character states (= synapomorphies)

What makes a GOOD (evolutionary) classification?

Every taxon (named group) should be <u>monophyletic</u>

Know these terms:

- Monophyletic
- Polyphyletic
- Paraphyletic
- Synapomorphy, symplesiomorphy, convergence, homoplasy

A phylogenetic tree of eukaryotes

- [Lecture 2, slide 3; also slide 7 of plants]
- Thank goodness we don't have to study all <u>these</u> groups!
- Our classification comes from Palmer et al. (2004, Amer. J. Bot. 91:1437-1445) and the Angiosperm Phylogeny Website <http://www.mobot.org/MOBOT/research/APWeb/>

Names change!

- The species epithets, generic names, and even family placements of many familiar plants have changed in recent years.
  - One name may be found to be a later synonym of another - the older one has "priority"
    - E.g., *Dentaria laciniata* is now *Cardamine concatenata*.
  - Classification at the generic or family level may change with new evidence such as DNA sequences
    - E.g., the maple family, *Aceraceae*, and horsechestnut family, *Hippocastanaceae*, are now included in the soapberry family, *Sapindaceae*. *Acer saccharum* remains the sugar maple.