Plant Systematics
Botany 400
http://botany.wisc.edu/courses/botany_400/

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What is Systematics?
or Why Study Systematics?
Read: Daly et al.’s Systematics Agenda 2020

Pick up course syllabus from front if you have not already downloaded the pdf from Canvas or picked up the required booklet

What is Systematics — or Why Study Systematics?

Systematics is a broad field encompassing 3 major areas

• Taxonomy
• Phylogenetics
• Biosystematics

Systematics → Taxonomy
What is Systematics — or Why Study Systematics?

**Taxonomy:**
Identification, nomenclature, classification

**Phylogeny:**
Relationships of taxa

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**Cirsium pitcheri** Eaton
Dune thistle - family Asteraceae

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**Zina Pitcher**
Ft. Brady
Sault St. Marie
Michigan

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**Source of "type" specimen in 1826**

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**Cirsium canescens** Nutt.
Prairie thistle

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Closest relative of the dune thistle
**What is Systematics — or Why Study Systematics?**

**Phylogeny:** “pattern” of evolution

- Cirsium pitcheri
- Cirsium canescens
- Cirsium muticum
- Carduus acanthoides

Common ancestor of dune and prairie thistles

Common ancestor of all thistles

Common ancestor of thistles and other genera of the thistle tribe

**What is Systematics — or Why Study Systematics?**

**Biosystematics:** “process” of evolution

- Carduus acanthoides
- Cirsium canescens
- Cirsium pitcheri

How, when, where did this speciation event occur?

? During Pleistocene alternating shifts of ice fronts ?

**What is Systematics — or Why Study Systematics?**

**Phylogeny:** “pattern” of evolution - for family Asteraceae

**Systematics — Goal 1: Inventory Earth’s Biota**

Scientific community obsessed with finding life on other planets – weird and exotic life forms

Kepler-186 f in Cygnus constellation

492 light years
Systematics — Goal 1: Inventory Earth’s Biota

Proxima Centauri b – 4.2 light years

Weird and exotic life forms exist on Earth!

• 1.4 X 10^6 species discovered and described
• but cannot estimate the number of species to an order of magnitude!

We do know that there are 24,189,688 catalogued books in the Library of Congress classification system as of Aug. 31, 2017!

• 1.4 X 10^6 species discovered and described
• but cannot estimate the number of species to an order of magnitude!
• insects and microbes problematic
Systematics — Goal 1: Inventory Earth’s Biota

Temperate inventory nearly complete

- Regional or local floras still important

DNA Barcode phylogenetic tree of Wisconsin flora
Systematics — Goal 1: Inventory Earth’s Biota

Tropical inventory wide opened

• 4/5ths of 250-300K angiosperms in tropics

• 4 ha in neotropical cloud forest > 2400 spp in WI!

= 8 Camp Randall stadium playing fields

Systematics — Goal 1: Inventory Earth’s Biota

Tropical inventory wide opened

• 4/5ths of 250-300K angiosperms in tropics

• 4 ha in neotropical cloud forest > 2400 spp in WI!

• > 200 species of orchids
Systematics — Goal 1: Inventory Earth’s Biota

Tropical inventory wide opened

- 4/5ths of 250-300K angiosperms in tropics
- 4 ha in neotropical cloud forest > 2400 spp in W!'
- > 200 species of orchids
- 10%+ undescribed!

New mycotrophic genus (monocot)
from Ecuador found by Botany grad Catherine Woodward in 2005

Systematics — Goal 1: Inventory Earth’s Biota

Tropical systematics at the cutting edge

- biodiversity endangered

Listanthus habuenis Sytsma sp. nov.

- New species endemic to one lowland cloud forest peak, Cerro Haba, central Panama - in 1983

1985, the forest - and the species - were gone; one of the 13,800 species of plants E.O. Wilson had projected to disappear in the last century

Systematics — Goal 2: Identification and Communication: Nomenclature

- to many - keying, identifying, putting names on organisms is systematics (= taxonomy)

- “species” names (binomial, common, polynomial, uninomial)

Solidago canadensis - Canada goldenrod

Systematics — Goal 2: Identification and Communication: Nomenclature

- “words” and “vocabulary”

- systematics integral to other disciplines

Arabidopsis thaliana - Thal’s mouse-ear cress
Systematics — Goal 2: Identification and Communication: Nomenclature

• but how do we “define” species?
• ongoing issue that we have still not resolved!

Arabidopsis thaliana - Thal’s mouse-ear cress

Systematics — Goal 3: Orderly, Logical Sequence of Classification

• place species in logical framework that relates organisms with one another
• “encyclopedia” for the “vocabulary” of names

Solidago canadensis - Canada goldenrod

Systematics — Goal 3: Orderly, Logical Sequence of Classification

An Example of an Hierarchical Classification System for Solidago canadensis (Canada goldenrod)

<table>
<thead>
<tr>
<th>taxon</th>
<th>ending</th>
<th>rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnoliophyta</td>
<td>-phyta</td>
<td>Phylum</td>
</tr>
<tr>
<td>Magnoliopsida</td>
<td>-opsida</td>
<td>Class</td>
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<tr>
<td>Asterales</td>
<td>-ales</td>
<td>Order</td>
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<td>Asteraceae</td>
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<td>-eae</td>
<td>Tribe</td>
</tr>
<tr>
<td>Solidago</td>
<td></td>
<td>Genus</td>
</tr>
<tr>
<td>S. canadensis</td>
<td></td>
<td>Species</td>
</tr>
</tbody>
</table>
Systematics — Goal 3: Orderly, Logical Sequence of Classification

- place species in logical framework that relates organisms with one another
- “encyclopedia” for the “vocabulary” of names
- “information-retrieval” as in herbarium or in web-based resources

Missouri Botanical Garden Herbarium

Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

- detect evolution at work, present and past, understand its pathways and results
- substance or “meat” of systematic biology

Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

- systematics looks at the origin of ancient diversity:
  - back in time 500 million ya to the movement of plants onto land

Silurian view - plants conquer land

Adaptive radiation of Lobeliaceae on the Hawaiian Islands in last 15 my
Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

• and systematics looks at the origin of very recent diversity:

  • rise of polyploid species in less than 100 years!

Tragopogon - goat’s beard

Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

• systematics looks at process and pattern

• morphological and molecular characters

• tree metaphor = genealogy = phylogeny

Tree of Life
www.tolweb.org/tree/

Plant systematics has not outlived its usefulness; it is just getting underway on an attractively infinite task.

Lincoln Constance