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

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What is Systematics — or Why Study Systematics?

Systematics is a broad field encompassing 3 major areas

- Taxonomy
- Phylogenetics
- Biosystematics

What is Systematics — or Why Study Systematics?

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

Taxonomy: identification, nomenclature, classification

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Cirsium pitcheri Eaton
Dune thistle - family Asteraceae

Phylogeny: relationships of taxa

Cirsium canescens Nutt.
— Prairie thistle
Closest relative of the dune thistle

Cirsium pitcheri Eaton
Dune thistle - family Asteraceae

To what is the dune thistle related?

What is Systematics — or Why Study Systematics?

Phylogeny: “pattern” of evolution

Carduus acanthoides
Cirsium malacum
Cirsium canescens
Cirsium pitcheri

Common ancestor of dune and prairie thistles

Common ancestor of all thistles

Common ancestor of thistles and other genera of the thistle tribe

Source of “type” specimen in 1826

Cirsium pitcheri Eaton
Dune thistle - family Asteraceae
What is Systematics — or Why Study Systematics?

Phylogeny: “pattern” of evolution - for family Asteraceae

How, when, where did this speciation event occur? During Pleistocene alternating shifts of ice fronts?

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

Proxima Centauri b – 4.2 light years
Systematics — Goal 1: Inventory Earth’s Biota

Weird and exotic life forms exist on Earth!

- 1.4 X 10^6 species discovered and described
- but can not estimate the number of species to an order of magnitude!

Systematics — Goal 1: Inventory Earth’s Biota

- we do know that there are 24,189,688 catalogued books in the Library of Congress classification system as of Aug. 31, 2018!
- 1.4 X 10^6 species discovered and described
- but can not estimate the number of species to an order of magnitude!

Systematics — Goal 1: Inventory Earth’s Biota

Temperate inventory nearly complete

- Regional or local floras still important
- 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

Welcome to the Online Virtual Flora of Wisconsin

This site is a collaborative effort between the herbarium of the University of Wisconsin-Madison and the University of Wisconsin-Milwaukee, along with the forests of the eastern United States. It contains information on over 250,000 vascular plant species that are found in Wisconsin, including affinis, distribution maps, specimen records, and more.

Quick Search

Enter a genus, species, or common name to view the species description pages.

Advanced Search:

- Use Advanced Search tab above to search for specimen records
- Use the Image Library to view and download more than 100,000 specimen records and photos of images.

Checklists (i.e., Coasts, Flora, Insects by Color) are under development. Take a look or create your own!
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

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

*Lisianthus habuenis* Sytsma sp. nov.

- New species endemic to one lowland cloud forest peak, Cerro Habu, 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

- alternative classifications to traditional ranked hierarchical systems

PhyloCode

http://www.ohiou.edu/phylocode/

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 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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<tr>
<td>Asteraceae</td>
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<td>Family</td>
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<tr>
<td>Solidago</td>
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<td>Genus</td>
</tr>
<tr>
<td>S. canadensis</td>
<td></td>
<td>Species</td>
</tr>
</tbody>
</table>
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 looks at the origin of ancient diversity:
  • back in time 500 million ya to the movement of plants onto land

Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

• systematics looks at the origin of very recent diversity:
  • rise of polyploid species in less than 100 years!

Adaptive radiation of Lobeliaceae on the Hawaiian Islands in last 15 my

T. autumnalis
T. micranthus
T. nanus
T. speciosissimus

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

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

Lincoln Constance