

Plant Systematics

Botany 400

information on Canvas

http://botany.wisc.edu/courses/botany_400/

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University of Wisconsin

**Pick up course syllabus
from front desk**



Required plant
collection



What is Systematics? or Why Study Systematics?

Read: Daly et al.'s *Systematics Agenda 2020*

What is Systematics — or Why Study Systematics?

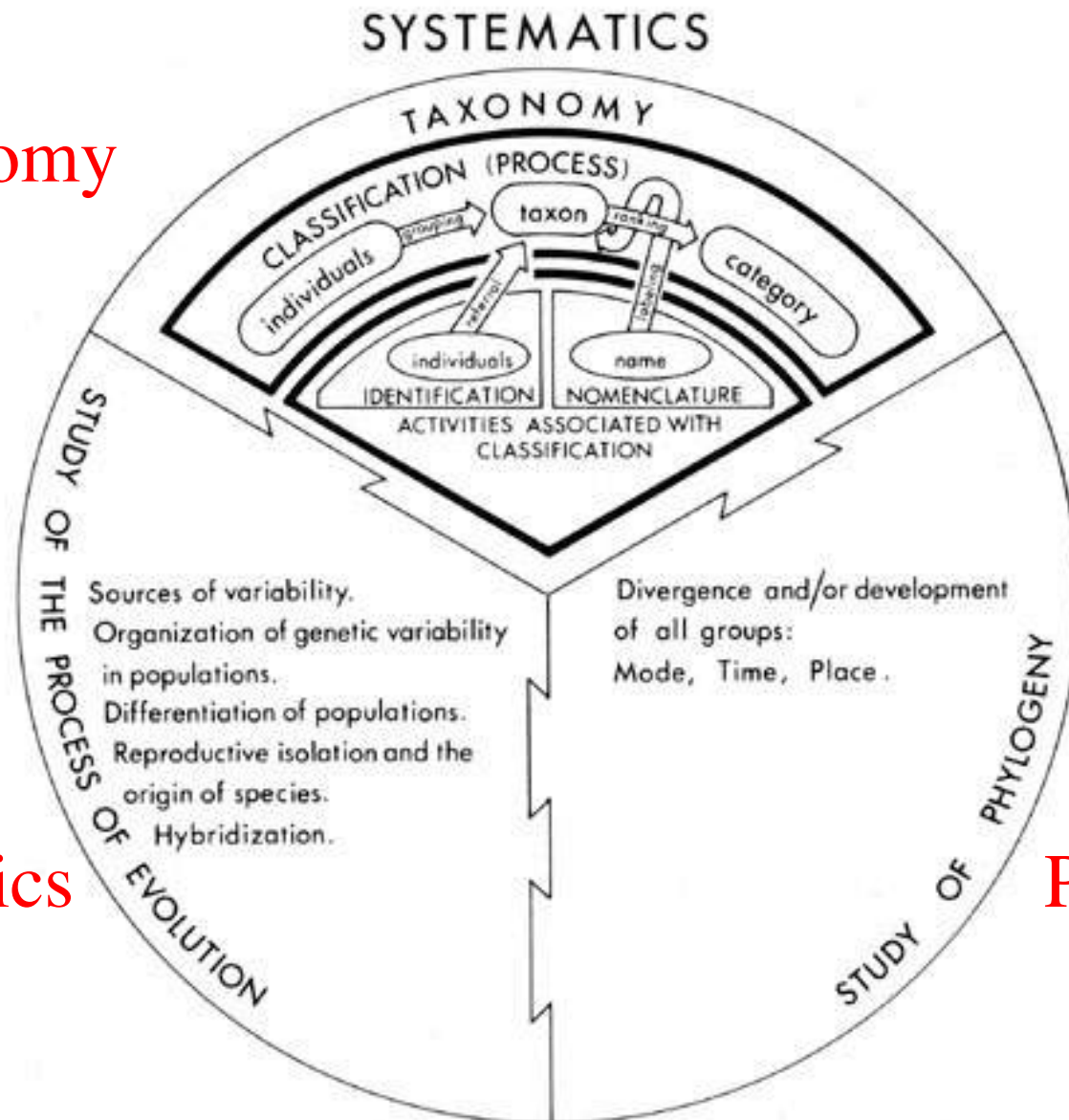


Systematics is a broad field encompassing 3 major areas

- Taxonomy
- Phylogenetics
- Biosystematics

What is Systematics — or Why Study Systematics?

Taxonomy



Biosystematics

Phylogenetics

What is Systematics — or Why Study Systematics?

Taxonomy: identification, nomenclature, classification



Zina Pitcher



Ft. Brady
Sault St. Marie
Michigan



Cirsium pitcheri Eaton
Dune thistle - family Asteraceae

What is Systematics — or Why Study Systematics?

Phylogeny: relationships of taxa



To what is the dune thistle related?

Cirsium canescens Nutt.

— Prairie thistle

Closest relative of the dune thistle?

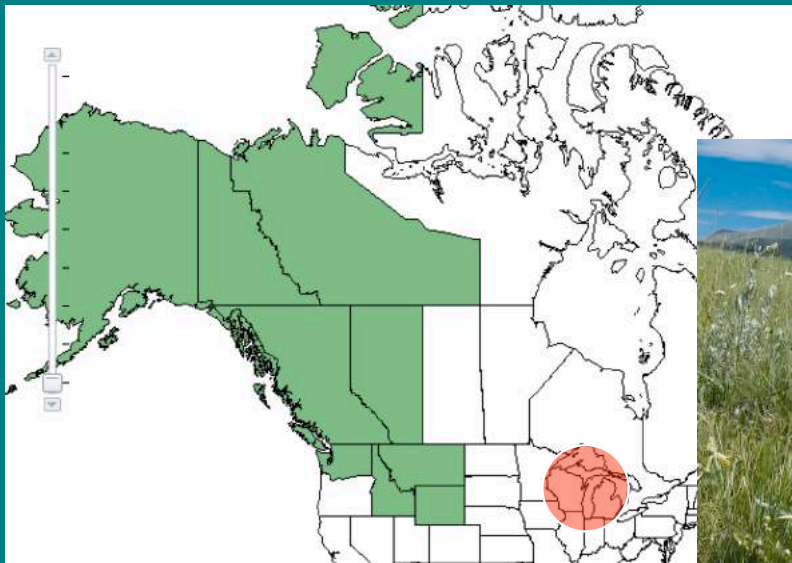


Cirsium pitcheri Eaton

Dune thistle - family Asteraceae

What is Systematics — or Why Study Systematics?

Phylogeny: relationships of taxa



Cirsium foliosum Hook DC

— Elk thistle

Cirsium pitcheri Eaton

Dune thistle - family Asteraceae

Closest relative of the dune thistle?

What is Systematics — or Why Study Systematics?

Phylogeny: “pattern” of evolution



Carduus acanthoides



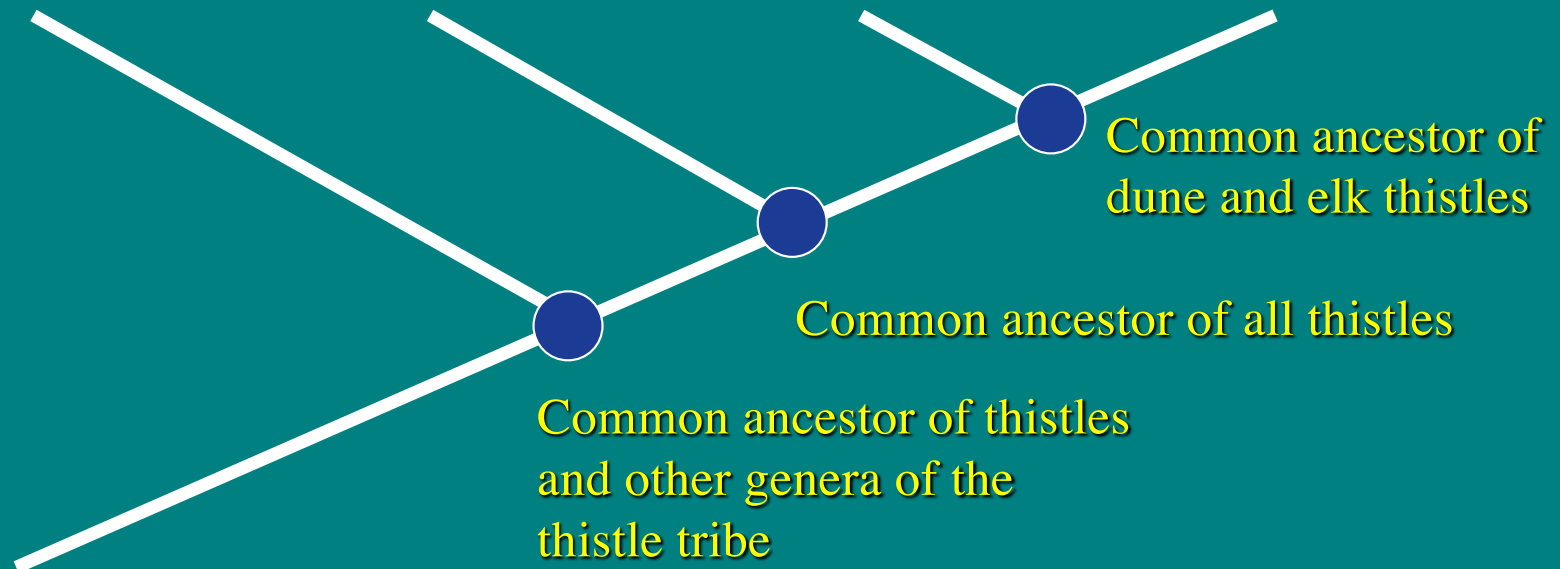
Cirsium muticum



Cirsium foliosum

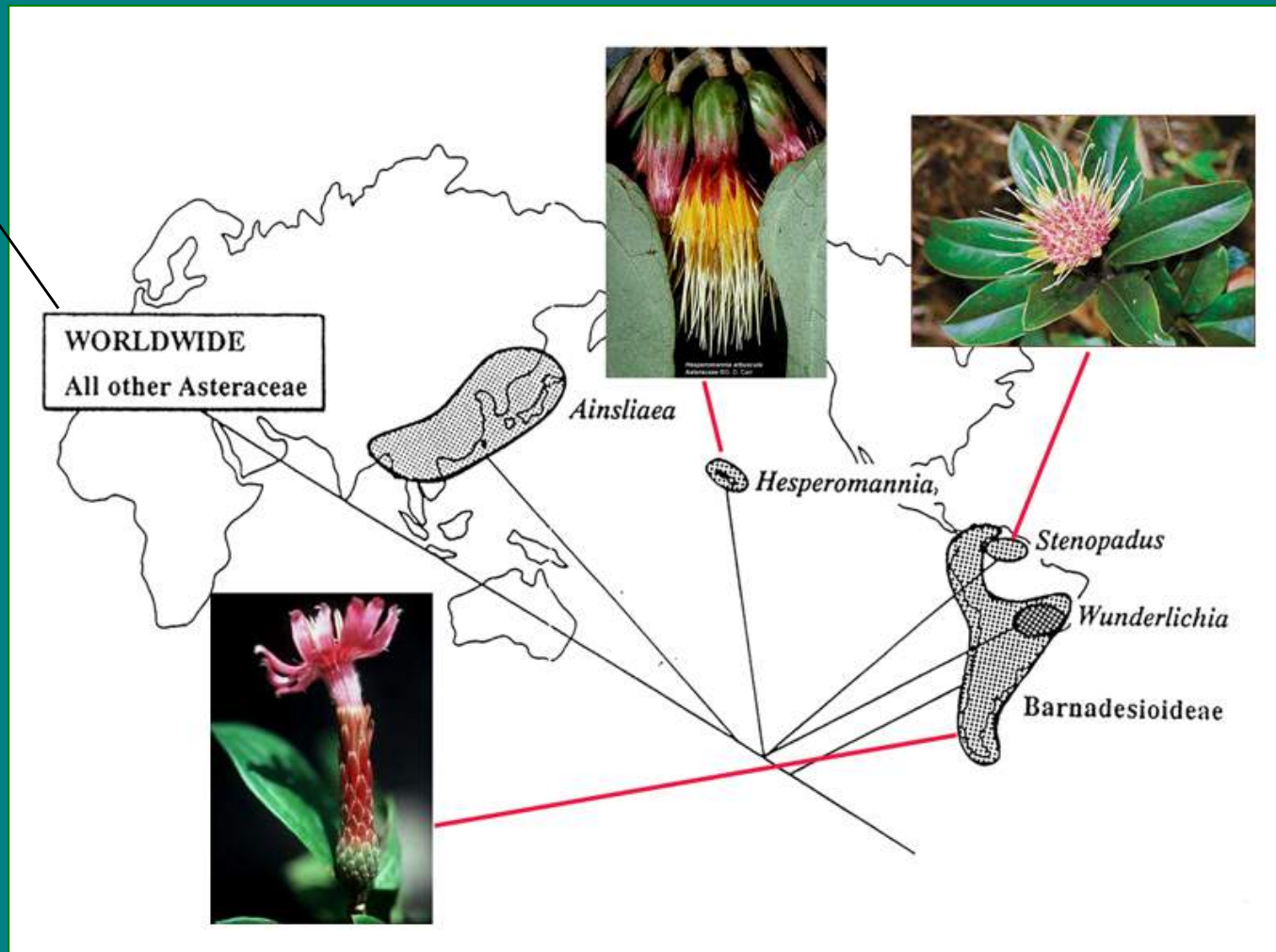
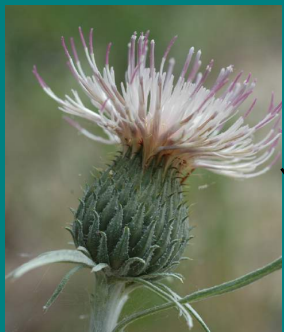


Cirsium pitcheri



What is Systematics — or Why Study Systematics?

Phylogeny: “pattern” of evolution - for family Asteraceae



What is Systematics — or Why Study Systematics?

Biosystematics: “process” of evolution



Cirsium foliosum



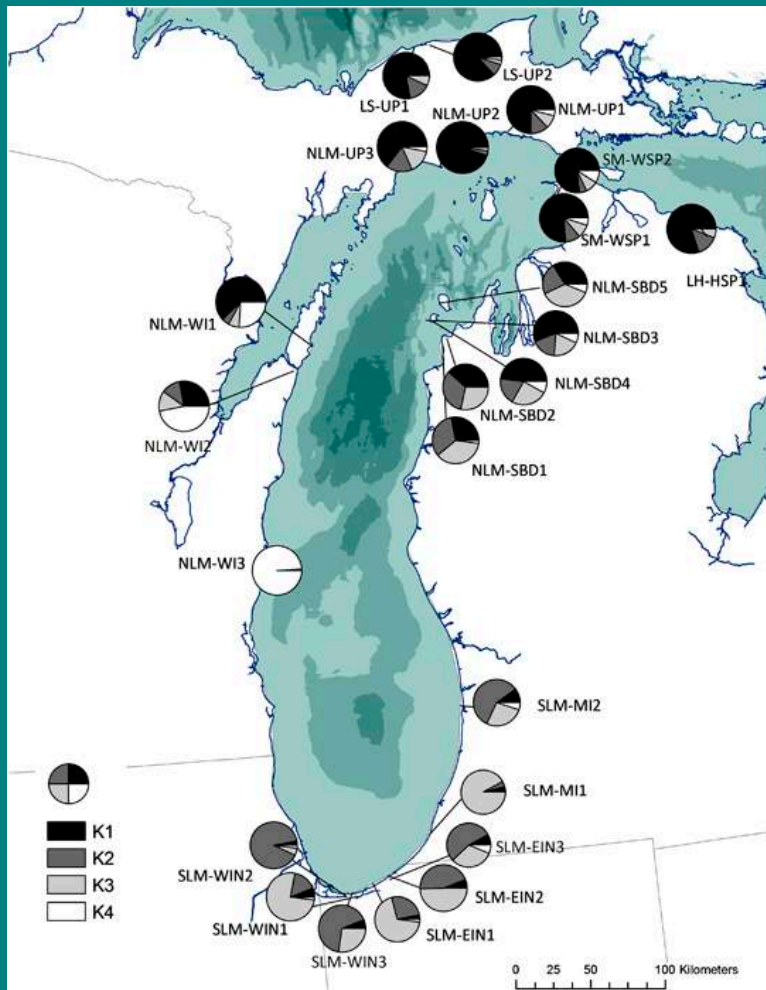
Cirsium pitcheri

How, when, where did this speciation event occur?

During Pleistocene alternating shifts of ice fronts ?

What is Systematics — or Why Study Systematics?

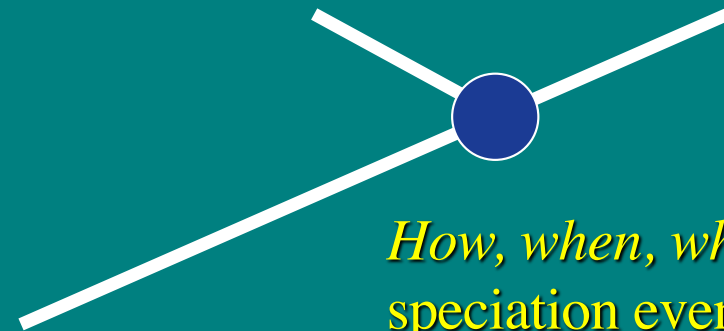
Biosystematics: “process” of evolution



Cirsium foliosum



Cirsium pitcheri

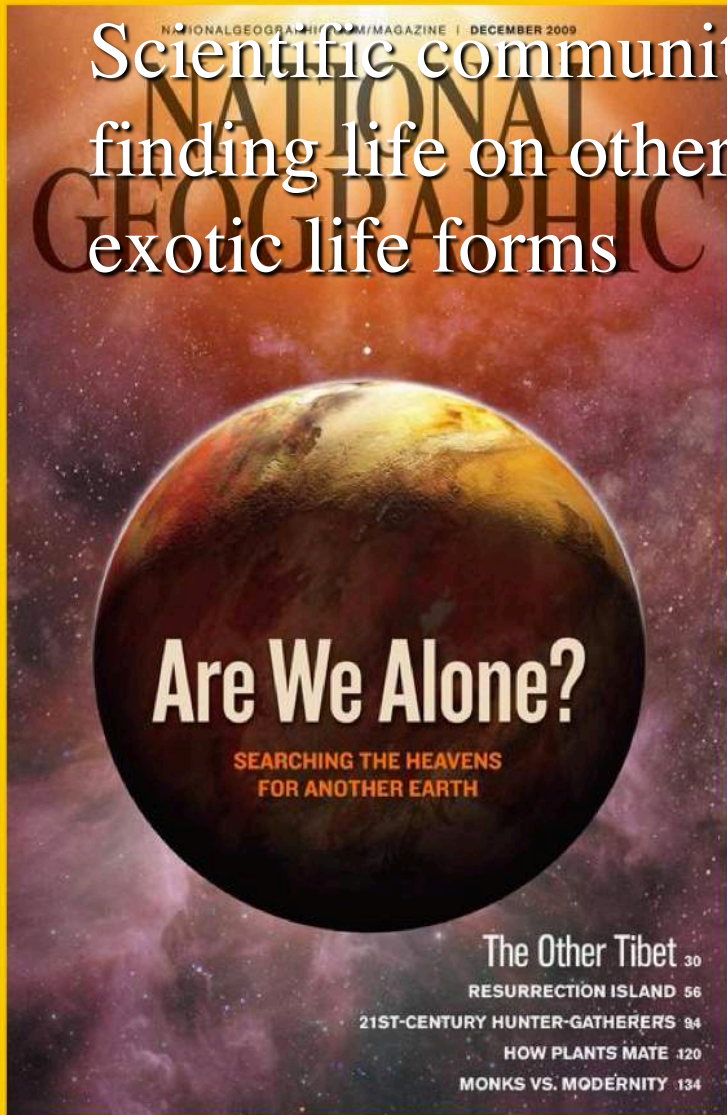


How, when, where did this speciation event occur?

How much genetic variation is in the pitcher thistle?

Systematics — Goal 1: Inventory Earth's Biota

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



SCIENCE FINDS EARTH'S TWIN

Kepler-186 f

Earth



Kepler-186 f in Cygnus constellation
492 light years

Systematics — Goal 1: Inventory Earth's Biota

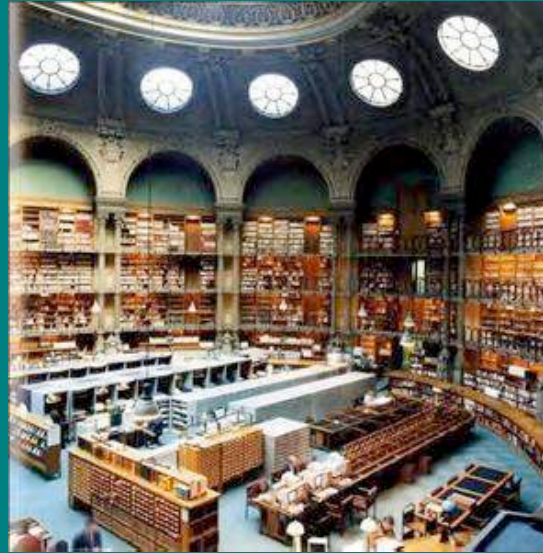
Weird and exotic life forms exist on **Earth!**

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



Systematics — Goal 1: Inventory Earth's Biota

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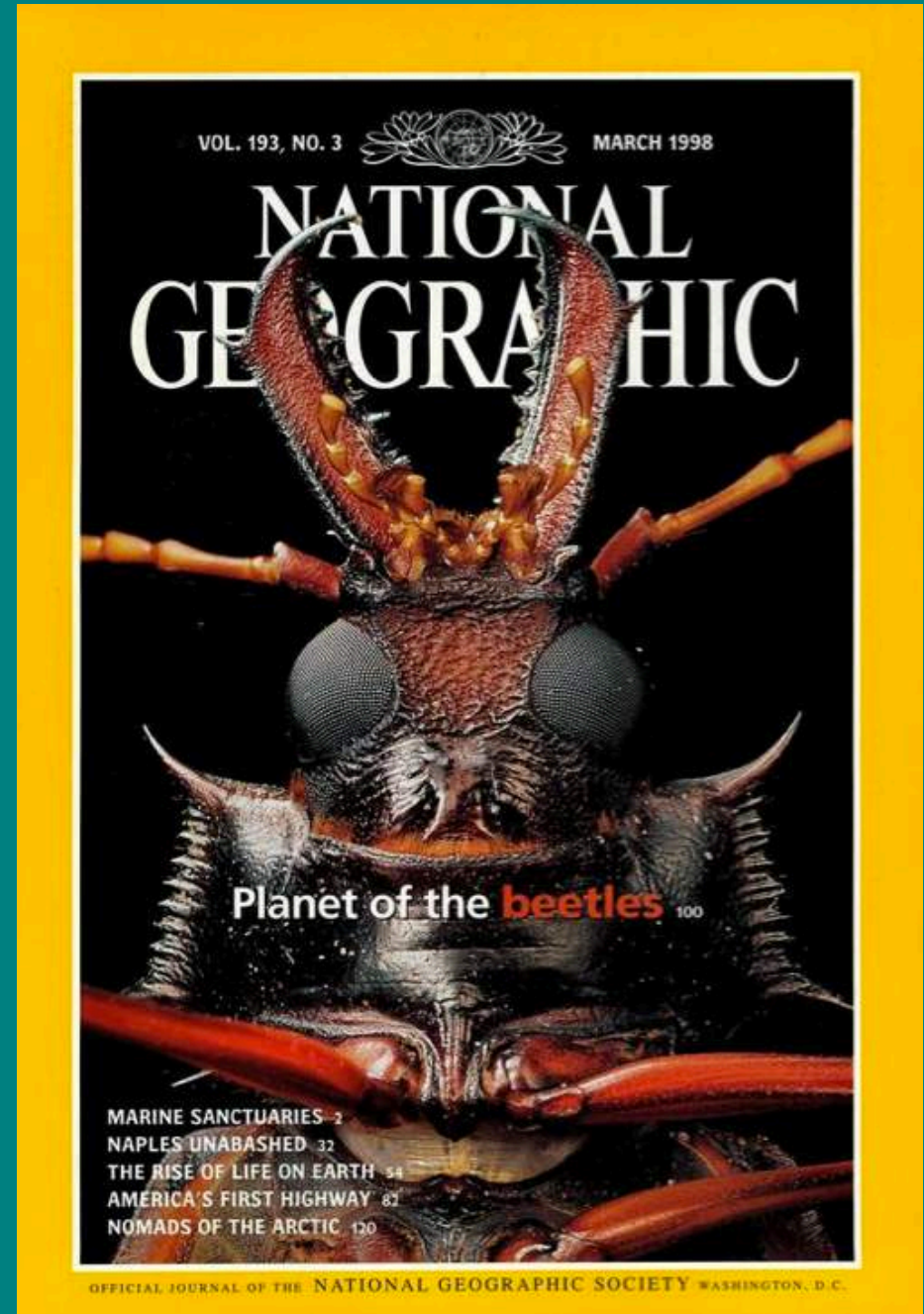


- we **do know** that there are 24,863,177 catalogued books in the Library of Congress classification system as of Aug. 31, 2020!



Systematics — Goal 1: Inventory Earth's Biota

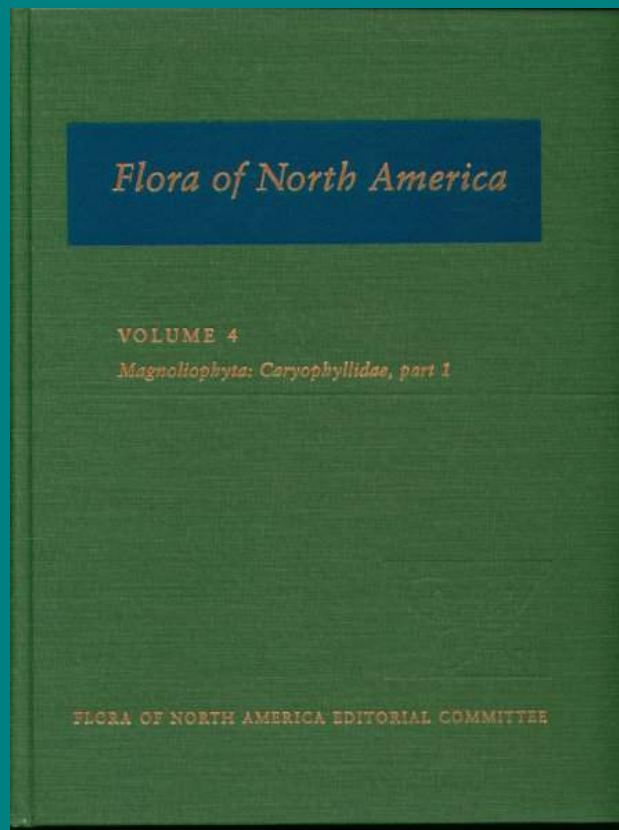
- 1.4×10^6 species discovered **and** described
- but can **not** estimate the number of species to an order of magnitude!
- insects and microbes problematic



Systematics — Goal 1: Inventory Earth's Biota

Temperate inventory nearly complete

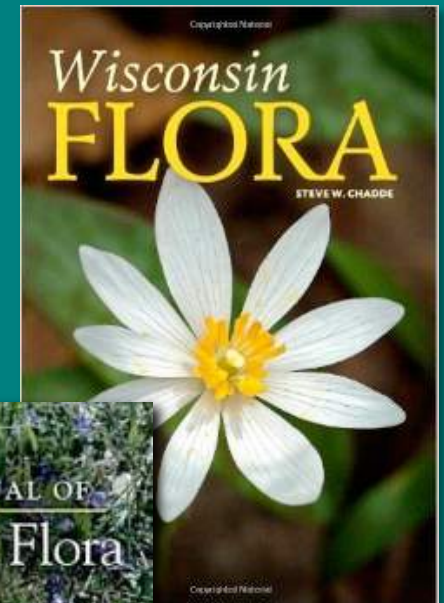
- Regional or local floras still important



Systematics — Goal 1: Inventory Earth's Biota

Temperate inventory nearly complete

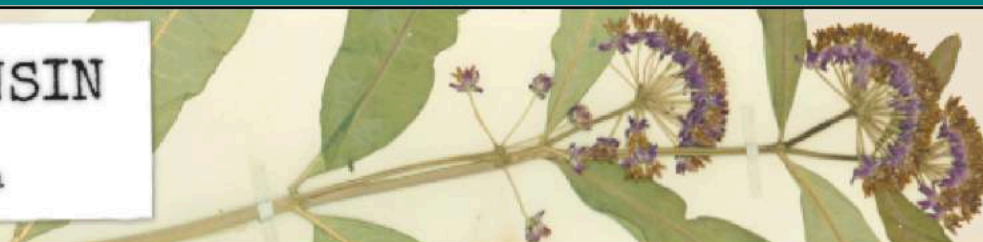
- Regional or local floras still important



Systematics — Goal 1: Inventory Earth's Biota



FLORA of WISCONSIN
Consortium of
Wisconsin Herbaria



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Welcome to the Online Virtual Flora of Wisconsin

This site is a collaborative effort between the herbaria of the UW-Madison (WIS) and the UW-Steven's Point (UWSP), along with most of the other herbaria located in the state of Wisconsin. It contains information on each of the more than 2600 vascular plant species that occurs in Wisconsin, including photos, distribution maps, specimen records, and more.

Quick Search

- Enter a **genus, species, or common name to view the species description pages.**
- View detailed species descriptions, photos, interactive maps, and links to specimen records and additional information.

Advanced Searches

- See **Advanced Searches** tab above to **Search for Specimen Records** and to **Browse the Image Library.**
- Search, view, and download more than 385,000 herbarium specimen records and thousands of images.

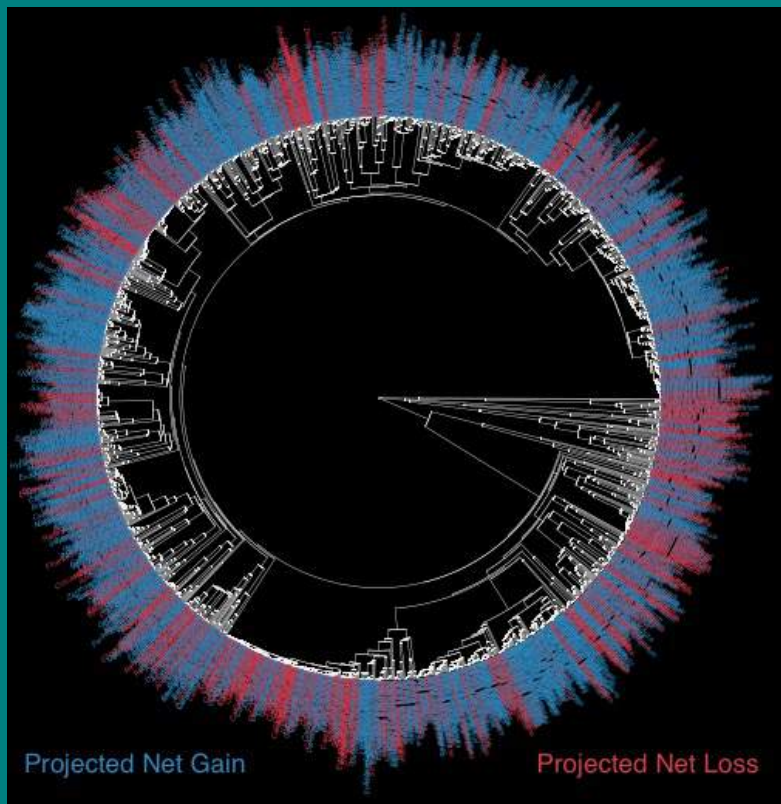
Checklists (e.g., County Floras, Wildflowers by Color) are under development. Take a look or create your own!

Plant of the Day

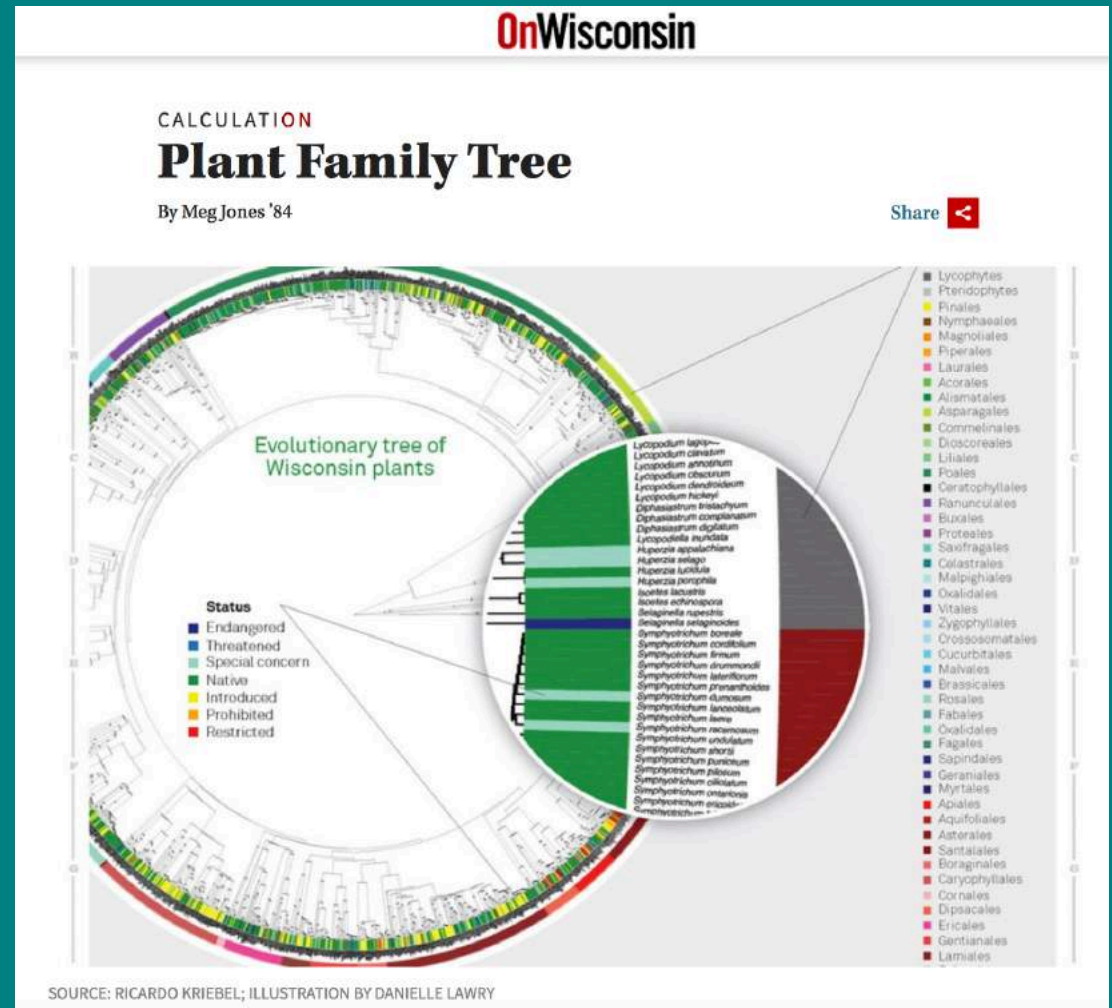


Systematics — Goal 1: Inventory Earth's Biota

Projecting species niche models to 2070 under climate change model



Spalink et al. 2018 American Journal of Botany

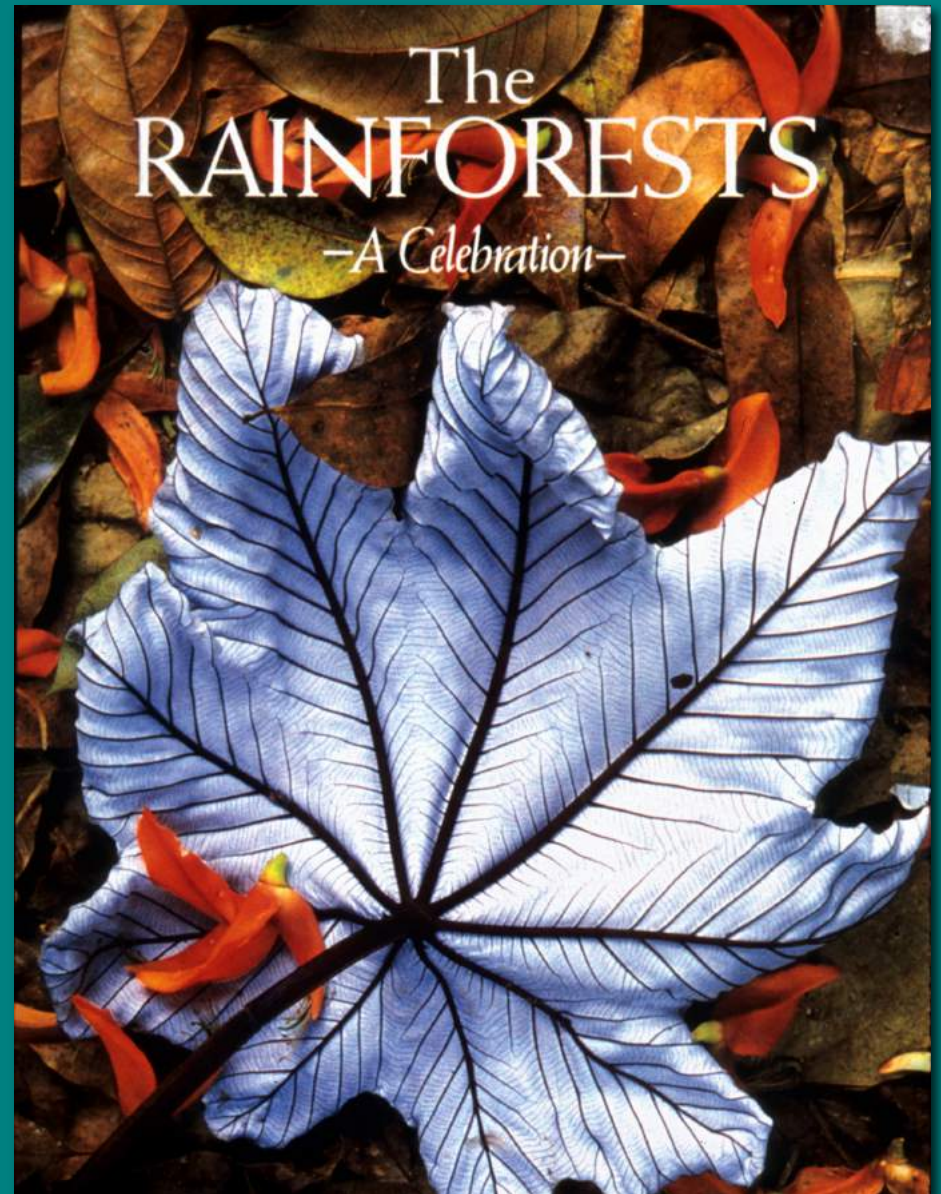


DNA Barcode phylogenetic tree of Wisconsin flora

Systematics — Goal 1: Inventory Earth's Biota

Tropical inventory wide opened

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



Systematics — Goal 1: Inventory Earth's Biota

Tropical inventory wide opened

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



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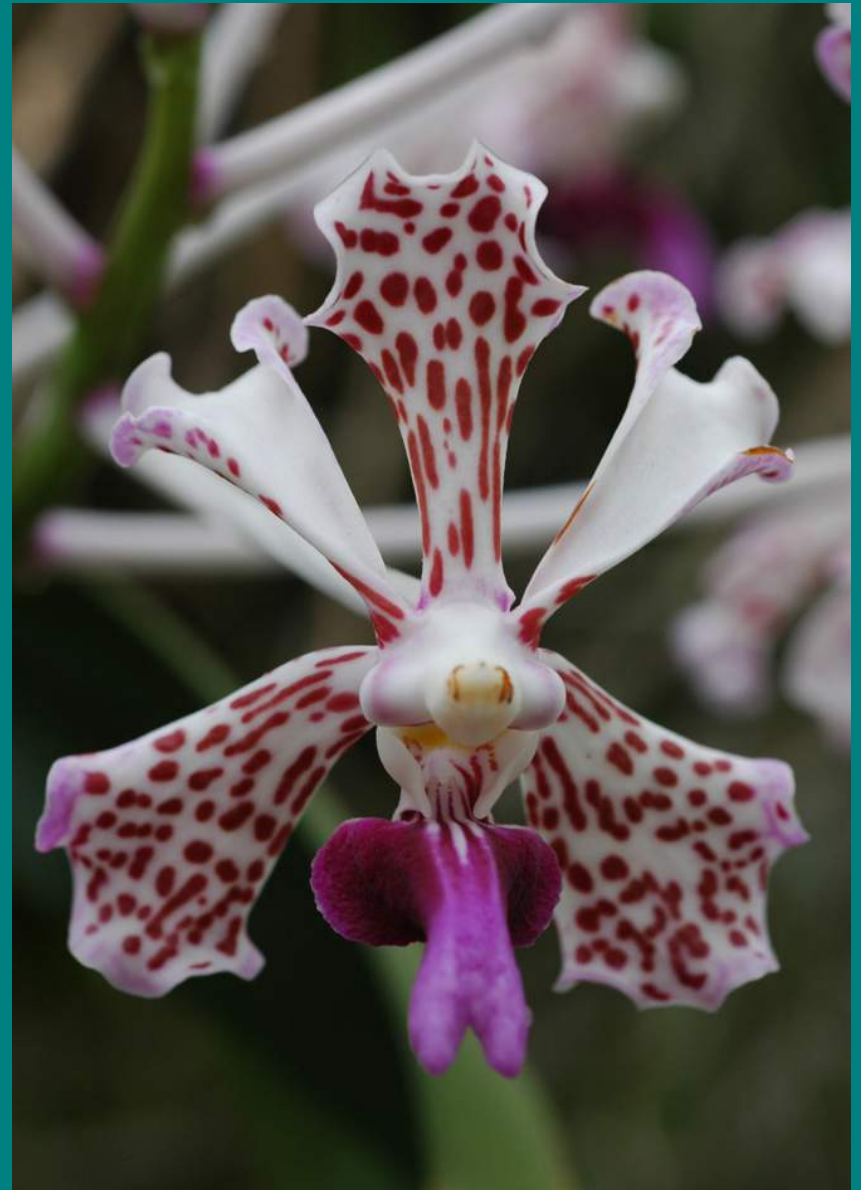


= 8 Camp Randall stadium playing fields

Systematics — Goal 1: Inventory Earth's Biota

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- 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 WI!
- > 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



Lisianthus habuenis Sytsma sp. nov.

- 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

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

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

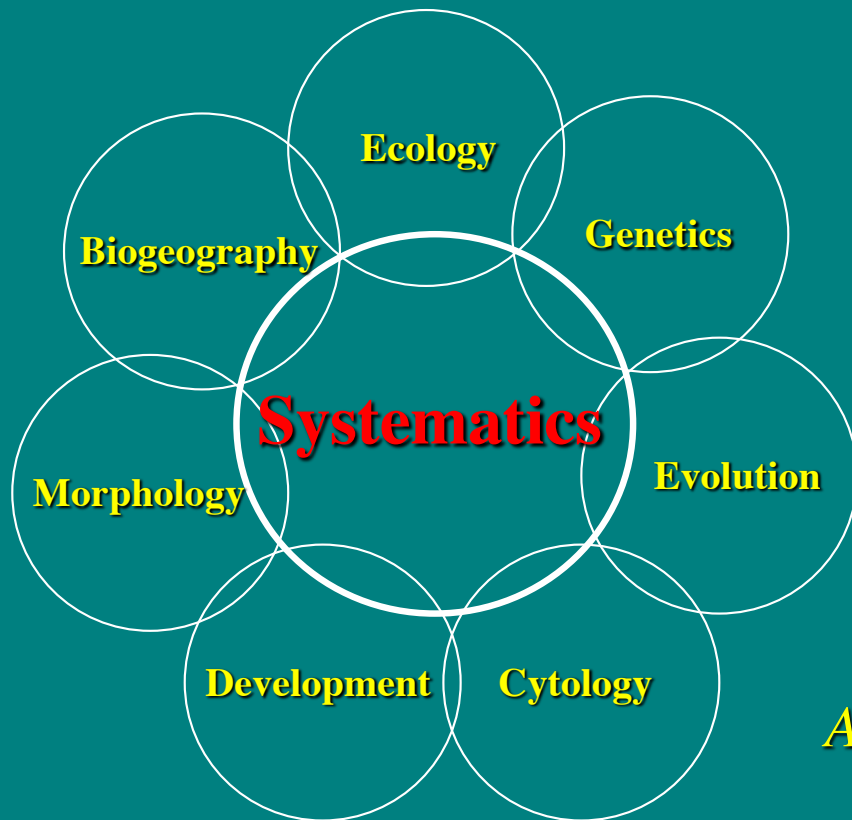
Systematics — Goal 2: Identification and Communication: Nomenclature

- to many - keying, identifying, putting names on organisms is systematics (= taxonomy)
- learn skills to do this – smart phone apps as well!



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)

<i>taxon</i>	<i>-ending</i>	<i>rank</i>
Magnoliophyta	-phyta	Phylum
Magnoliopsida	-opsida	Class
Asterales	-ales	Order
Asteraceae	-aceae	Family
Asteroideae	-oideae	Subfamily
Astereae	-eae	Tribe
<i>Solidago</i>		Genus
<i>S. canadensis</i>		Species

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](#)



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

Eastern Colorado
100 mya — Cretaceous



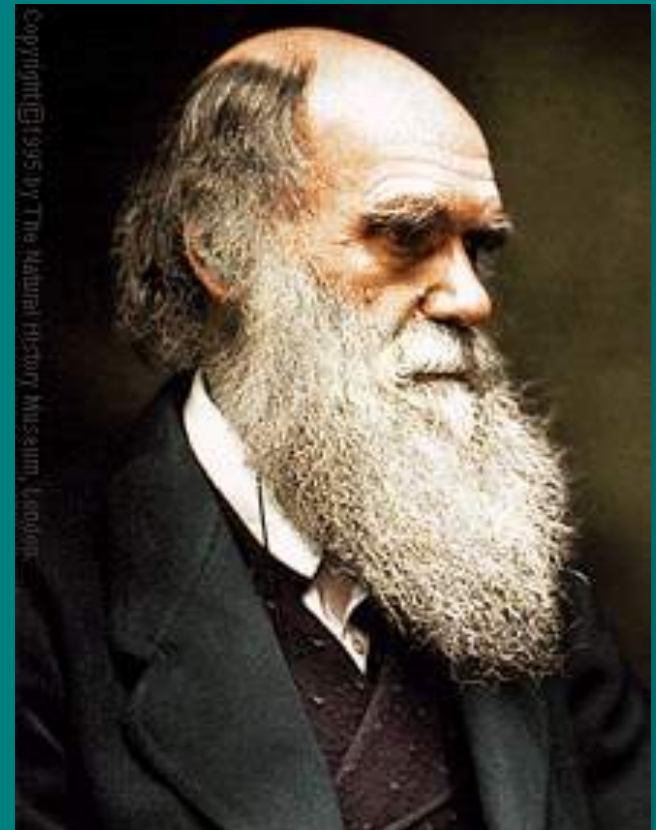
Liriophyllum



Sapindopsis



Protophyllum



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

Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

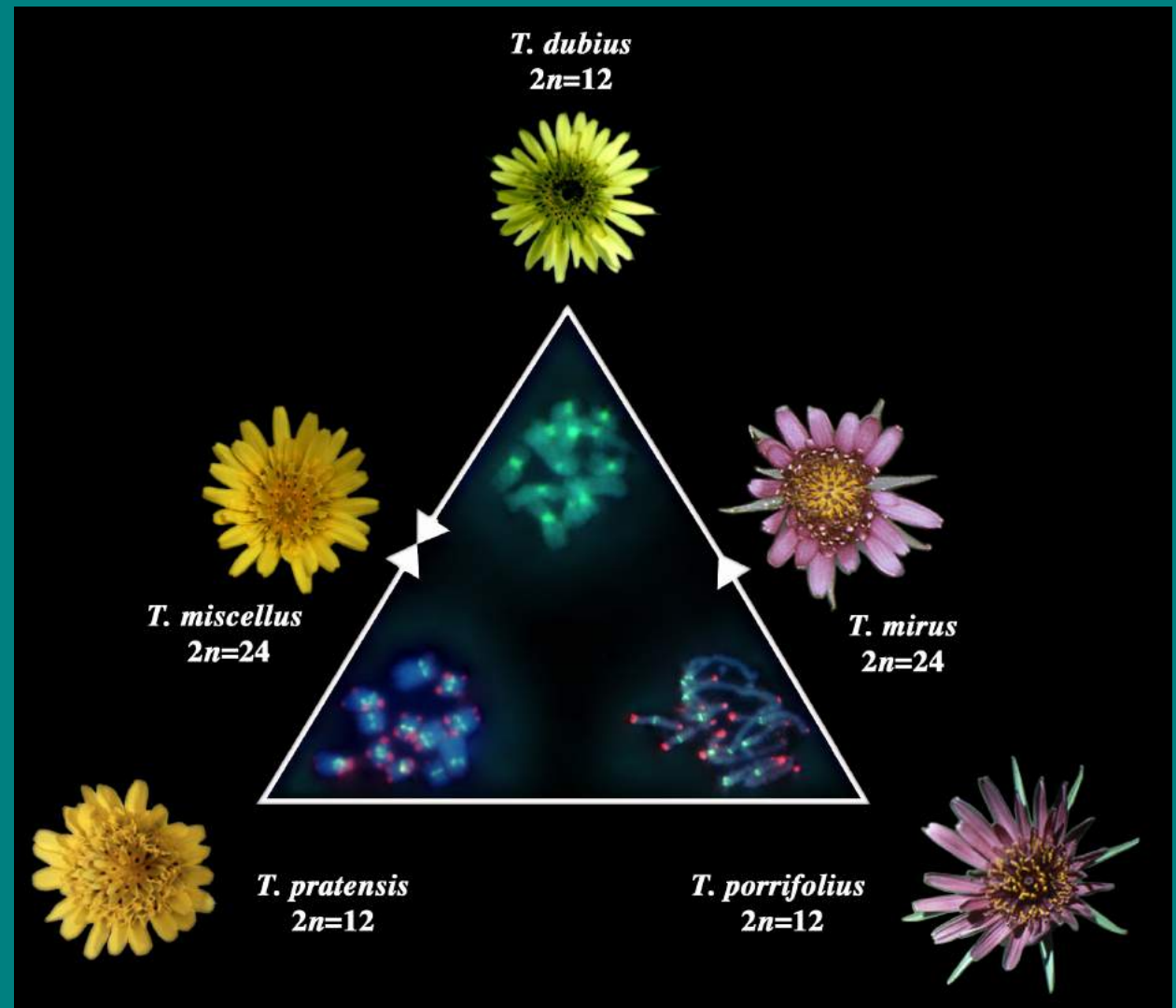
- systematics looks at the origin of **more recent** diversity:



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

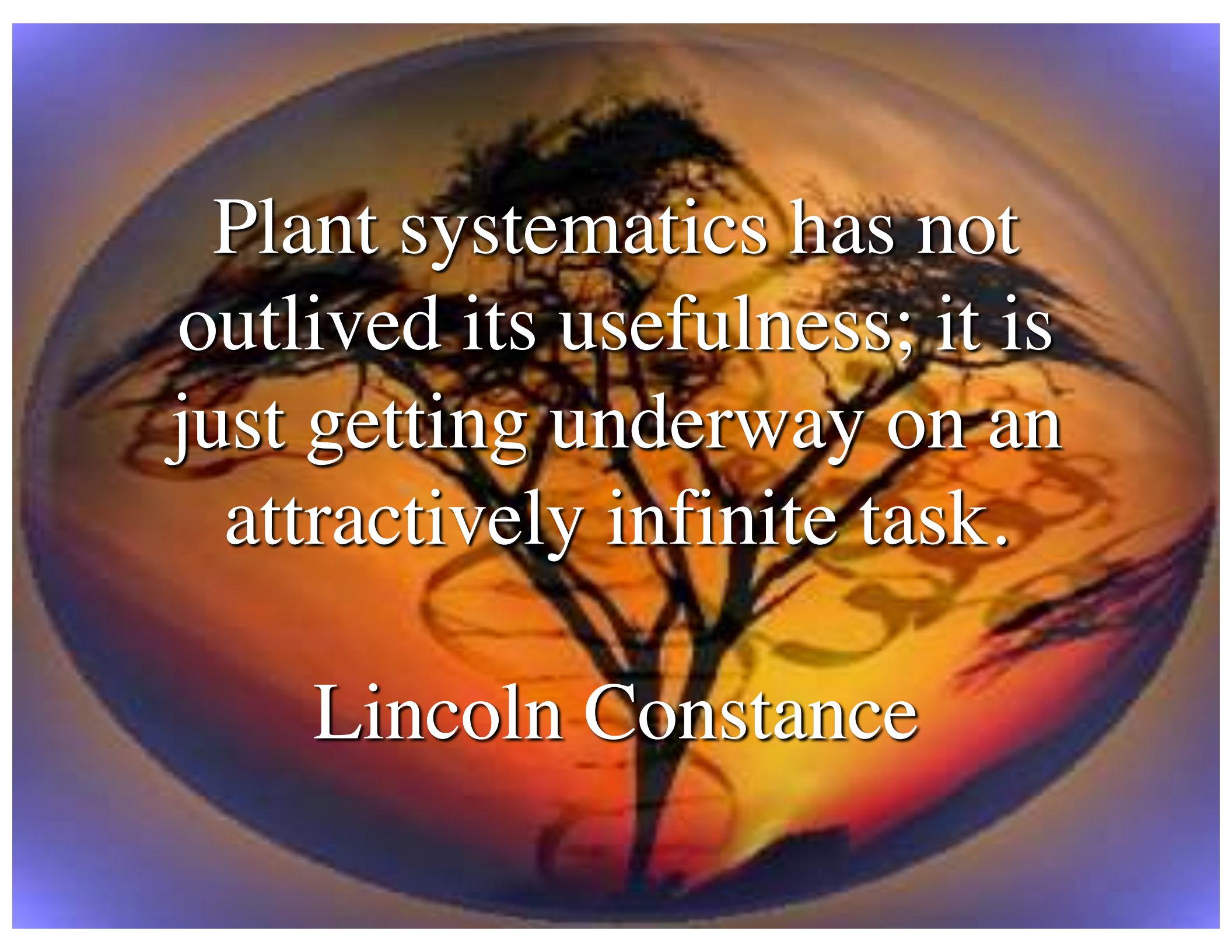
Systematics — Goal 4: Demonstrate Evolutionary Implications of Biodiversity

- 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