

Introduction to Evolution - Biology 3302

Dr. David Bogler

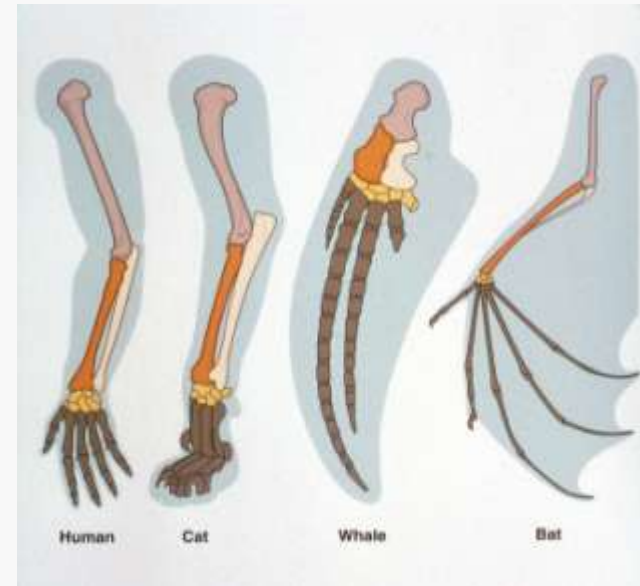
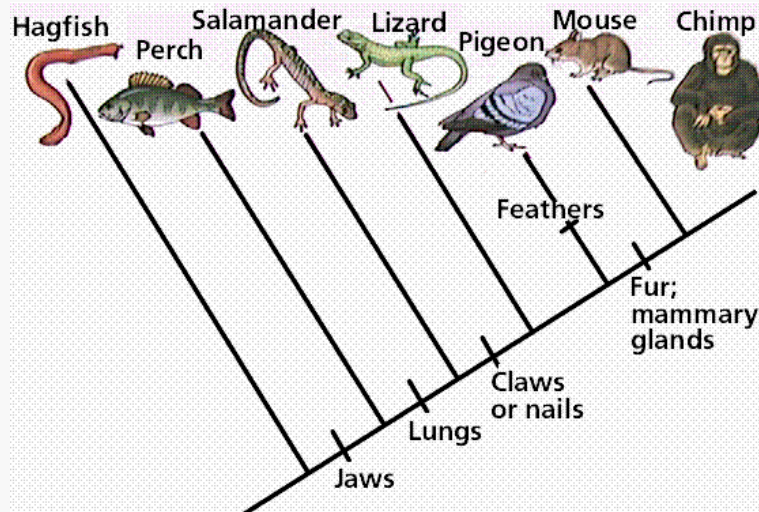
Email: boglerd@umsl.edu

Telephone: 314-516-6577 (UMSL, MW)

314-577-0831 (MBG, other days)

UMSL Office: Stadler Hall S204a

Office Hours: MW 2-4 pm, or by appointment



Course Objectives:

1. Investigate major evolutionary processes including heredity, natural selection, adaptation, speciation, extinction, social evolution, and human evolution.
2. Explore the historical development of the idea of evolution and the evidence that supports it.
3. Discuss how genetic variation arises and how gene frequency may change in populations.
4. Consider the origin of life and major evolutionary events that shaped diversity through geologic time.

Required Text:

Herron, J.C. and S. Freeman. 2014. Evolutionary Analysis, 5th Edition.

Additional Course Materials:

Journal articles or readings from additional texts will be assigned periodically. I will provide references for these materials and/or post electronic copies of them on MyGateway. The syllabus, course lecture schedule (with periodic updates), problem sets, assigned readings, and handouts will be available on MyGateway.

Downloadable copies of lecture slides or lecture notes, when made available, should be viewed as a convenience and not as an expected resource. You should plan on taking comprehensive lecture notes of your own. If you miss a lecture, please do not ask the instructor for the lecture notes or slides. Arrange to get them from another student.

Attendance:

Students are expected to attend all lectures, and are responsible for all relevant announcements made during class.

It is recommended that you introduce yourself to someone in class whom you can contact for notes and information in case you must be absent.

Examinations will be based on mostly on material presented in class, as well as readings from the textbook and handouts.

Grading:

Exam I	100 pts
Exam II	100 pts
Final Exam	200 pts
<u>Problem Sets</u>	<u>100 pts</u>
Total	500 pts

Final Grades: The final letter grades will be based on a point percentage tallied at the end of the semester and adjusted for class averages and natural gaps.

A=90-100%; B=80-89%; C=70-79%; D=60-69%; F=<60%

Grading:

Exams will consist of multiple choice, short answer, and short essay questions.

Makeup exams will be given **only** in the case of an extreme personal emergency or medical emergency requiring medical treatment, verified by a physician's note and/or your academic advisor from the Dean's office in advance. Makeup exams are not allowed for minor illnesses or student convenience (e.g. multiple exams scheduled in one week, conflict with extracurricular activities or travel plans, etc.).

Problem Sets: There will be several assignments consisting of problems or questions to be answered. These will be worth 100 points.

Extra Credit: From time to time a few extra points may be offered for pop quizzes or for attending outside events or seminars.

Cheating and Plagiarism:

Cheating or plagiarism will not be tolerated. Your work must be your own.

Do not copy the work of others. If you are caught, you will receive no credit for that work, whether it is a homework assignment or an exam, and it will be reported to the Dean's office. Depending on the seriousness of the offense, you could get an F or even expelled from the university.

Discuss homework and projects with classmates, but you must do your own work.

WHAT IS PLAGIARISM?

Deliberate Plagiarism

- Rewriting from books or articles
- copying & pasting from web pages and online sources to create a **patchwork** writing
- buying, downloading, or borrowing a paper



Accidental Plagiarism

- not knowing when & how to cite
- not knowing how to paraphrase or summarize
- not knowing what “common knowledge” is
- recycling an old paper

Student Participation and Civility:

Play an active role in the learning process. You will learn more and enjoy the process more if you participate.

Ask questions during lecture, but please raise your hand and wait to be called on.

Participate in study groups.

If you arrive late, please find your seat with a minimum of disturbance to others.

If you have a cell phone, please turn it off before class.

Laptops may be used for note-taking only, not for email, surfing the internet, or working on other projects.

Disruptive behavior, intimidation, and sexual harassment will not be tolerated.

No one may be present in the classroom or lab who is not enrolled in the course.

Students are expected to abide by the Student Conduct Code.

Special Needs:

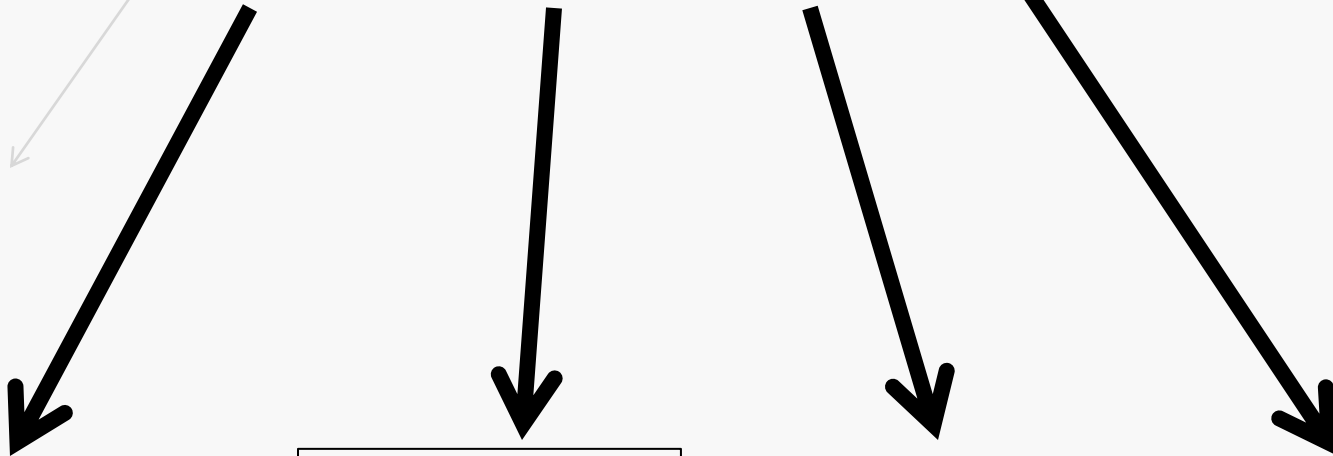
Please contact me early in the semester if you have special needs for lecture or testing so that we can make any necessary accommodations.

To request accommodations students must register through Disability Access Services, 114 MSC, (314-516-6554).

my background.....

Plant Systematics

taxonomy, ecology, genetics, evolution, phylogeny



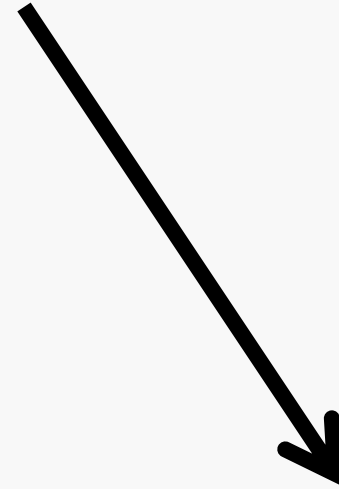
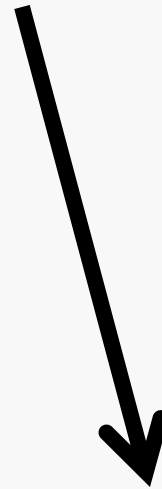
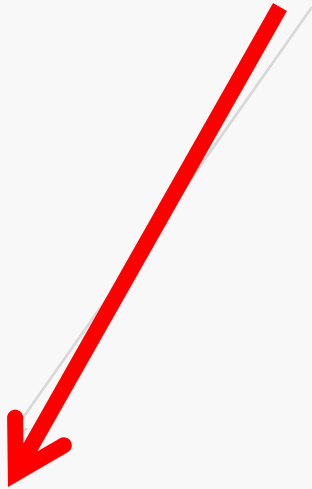
Floristic Treatments
Flora of Missouri
Flora North America
Interactive Keys

DNA Phylogeny
Agavaceae
Cycads
DNA Barcoding
Conservation
Genetics

Plant Anatomy
Pollen Atlas
Pollination

Teaching
Grant Writing
REU Program
Writing

Plant Systematics



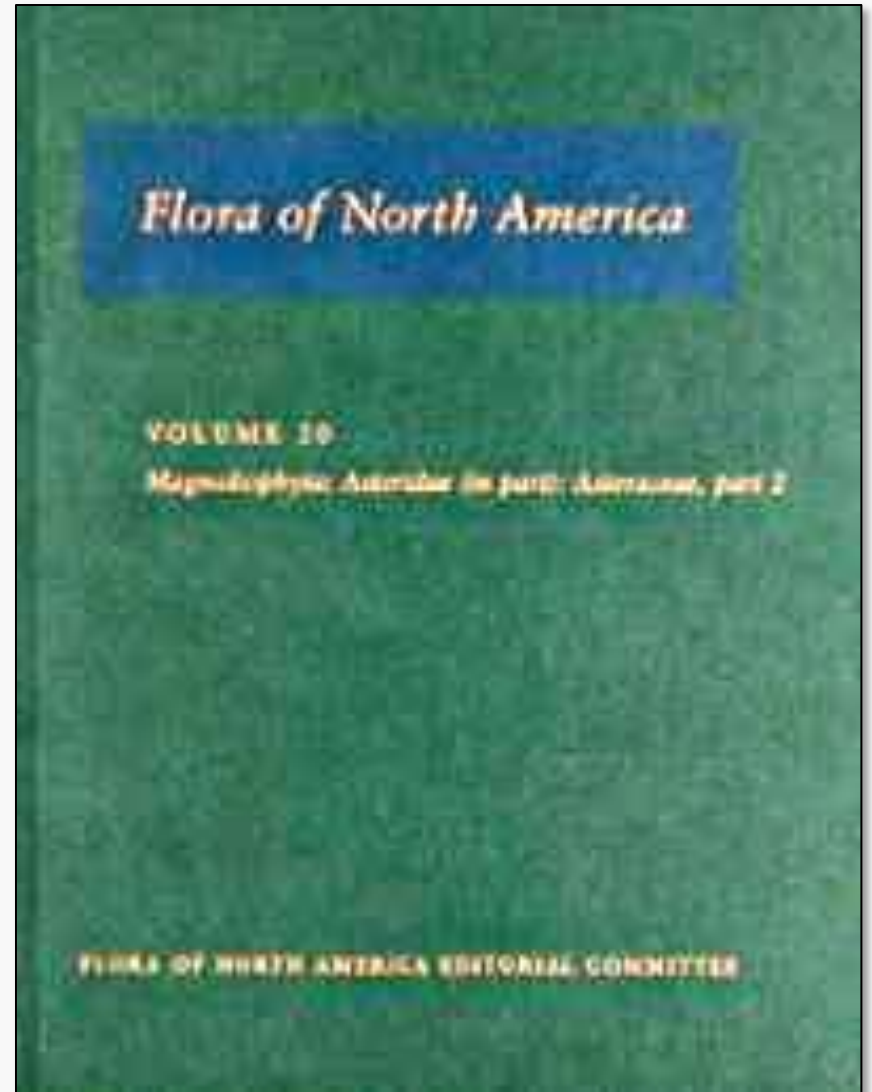
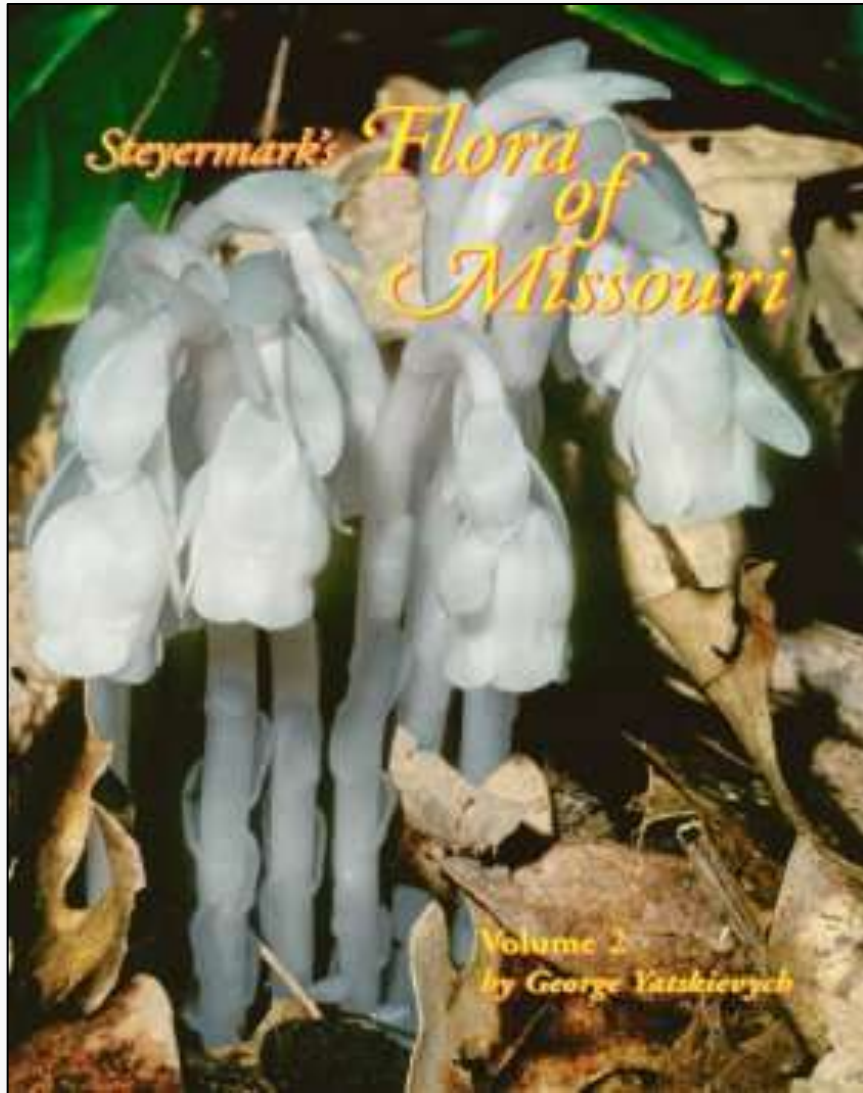
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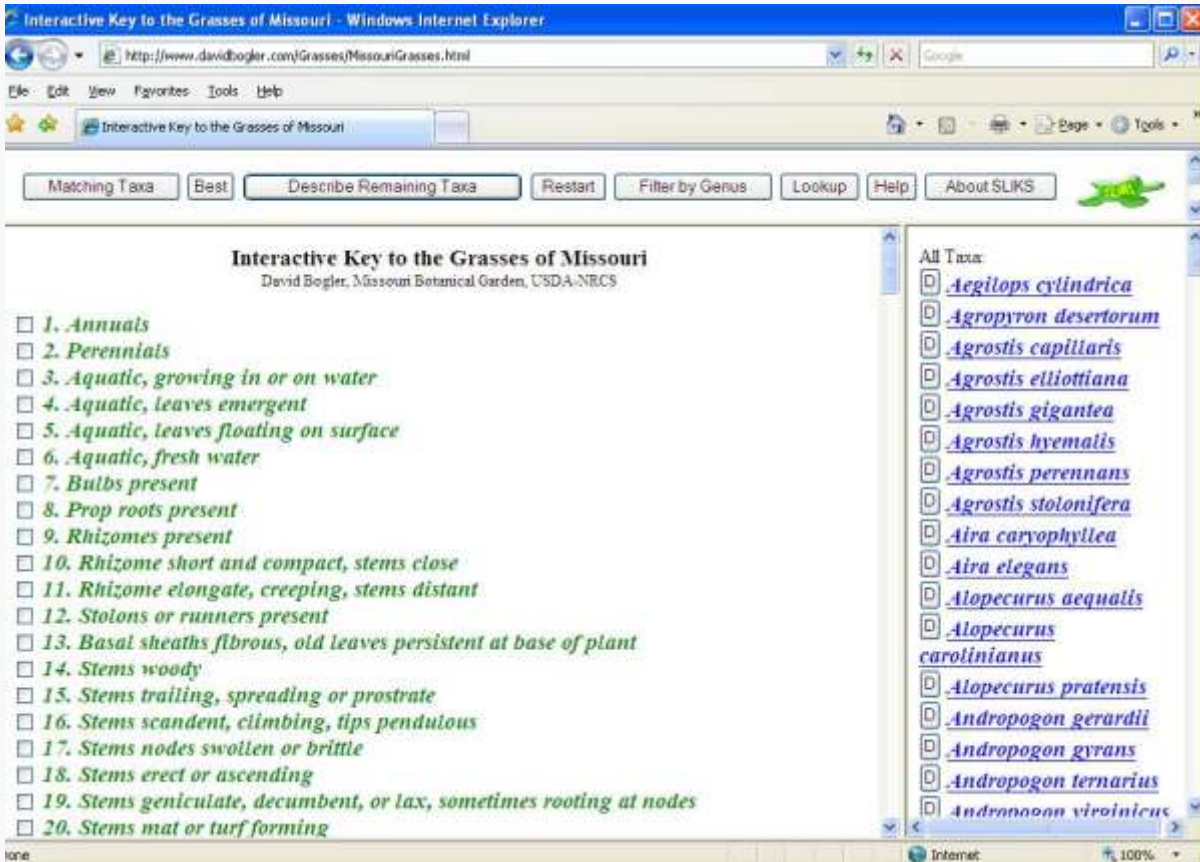
Plant Anatomy
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Taxonomic Revisions



Interactive Keys to Identify Species



<http://davidbogler.com>

Grasses of the U.S.

Legumes of the U.S.

Monocots of the U.S.

Works well on iPhones and tablets

Interactive Key to the Grasses of Missouri - Windows Internet Explorer

http://www.davidbogler.com/Grasses/MissouriGrasses.html

File Edit View Favorites Tools Help

Interactive Key to the Grasses of Missouri

Matching Taxa Best Describe Remaining Taxa Restart Filter by Genus Lookup Help About SLIKS

Interactive Key to the Grasses of Missouri

David Bogler, Missouri Botanical Garden, USDA-NRCS

- 1. Annuals
- 2. Perennials
- 3. Aquatic, growing in or on water
- 4. Aquatic, leaves emergent
- 5. Aquatic, leaves floating on surface
- 6. Aquatic, fresh water
- 7. Bulbs present
- 8. Prop roots present
- 9. Rhizomes present
- 10. Rhizome short and compact, stems close
- 11. Rhizome elongate, creeping, stems distant
- 12. Stolons or runners present
- 13. Basal sheaths fibrous, old leaves persistent at base of plant
- 14. Stems woody
- 15. Stems trailing, spreading or prostrate
- 16. Stems scandent, climbing, tips pendulous
- 17. Stems nodes swollen or brittle
- 18. Stems erect or ascending
- 19. Stems geniculate, decumbent, or lax, sometimes rooting at nodes
- 20. Stems mat or turf forming

All Taxa

- [Aegilops cylindrica](#)
- [Agropyron desertorum](#)
- [Agrostis capillaris](#)
- [Agrostis eliottiana](#)
- [Agrostis gigantea](#)
- [Agrostis hyemalis](#)
- [Agrostis perennans](#)
- [Agrostis stolonifera](#)
- [Aira caryophyllea](#)
- [Aira elegans](#)

Interactive Keys

1. Check the character boxes
2. Click Matching Taxa button
3. Narrow the possibilities
4. ID the species



Interactive Key to the Grasses of Missouri - Windows Internet Explorer

http://www.davidbogler.com/Grasses/MissouriGrasses.html

File Edit View Favorites Tools Help

Interactive Key to the Grasses of Missouri

Matching Taxa Best Describe Remaining Taxa Restart Filter by Genus Lookup Help About SLIKS

Interactive Key to the Grasses of Missouri

David Bogler, Missouri Botanical Garden, USDA-NRCS

Chosen characters:

- 14. Stems woody

Taxa Matching Your Description:

- [Arundinaria gigantea](#)
- [Arundo donax](#)

End of Matching Set

- 3. Aquatic, growing in or on water
- 21. Stems solitary
- 26. Stems terete, round in cross section, or polygonal
- 27. Stems compressed, flattened, or sulcate
- 37. Stems with inflorescence 1-2 m tall
- 44. Leaves pseudo-petiolate, petiole attached to sheath
- 54. Leaves borne on branches
- 61. Leaves with distinct crossveins, net-like transverse veins
- 63. Leaf auricles setose or ciliate
- 66. Leaf blades 1-2 cm wide
- 71. Leaf blades mostly glabrous
- 72. Leaf blades mostly or less hairy
- 73. Leaf blades scabrous, roughened, or wrinkled
- 81. Inflorescence racemose
- 84. Inflorescence a contracted panicle, narrowly paniculate, branches appressed or ascending
- 95. Inflorescence single raceme, fascicle or spike
- 96. Inflorescence with 2-10 branches
- 97. Inflorescence branches more than 10 to numerous
- 99. Inflorescence a single splkelet

Done

Internet 100%

PLANTS Profile for *Arundinaria gigantea* (giant cane) | USDA PLANTS - Windows Internet Explorer

http://plants.usda.gov/java/profile?symbol=ARGI

File Edit View Favorites Tools Help

PLANTS Profile for *Arundinaria gigantea* (giant cane) | ...

You are here: Home / PLANTS Profile


Printer-Friendly / Plug-Ins

PLANTS Profile

Arundinaria gigantea (Walter) Muhl. giant cane

Click on the image below to enlarge it and download a high-resolution JPEG file.

Symbol: ARG1
Group: Monocot
Family: Poaceae
Duration: Perennial
Growth Habit: Subshrub
Shrub
Graminoid
Native Status: L48 N



Robert H. Mohlenbrock, USDA
Midwest wetland flora: Field office guide to plant species, Midwest Technical Center, Lincoln, CO
[NRCS Wetland Science Institute Requirements.](#)

More Information:

- Characteristics
- Classification
- Fact Sheet (pdf) (doc)
- Data Source and Documentation

Search
Name Search

Scientific Name

- State Search
- Advanced Search
- Search Help

PLANTS Topics

- Alternative Crops
- Characteristics
- Classification
- Culturally Significant
- Distribution Update
- Fact Sheets & Plant Guides
- Invasive and Noxious Weeds
- Links
- Plant Materials Publications
- Threatened & Endangered
- Wetland Indicator Status

Image Gallery

- 40,000+ Plant Images
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- Complete PLANTS Checklist
- State PLANTS Checklist
- Advanced Search


Done

PLANTS Profile for *Arundinaria gigantea* (giant cane) | USDA PLANTS - Windows Internet Explorer

http://plants.usda.gov/java/profile?symbol=ARGI

File Edit View Favorites Tools Help

PLANTS Profile for *Arundinaria gigantea* (giant cane) | ...



View Native Status

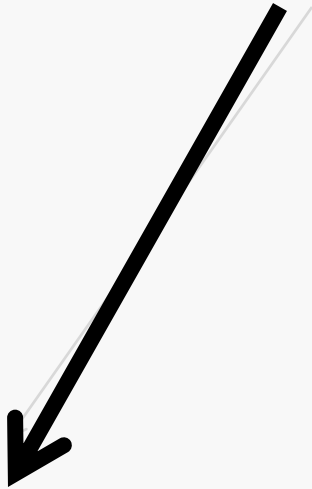
Legend: Present (Green) Absent (White)

See U.S. county distributions (when available) by clicking on the map or the listed states below:

Internet 100%

Links to data, images, maps,
more information.

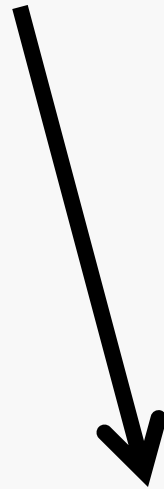
Plant Systematics



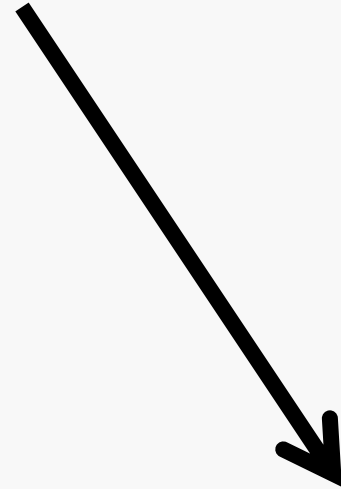
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Agave Family and Relatives





Tequila Plantation, Jalisco, Mexico

Tequila, Jalisco, Cuervo Distillery





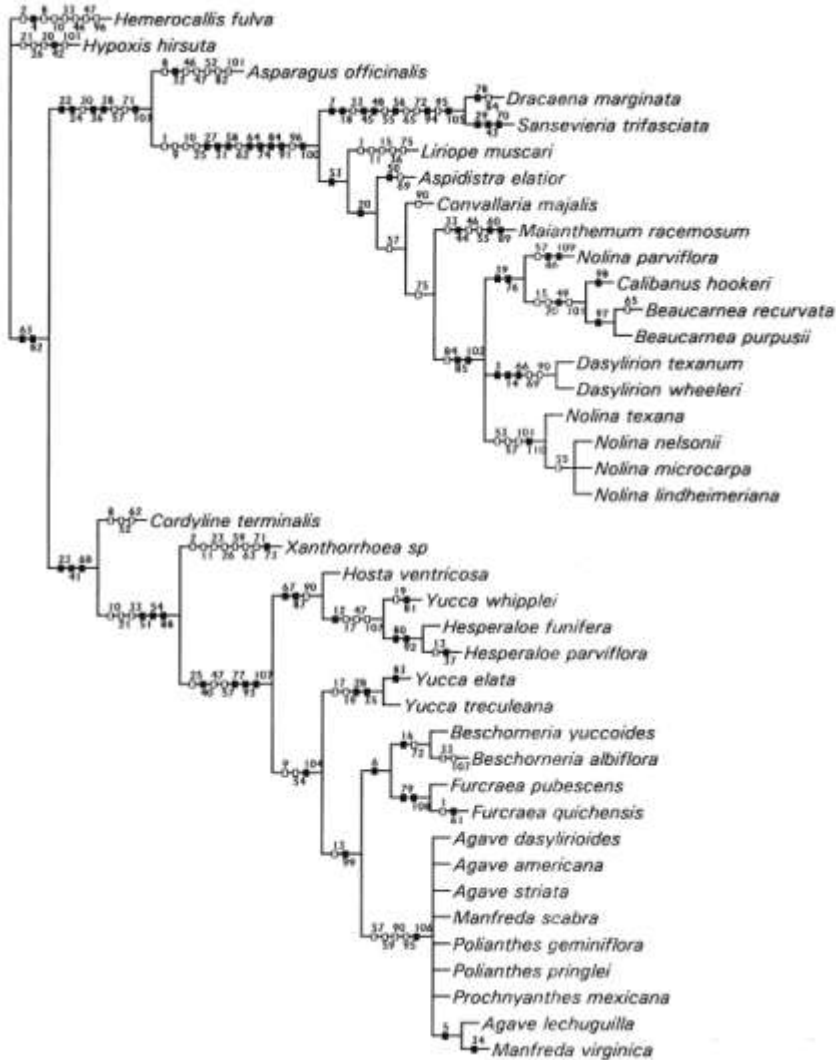
Dasyliirion wheeleri



Nolina parviflora

cpDNA Restriction Sites

Bogler and Simpson. 1995. Syst. Bot. 20: 191



Dracaenaceae

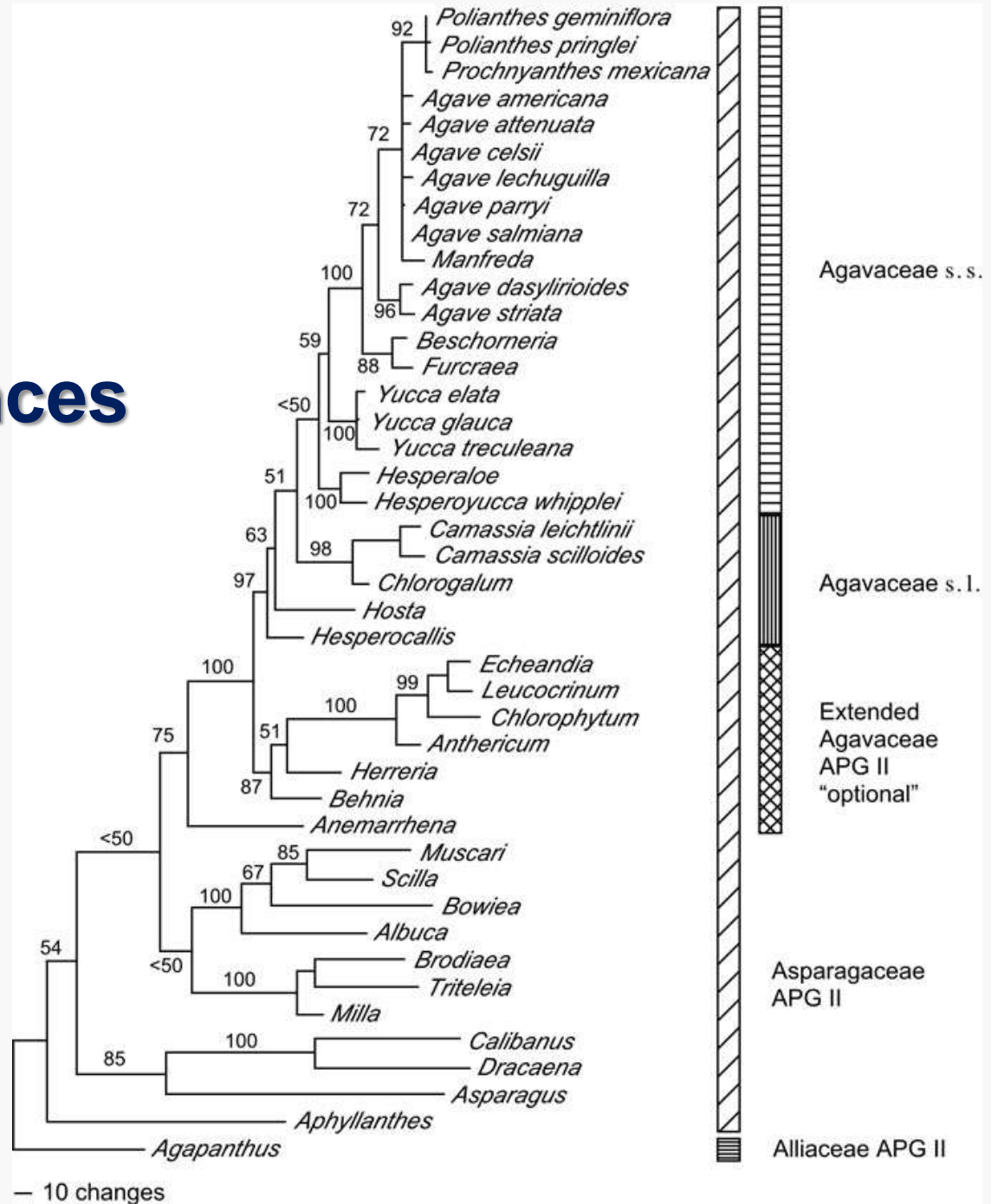
Convallariaceae

Nolinaceae

Agavaceae s.s.

Combined rbcL, ndhF, and ITS DNA sequences

Bogler et al. 2006
Aliso **22**: 313–328

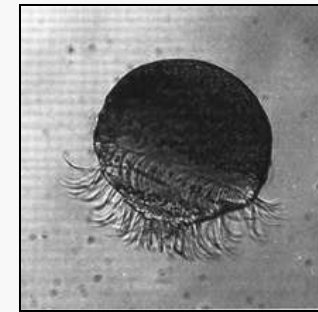




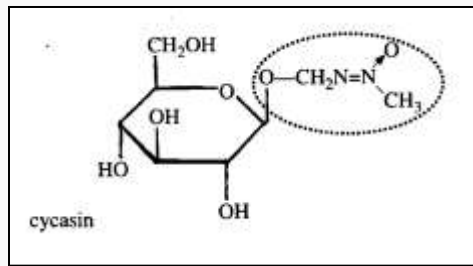
Atala Herbivory



Relict Distribution



Motile Spermatozoid



Toxins

The Strange and Fascinating World of Cycads



Sporophylls



Fern-like Leaves



Insect Pollination



Coralloid Roots

World Distribution of Cycads



from David Jones, *Cycads of the World*

Combined Data

trnL intron

ITS 2

atpB - *rbcl* spacer

trnS - *trnG* spacer

2405 Characters

520 Informative Sites

1 Tree

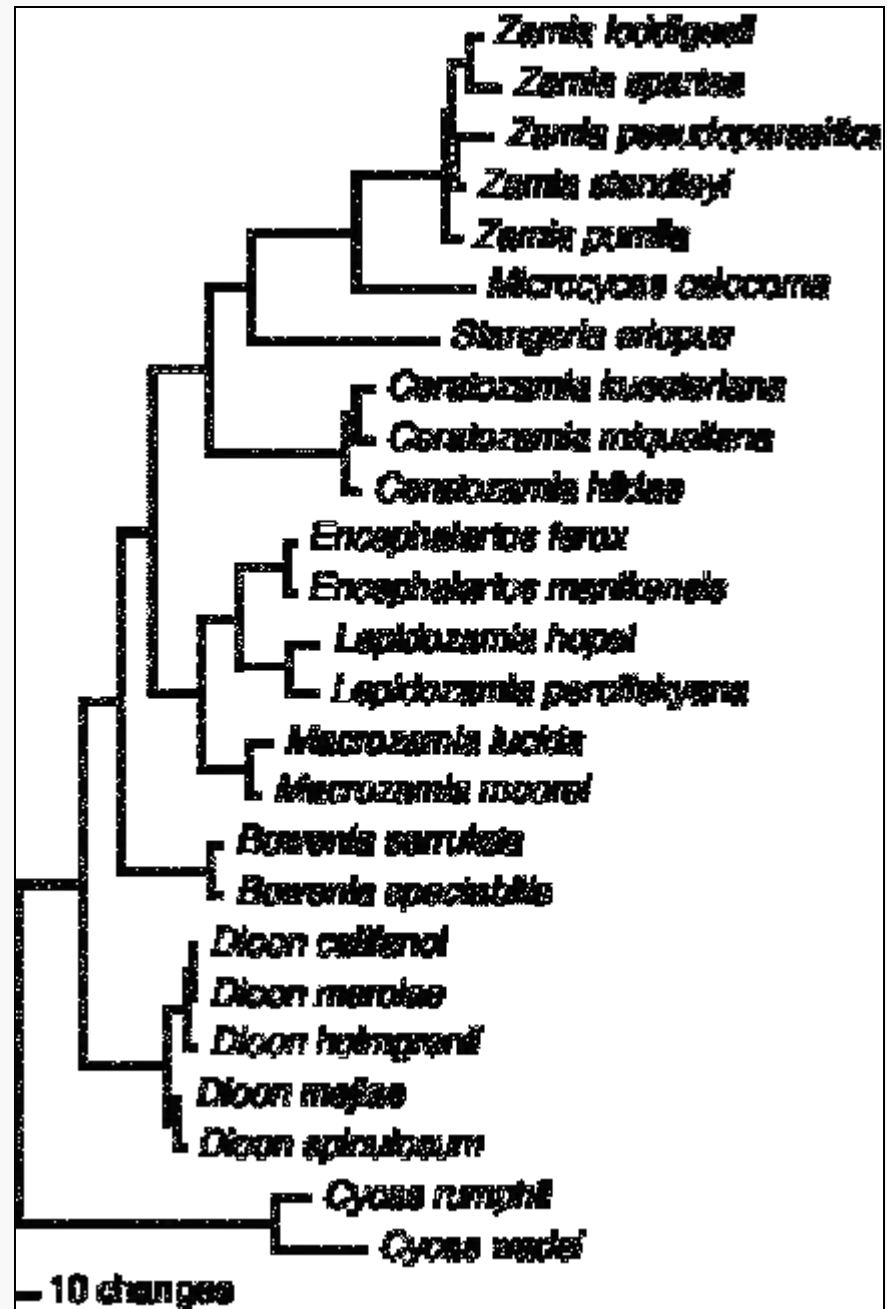
CI = 0.777

RI = 0.861

Single Most Parsimonious Tree

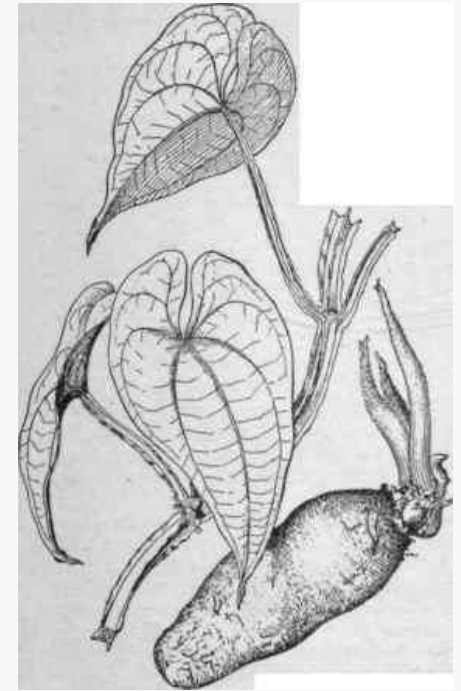
Number of Characters

Bootstrap Support Values



Classical Taxonomy Complex and Somewhat Subjective

Leaves alternate proximally, opposite and ultimately decussate distally, 6–16 × 4–13 cm; petiole ca. as long as blade, winged, base clasping, basal lobes stipulate, growing as extensions of wings, less than 1 mm wide; blade 5–7-veined, ovate, glabrous, base typically sagittate, margins entire, apex acute to acuminate. Staminate inflorescences axillary, 1–2 per axil, paniculate, fasciculate; panicles bearing flowers singly, bracteolate, in a zigzag pattern along rachis, internodes less than 2 mm; rachis to 25 cm, secondary axes 1–3(–6), fasciculate, less than 3 cm, each subtended by deltate-ovate bracteole shorter than 1 mm. Pistillate inflorescences solitary, 4–8(–20)-flowered, 6–35 cm, internodes ca. 1 cm

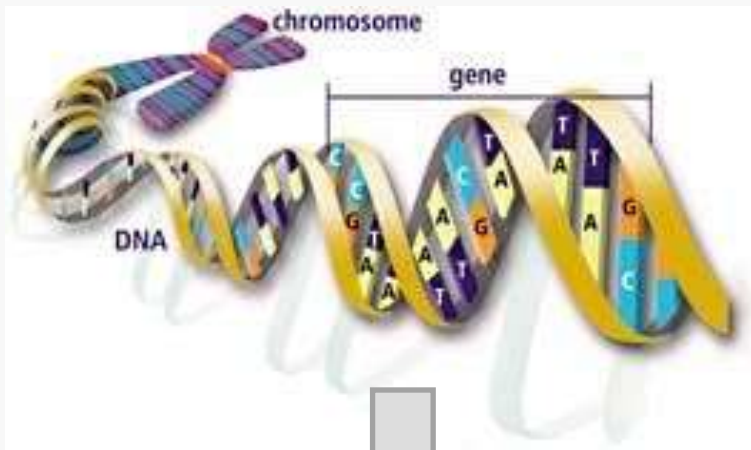


DNA Barcode Simpler (A,T,G,C) and More Objective

> *Dioscorea alata* (matK) gene, partial

```
ATTTAAATTATGTGTCAGATATATTAATACCCCATCCCATCCATCTGGAAATCCTGGTTCAAATA  
CTTCAATGCTGGACTCAAGATGTTTCCTCTTTGCATTATTGCGATTCTTTCTCCACGAATATC  
ATAATTCGAAT AGTTTCATTACTCCGAAAAAACCTATTTACGTGATTTC AATTTCAAAGAAA  
ATAAAAGATTTTTTCGATTCCTATATAATTCTTATGTATTTGAATGTGAATTTGTATTAGTTTTTT  
TTCATAAGCAATCCTCTTATTT ACGATCAA
```

Goal of DNA Barcoding: Identify species from DNA alone



```
ATGTTGAATCTGTGTCATGCTCTTCGAGGCGTACC  
AAAGTGAAATGTGCGTCATGTTCCATAAAACTACA  
TATTATACGAAGCCAAAAAGTCTACCCGACTCAA  
AAGTATTTGCTATTCAGTCAAGACATACAGCTCTC  
GACCTCAAACCAAAGAGATTTACTATTGAGAGT  
CTTCATCATAACAATTATAACCCGGAAGAGTTTTCC  
AACTACGTCCCCAGAGGCTCAAATGTTATGCATA  
CATTTAGACCCCAATGTTTTGAAACGAAATGATT
```



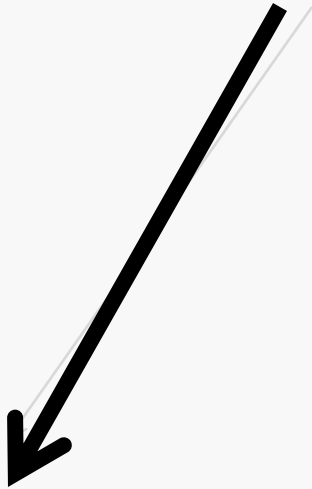
Family, Genus, Species



Plant Barcoding Applications



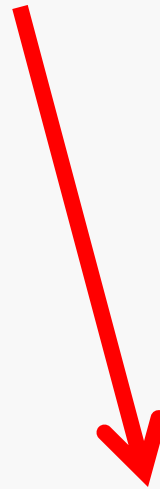
Plant Systematics



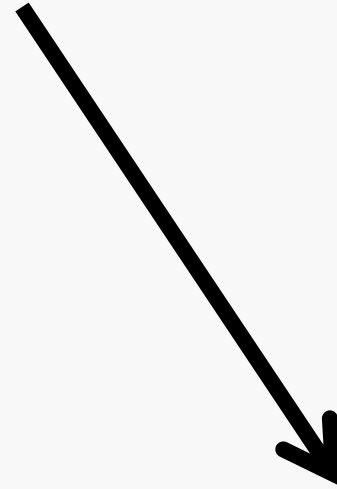
Floristic Treatments
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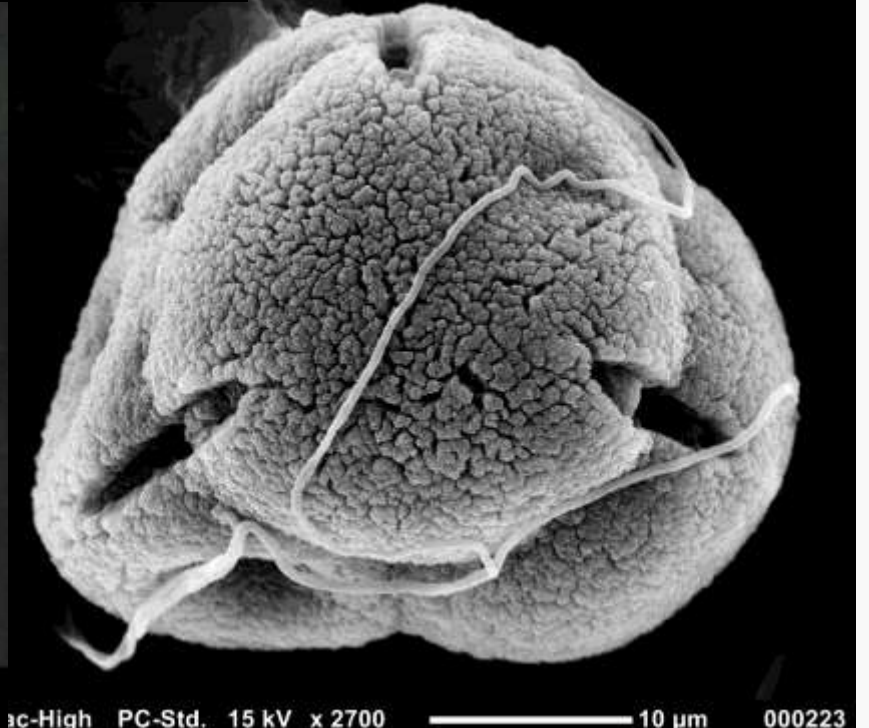
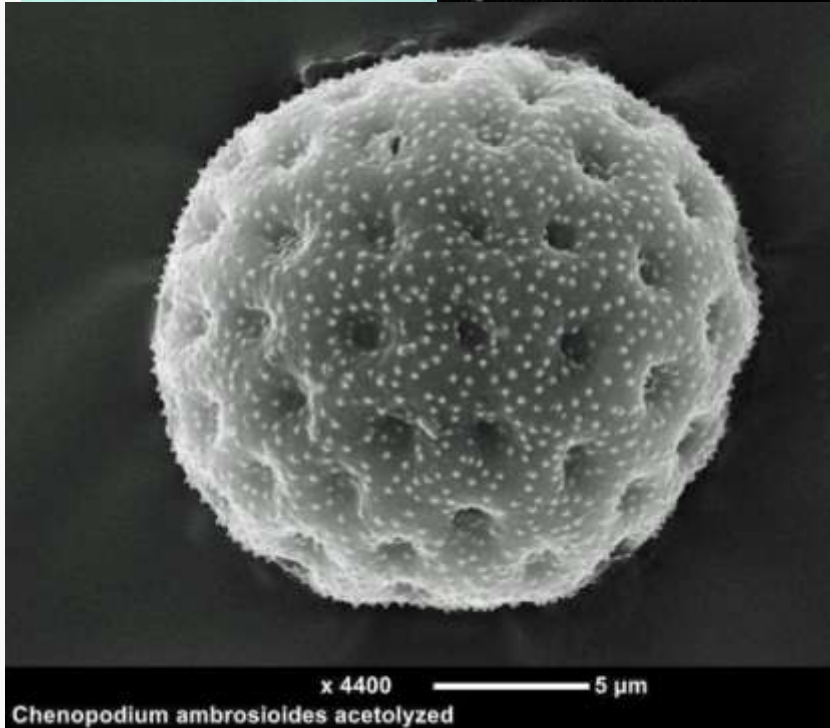
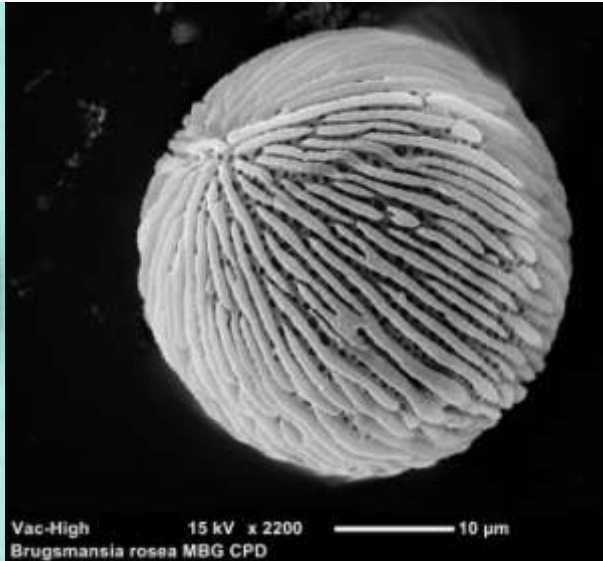


Plant Anatomy
Pollen Atlas
Pollination



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Pollen Morphology





Missouri Pollen Project

[Interactive Pollen Key](#)

[Pollen Glossary](#)

[Pollen Resources](#)
[Contact](#)

Welcome to the Missouri Pollen Project (MPP). Here you will find illustrations, descriptions, and keys to identification of pollen grains from plants of Missouri and much of the Midwestern United States. The goal is to provide a means of identifying pollen, as well as summarizing what is known about pollination biology of Missouri plants. The MPP is part of a larger long-term project to develop baseline data on pollen and pollinators in natural and altered communities, information that may be useful in a changing world. The keys and images will also be useful to botanists, entomologists, archeologists, paleobotanists, allergists and many others.

Navigating the MPP pages is quite simple. Individual pages for each genus are accessed through the [Interactive Pollen Key](#). Here you will find a list of pollen characters on the left and a list of plant taxa on the right. You may scroll down the list of taxa to access the page for a particular genus. If you are trying to identify an unknown pollen grain you simply check the boxes of one or more characters and press the Matching Taxa button at the top. The list of possible taxa on the right is reduced to only those matching those characters. The list of potential characters is also revised to correspond to the remaining taxa. The Best button will show how many of the taxa share each character. A [Glossary of Pollen](#) terms is provided to refresh your memory about terminology. A brief collection of websites and references to [Pollen Resources](#) is provided to assist in finding additional information. A larger version of the images can be seen by clicking on them with the mouse.

New Arrivals



[*Chenopodium*](#)



click 1

[*Celastrus*](#)



[*Passiflora*](#)

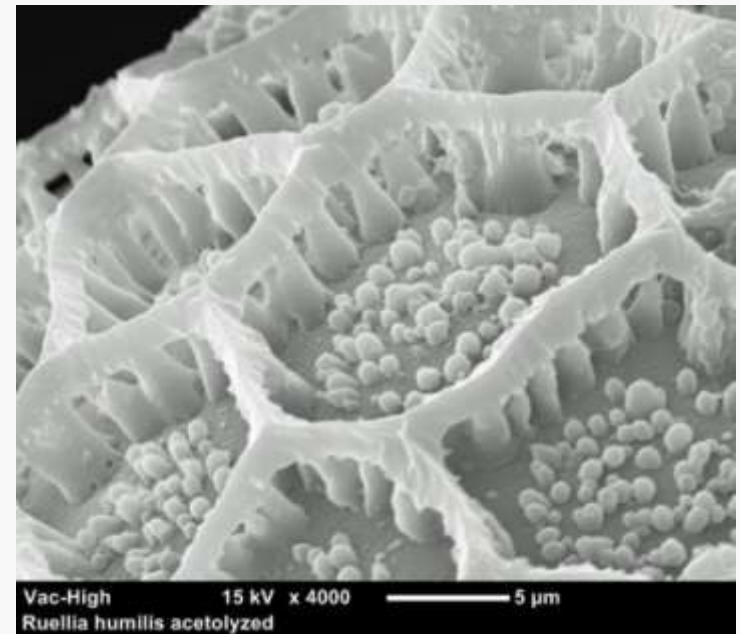
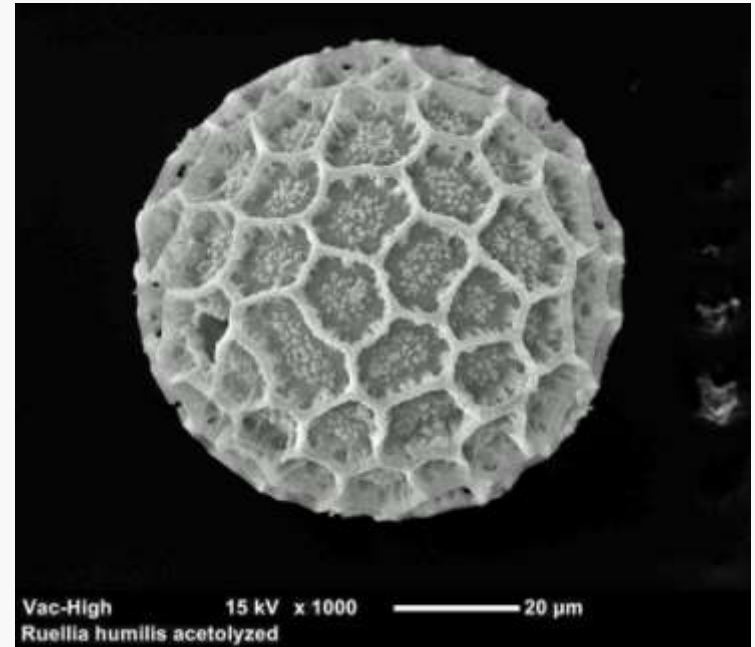


[*Opuntia*](#)

Justicia americana

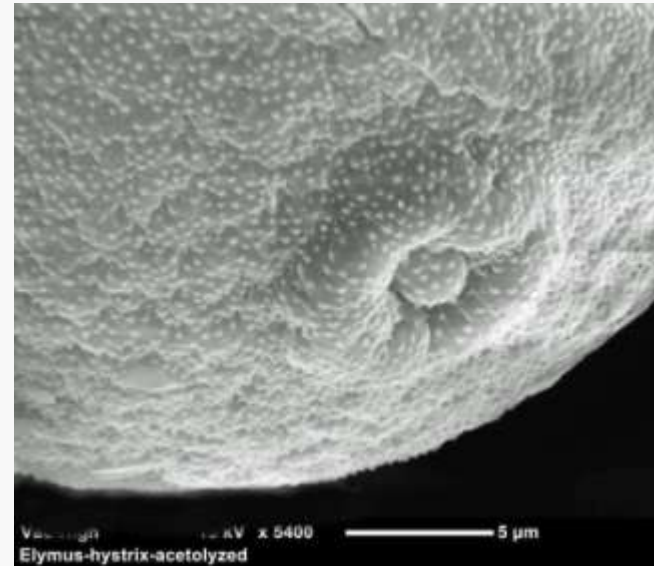
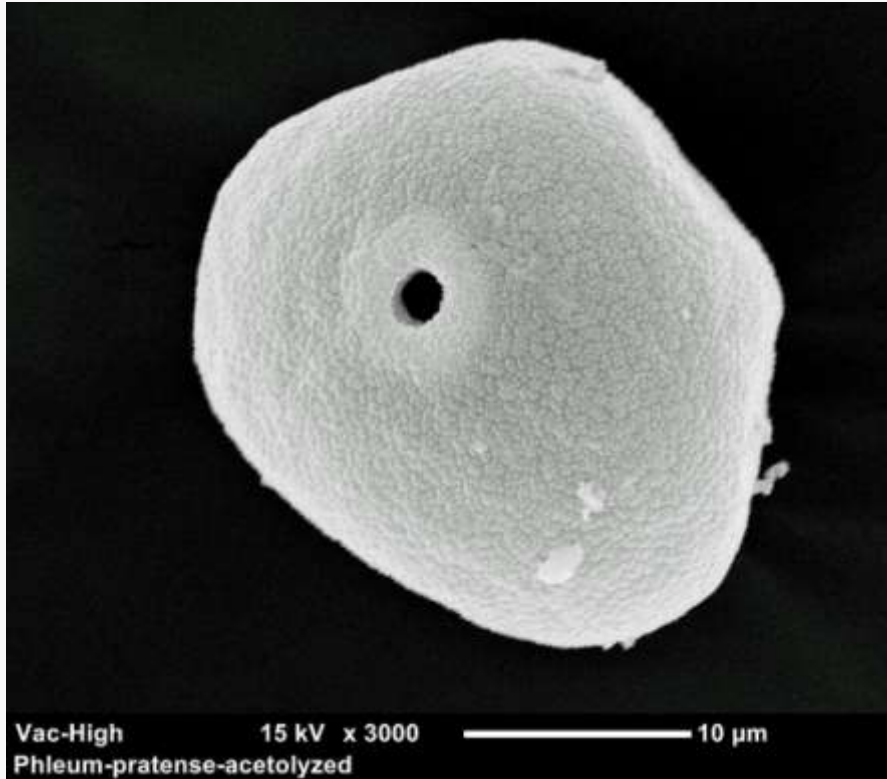


Ruellia humilis

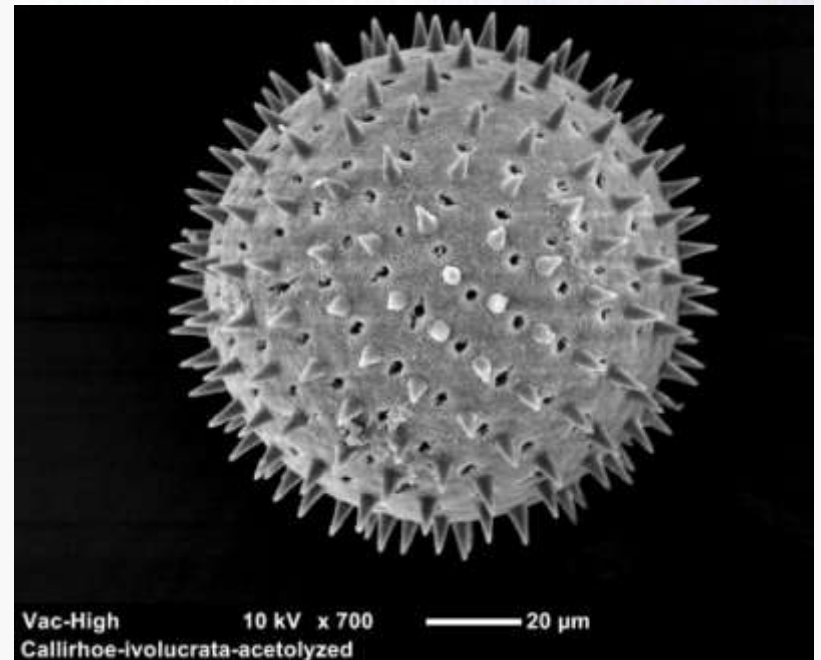
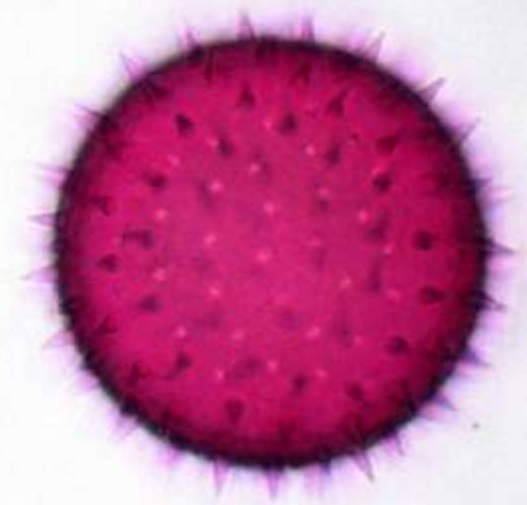


Elymus hystrix

Phleum pratense



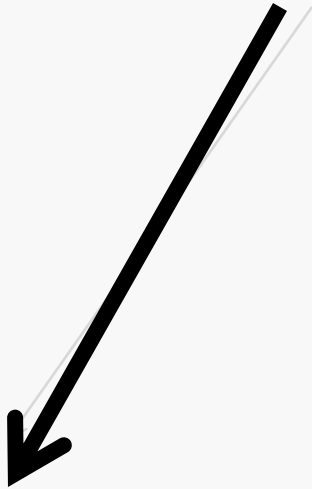
Callirhoe involucrata



Pollination Biology



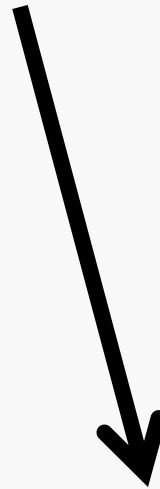
Plant Systematics



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MBG NSF Research Experiences for Undergraduates (REU)



Collecting Specimens

Pressing the Plant for Voucher



Livingstone Nganga, UMSL Undergraduate
2012 REU

Extracting DNA from Leaf Samples



FastPrep DNA Extraction Kit



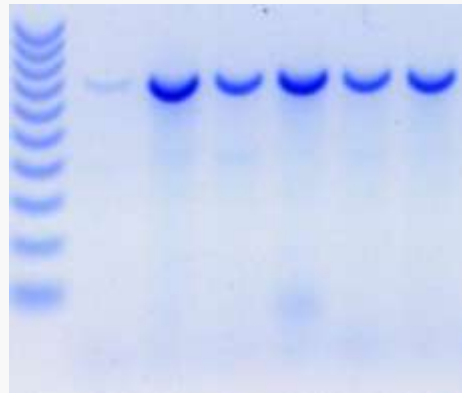
Livingstone Nganga



DNA Barcode Amplification: PCR



Kelsey Huisman, 2013 REU



**Sequencing
Facility**

PCR Product Gel Electrophoresis – check size

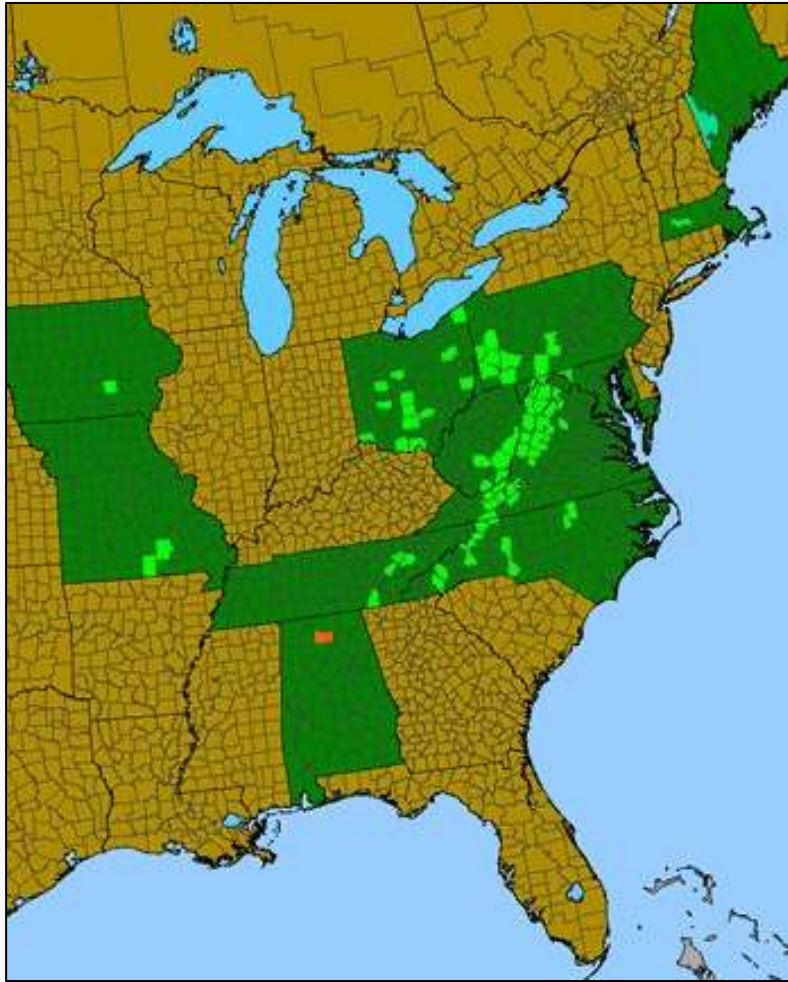
Conservation Genetics of Tall Larkspur (*Delphinium exaltatum*)



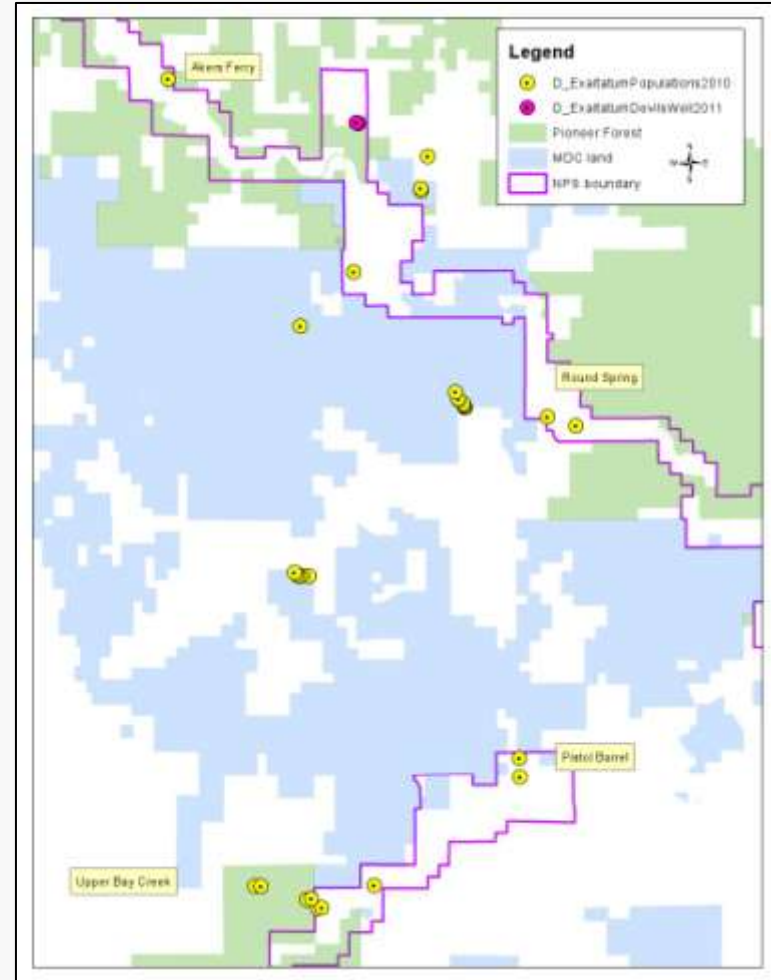
During summer 2009, the National Park Service Ozark Highlands fire ecology crew discovered the largest population of the nationally-rare tall larkspur (*Delphinium exaltatum*) in a prescribed fire management unit anywhere. A population of 2,481 tall larkspur plants was found at Ozark National Scenic Riverways (ONSR), near the park's famous Alley Spring.

Conservation Genetics of Tall Larkspur (*Delphinium exaltatum*)

U.S. Distribution



Shannon Co., Missouri



End