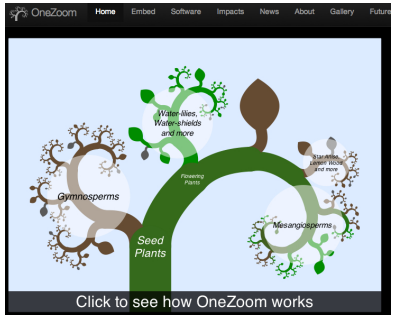


Phylogenetics and Linking Molecular Data with Collections

Pamela S. Soltis

Florida Museum of Natural History

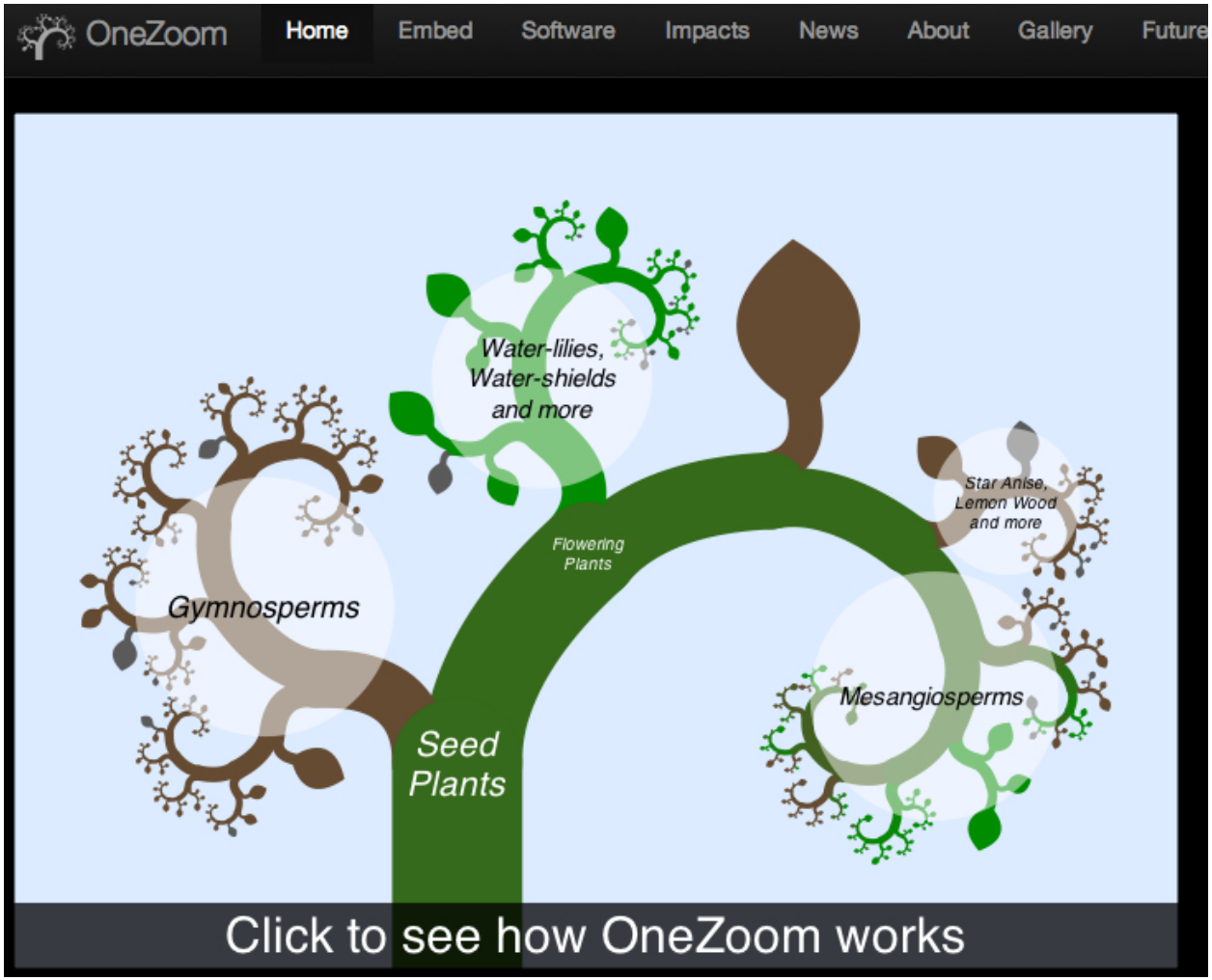
University of Florida

FLORIDA MUSEUM OF NATURAL HISTORY

UF UNIVERSITY of FLORIDA

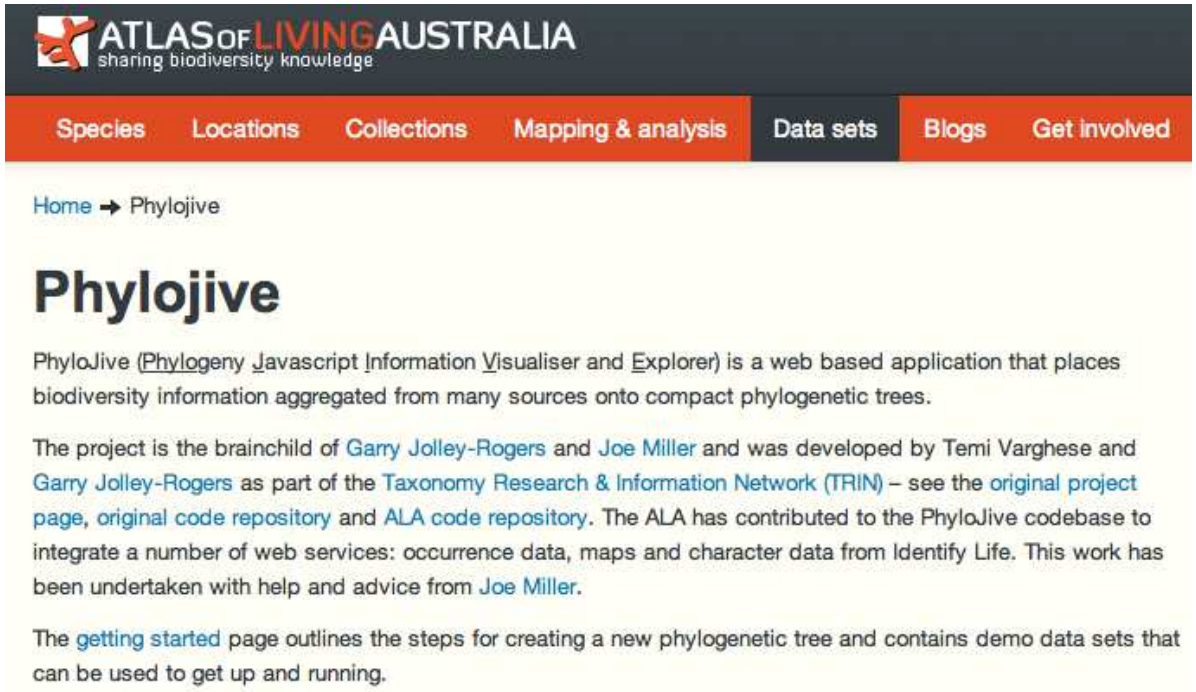
iDigBio Integrated Digitized Biocollections

Linking to Phylogeny



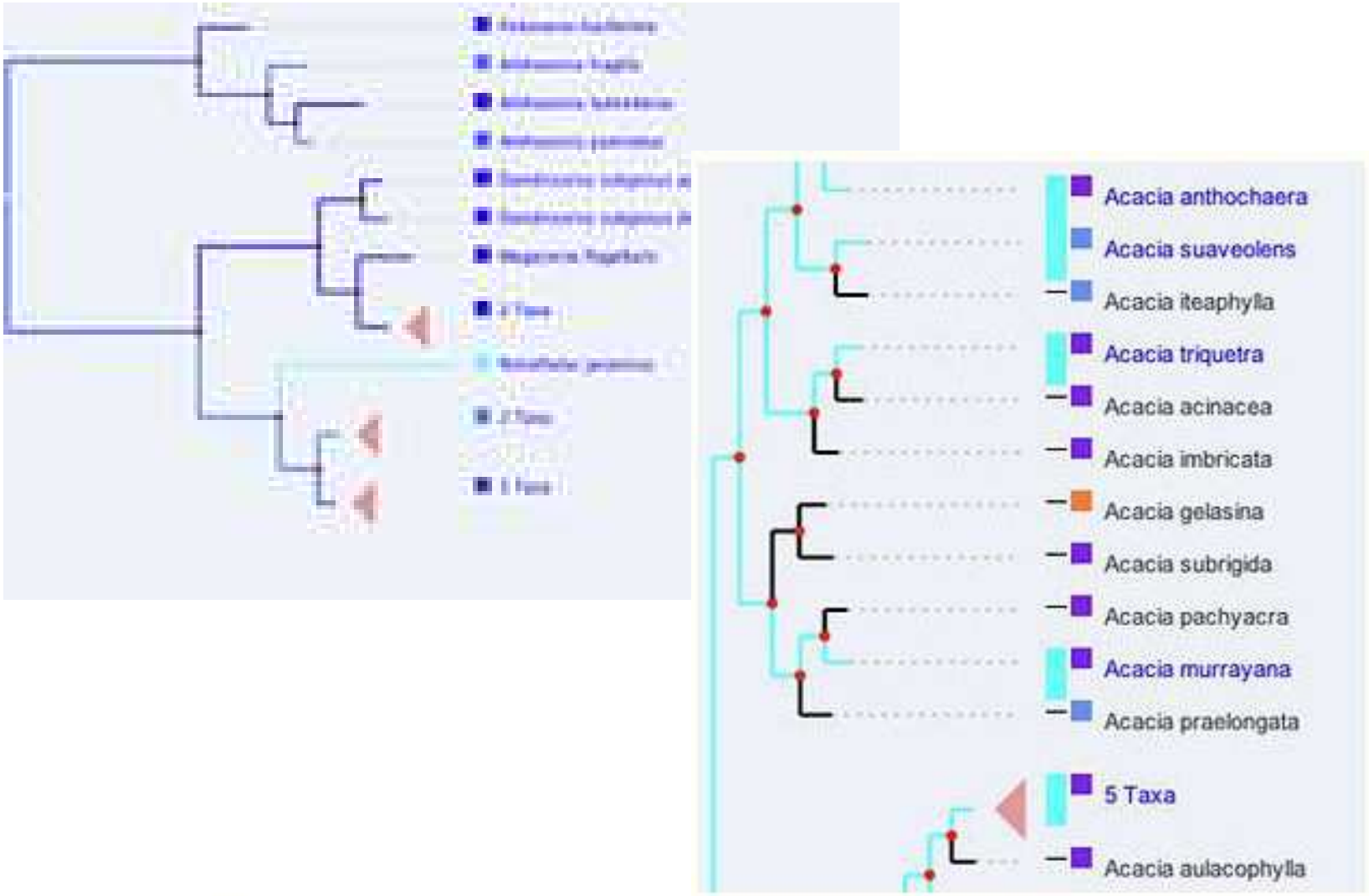
PhyloJIVE

Links biodiversity data to trees
Joe Miller & Garry Jolley-Rogers
phylojive.ala.org.au/

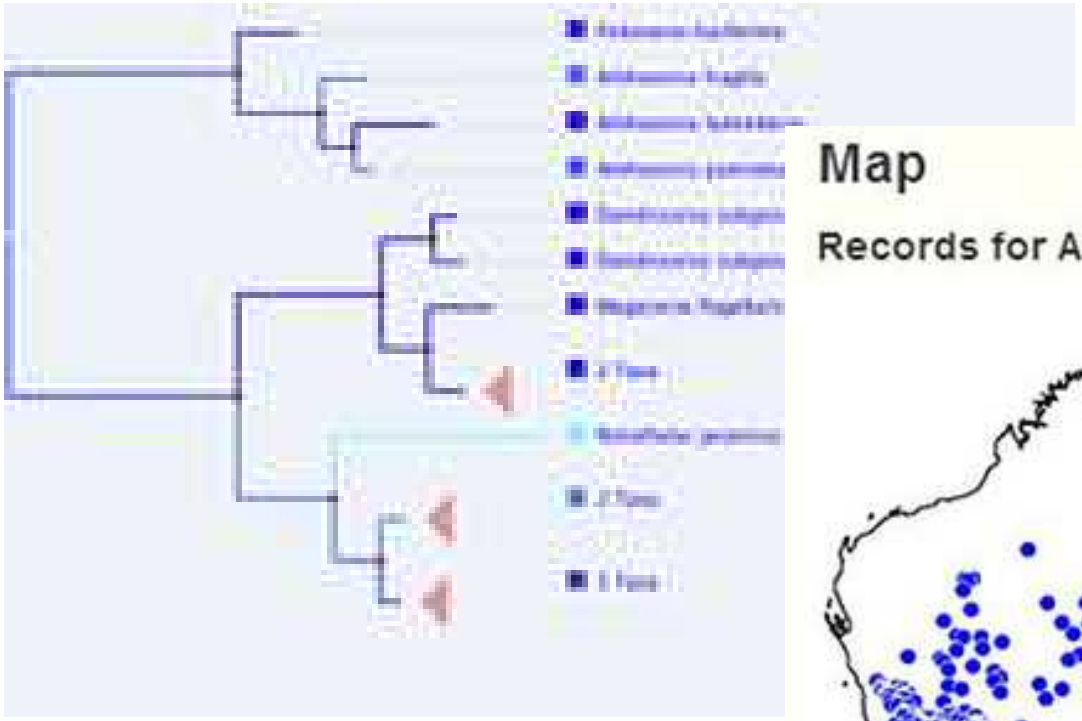


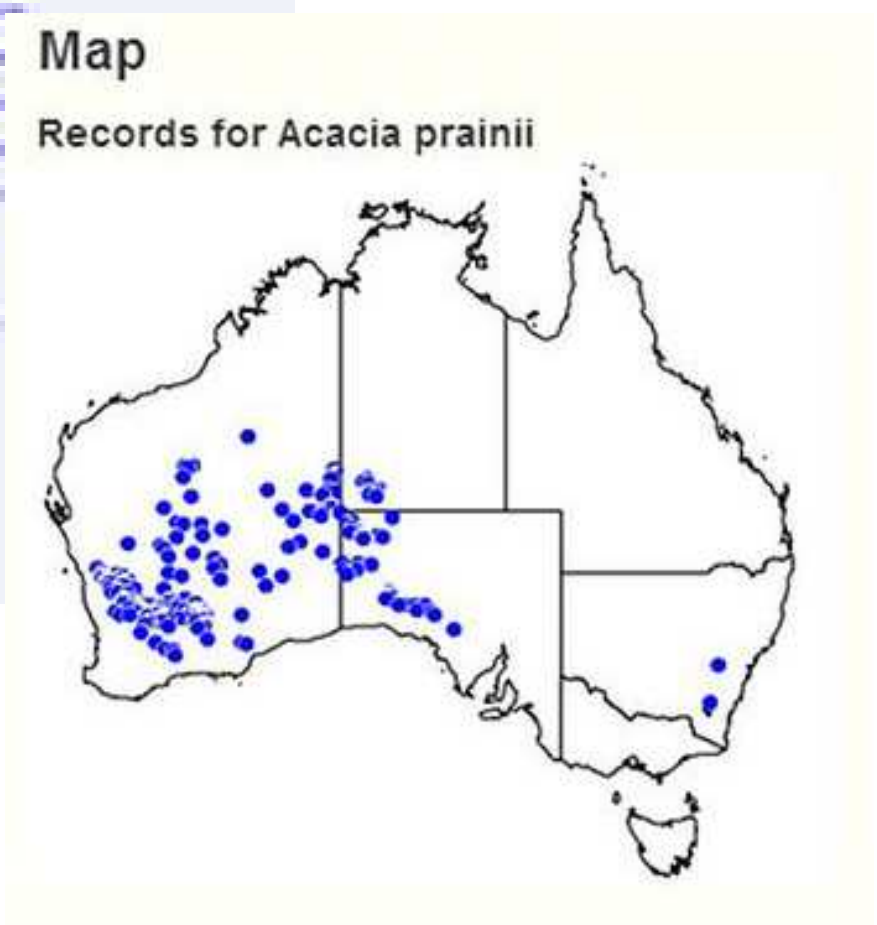
A. buxifolia
Source: Australian Plant Image Index Image by: Macd

PhyloJIVE: trees and traits

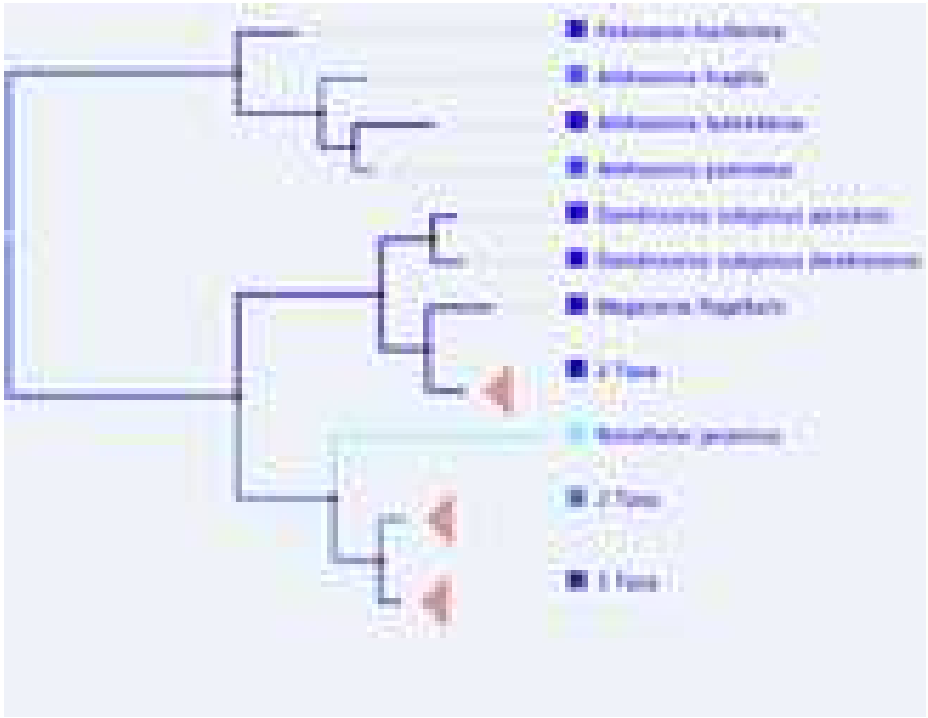


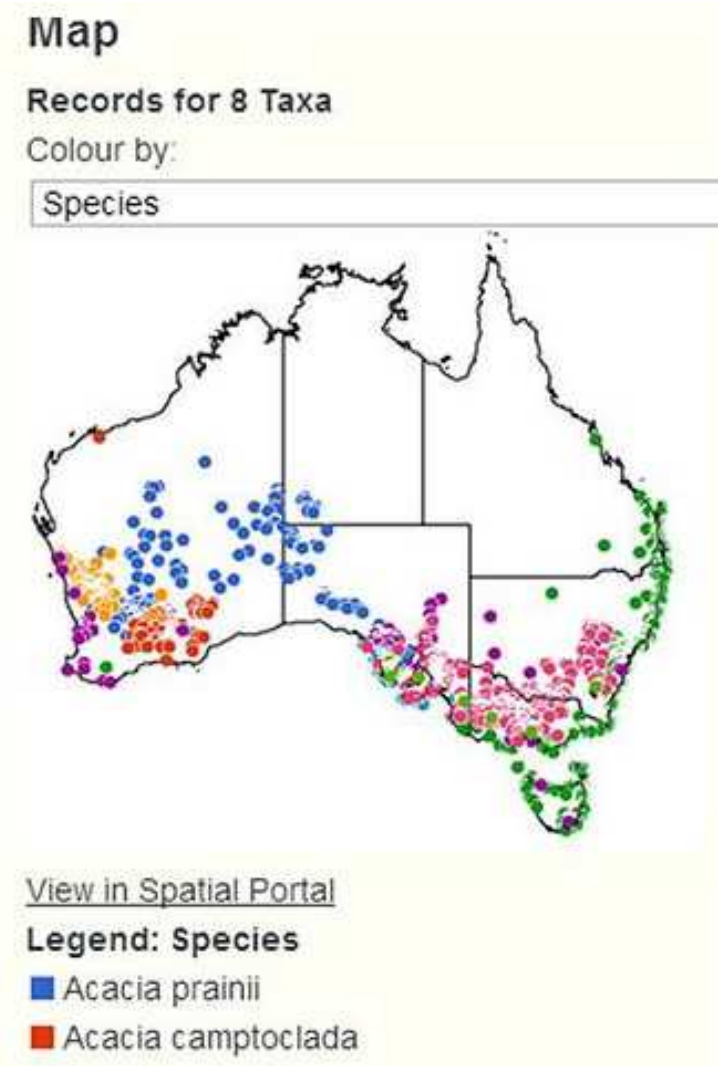
PhyloJIVE: trees and maps





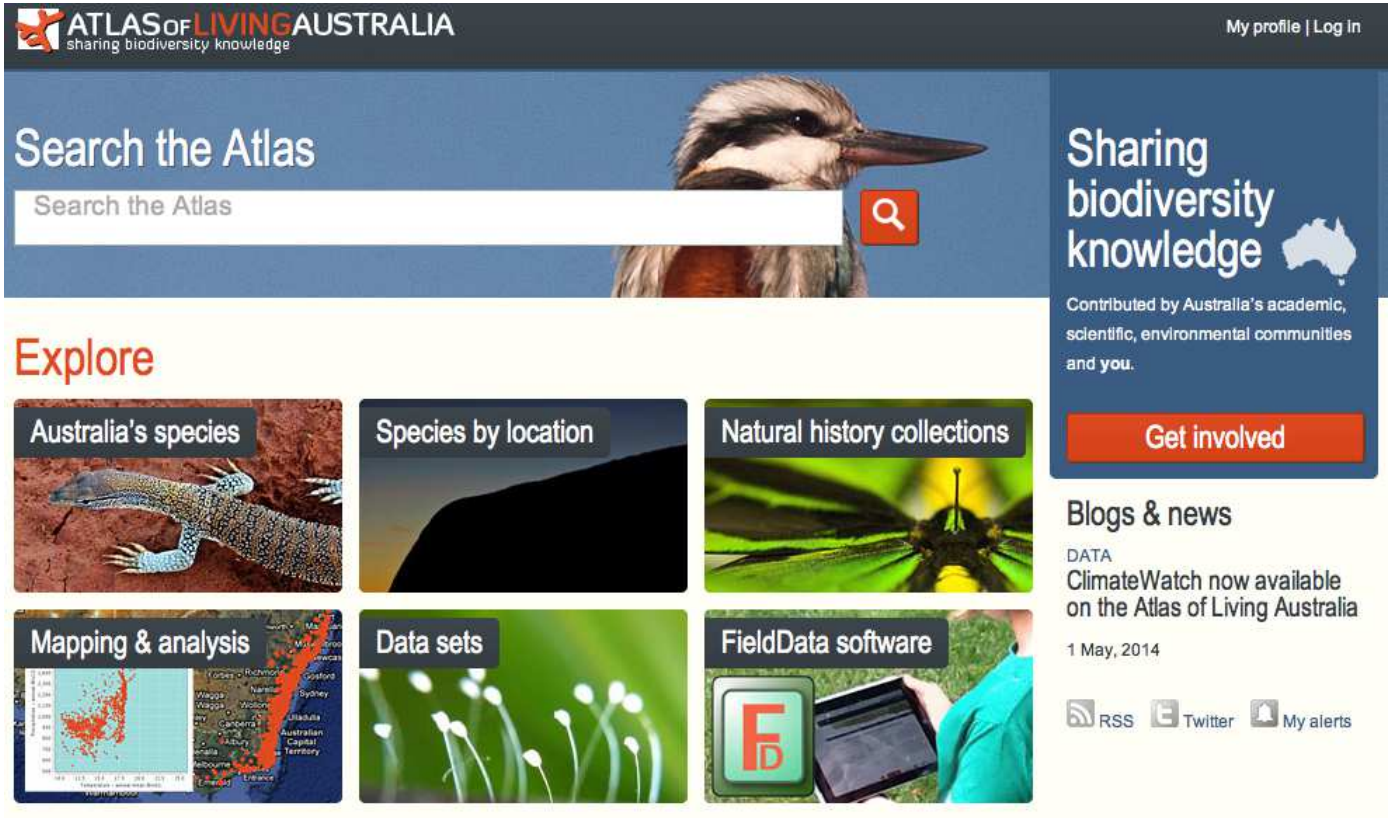
PhyloJIVE: trees and maps





Combine traits
and distributions

PhyloJIVE



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PhyloJIVE


ATLAS OF LIVING AUSTRALIA
sharing biodiversity knowledge
My profile | Log in
Search the Atlas
Search the Atlas
Sharing
Explore
Australia's species
Mapping & analysis
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Integrated Digitized Biocollections
About iDigBio
Portal
Technical Information
Education
Google™ Custom Search
Search
Log In | Sign Up
Making data and images of millions of biological specimens available on the web
14,036,195
Specimen Records
2,290,983
Media Records
235
Recordsets
Search the Portal
Why digitization matters
More about what we do and why
Digitization
Learn, share and develop best practices
Sharing Collections
Documentation on data ingestion
Working Groups
Join in, contribute, be part of the community
Proposals
New tool and workshop ideas
Citizen Scientists
How can you help biological collections?
Researchers
Learn about research directions
Collections Staff
Learn how your collection can benefit from our work
Teachers & Students
Download lesson plans about using digitized specimens
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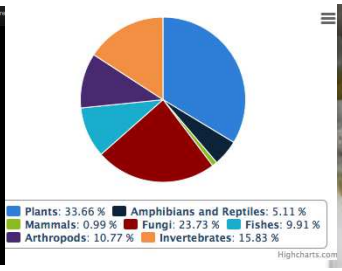
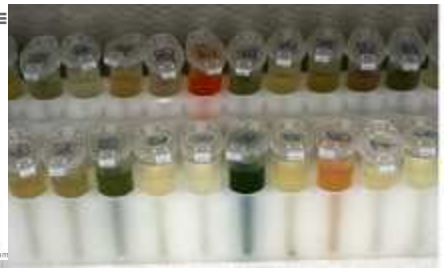
Next-Generation Biodiversity Research

- How are processes such as speciation and extinction associated with niche divergence?
- How have traits and ecological niches changed through time as a function of changes to geographic range and fluctuations in climate and geology?
- How is the evolution of phenotype correlated with changes in ecological niche at deep time scales?
- How is the phylogenetic diversity of a given area related to evolution of phenotype in that area?
- How have diversification processes interacted with climate and geology to shape modern biotas?
- How can fossil locality data inform our understanding of range and ecological niche evolution?
- How do traits change over time? Can within-species phenotype variation with respect to climate and ecology inform our understanding of trait lability and evolution at deep time scales?

Specimen Data & the Big Data Challenge

- Not just volume of data
- But integration of diverse data types
- For novel applications





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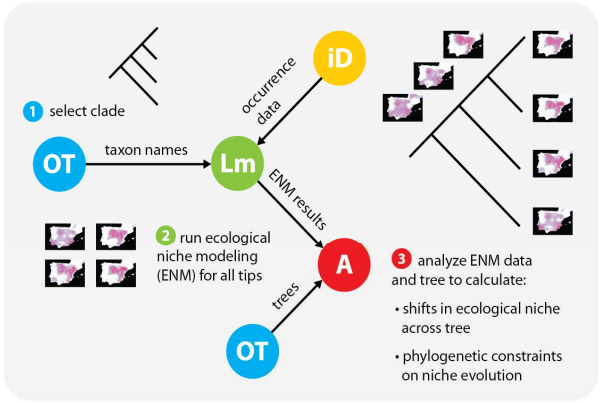
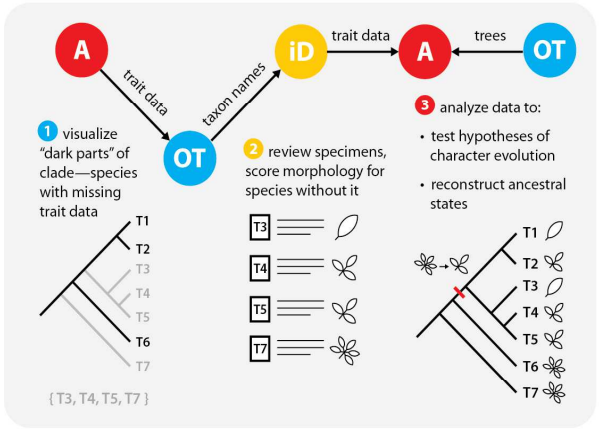
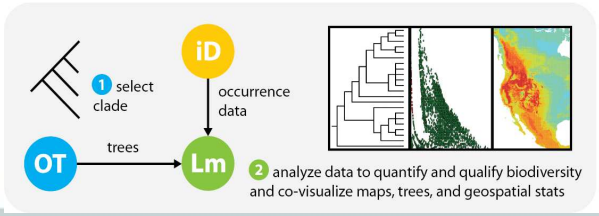
Connecting Trees, Specimens, Tools

EXAMPLE WORKFLOWS:







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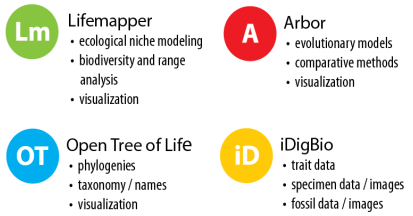

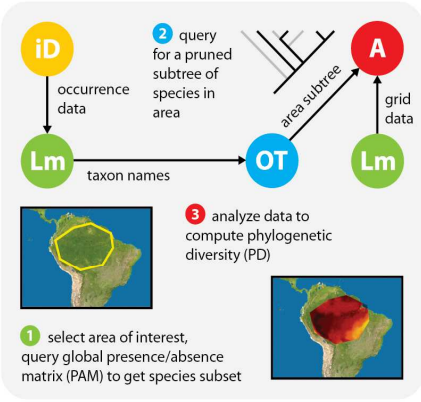

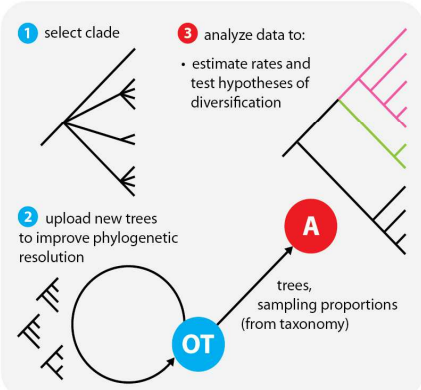

Connecting Trees, Specimens, Tools

Connecting Trees, Specimens, Tools

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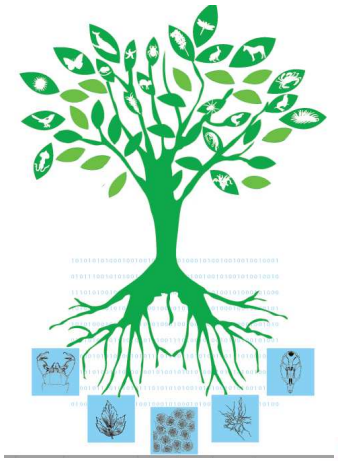


BIEN

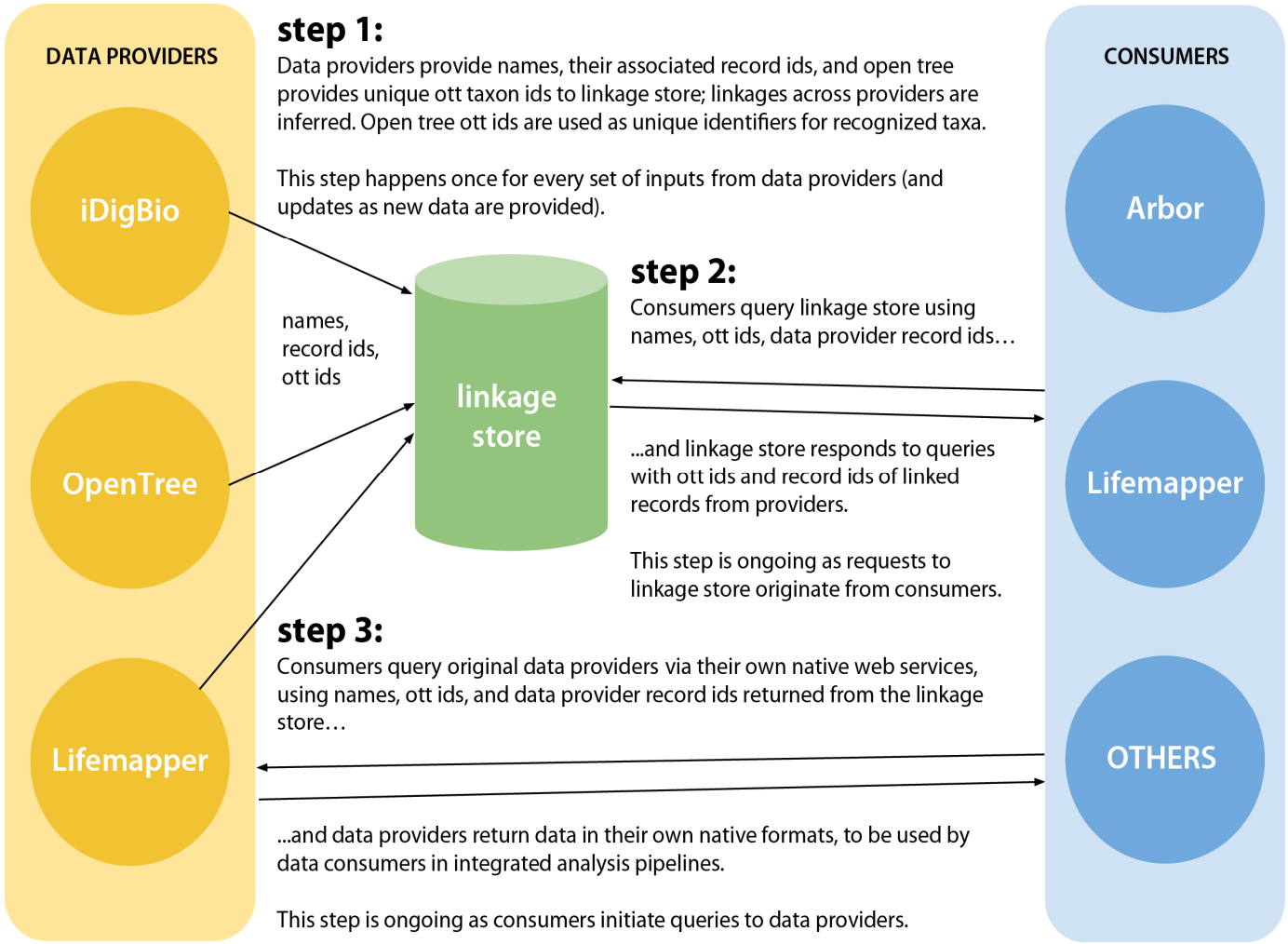
OPEN
Tree of Life
A community-assembled ToL

Lifemapper

ARBOR
revolutionary workflows

iDigBio
Integrated Digitized Biocollections

Connecting Trees, Specimens, Tools



Connecting Trees, Specimens, Tools

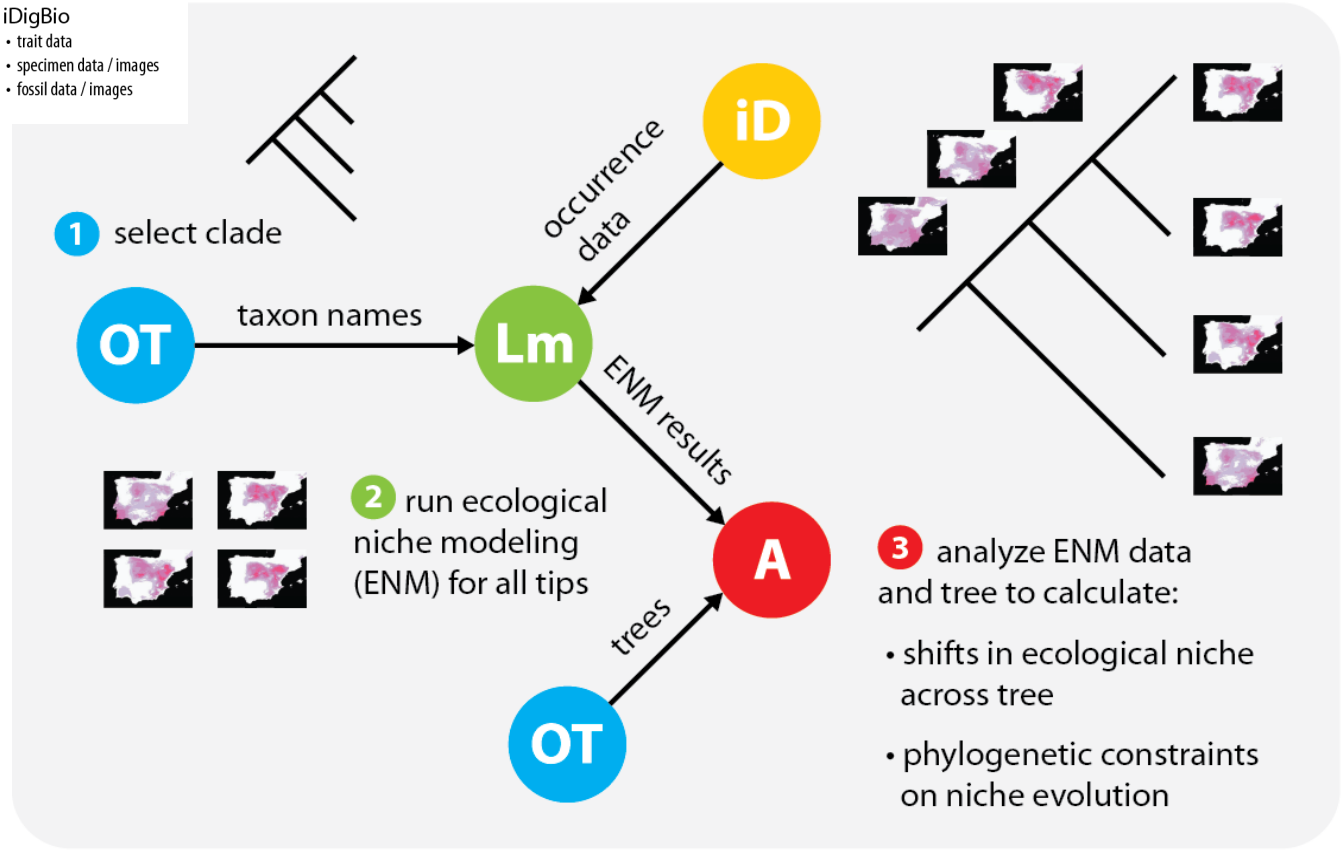
RESOURCES:

Lm Lifemapper
- ecological niche modeling
- biodiversity and range analysis
- visualization

A Arbor
- evolutionary models
- comparative methods
- visualization

OT Open Tree of Life
- phylogenies
- taxonomy / names
- visualization

iD iDigBio
- trait data
- specimen data / images
- fossil data / images



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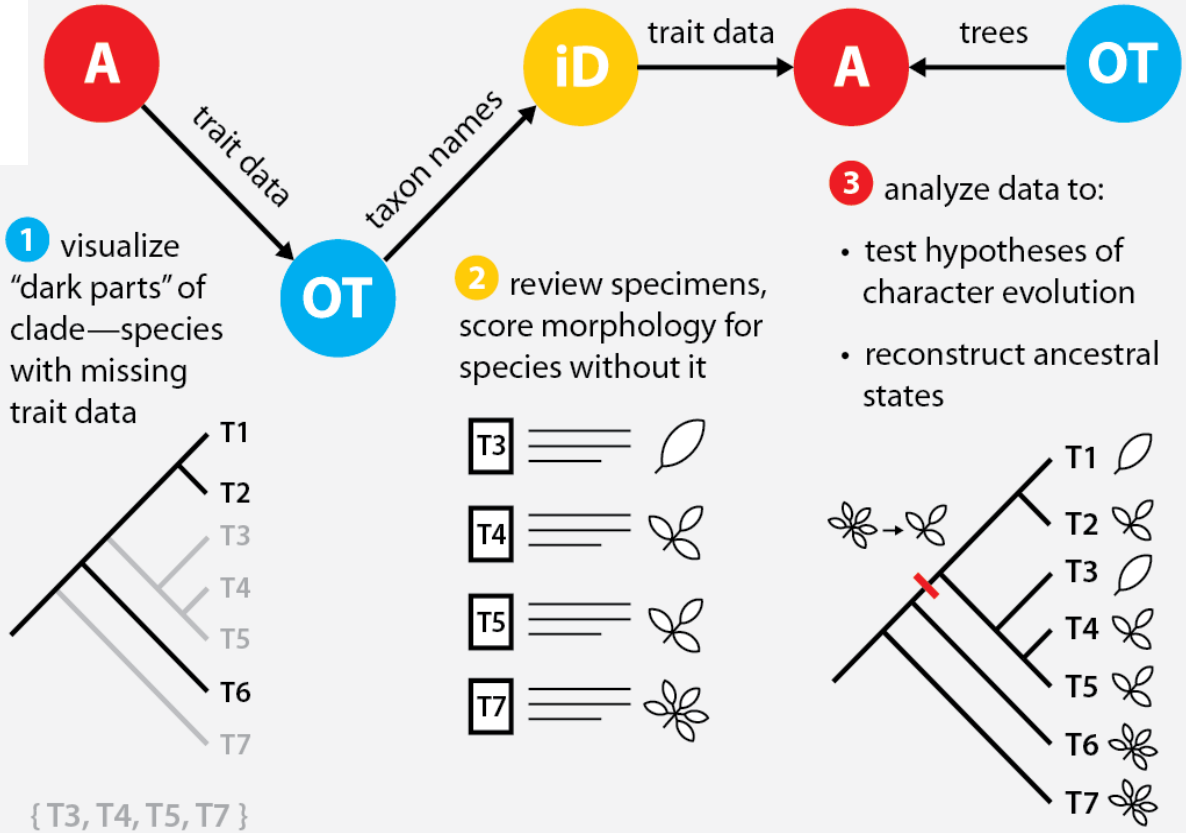

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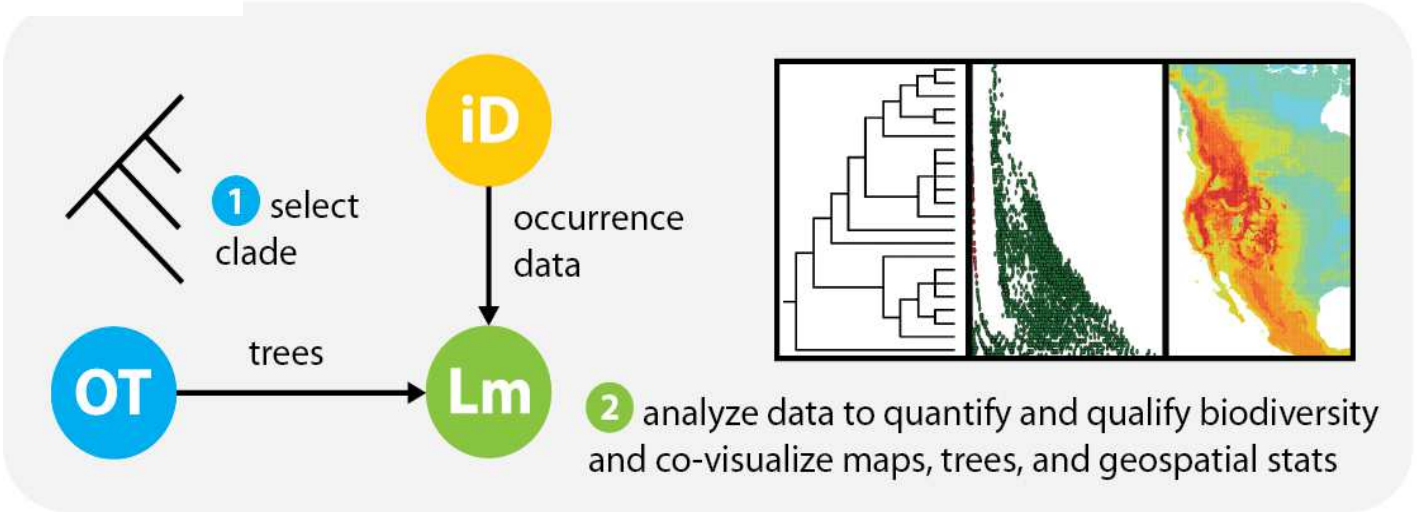

Connecting Trees, Specimens, Tools

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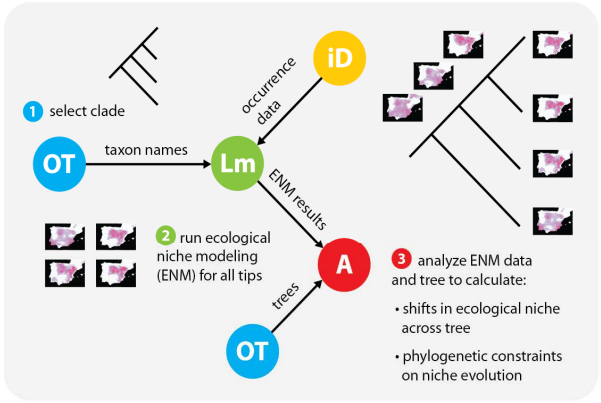

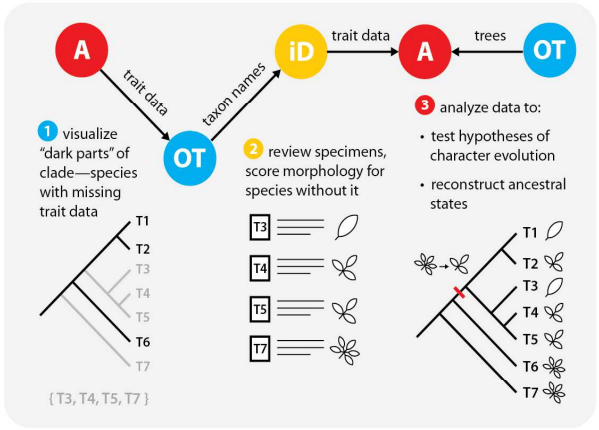

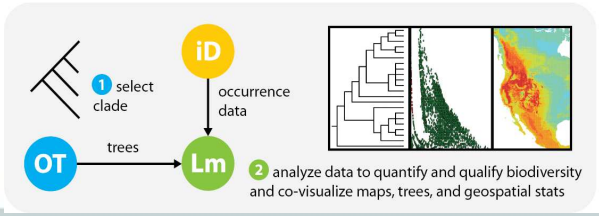

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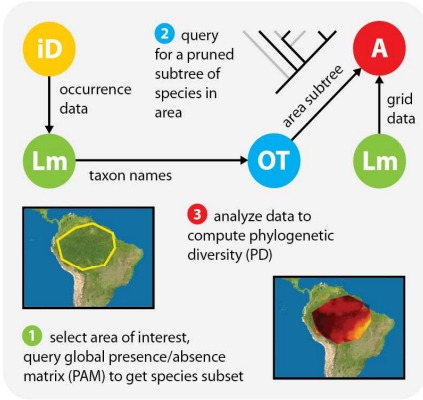
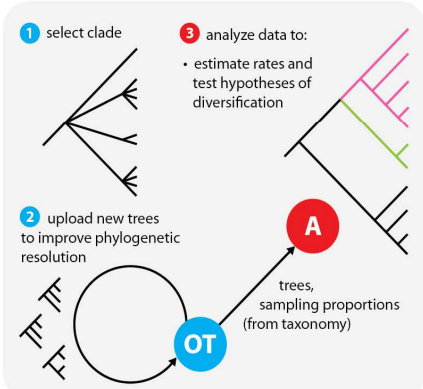
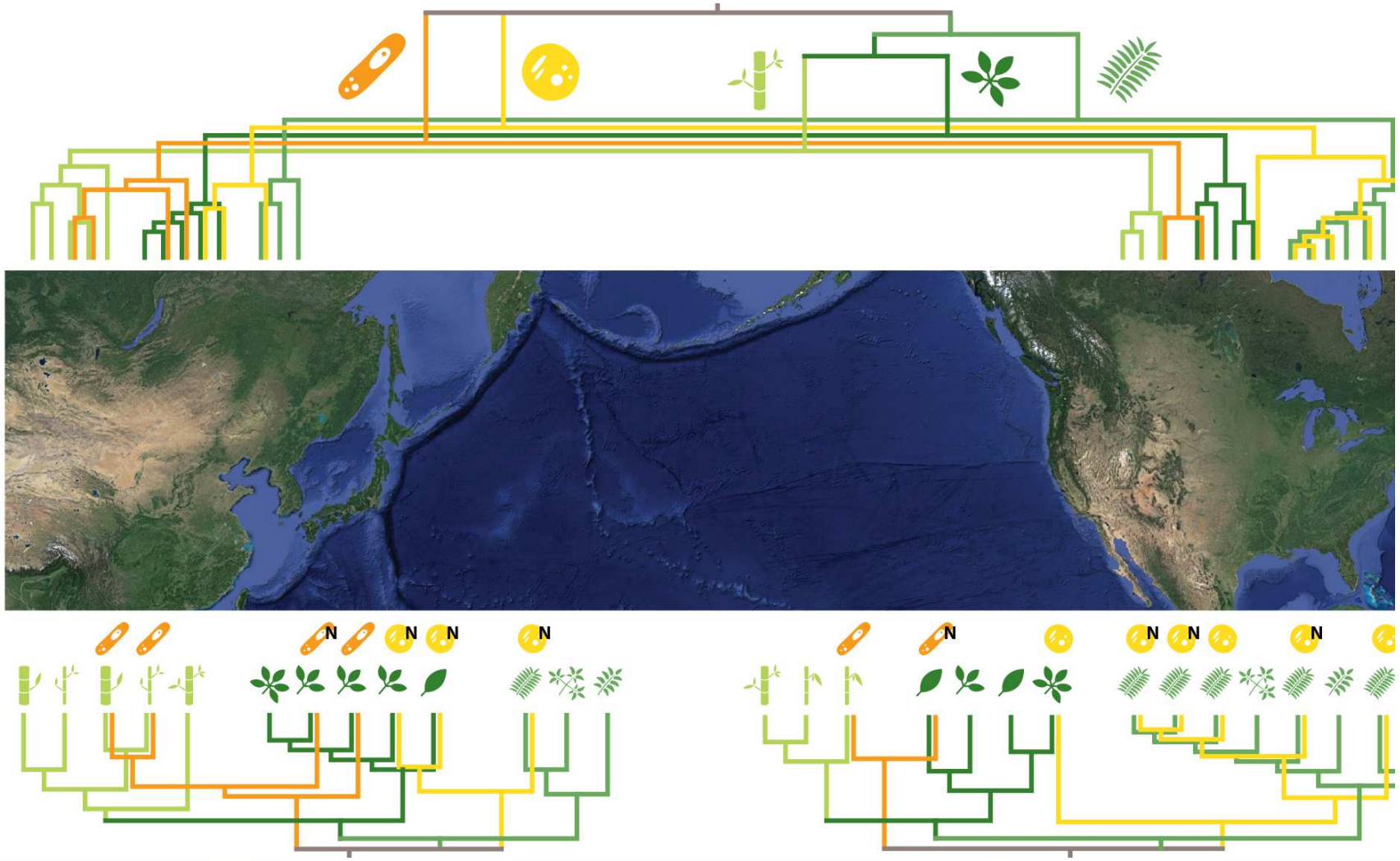




iDigBio Integrated Digitized Biocollections

Integrating Phylogenetics and Plant Trait Data

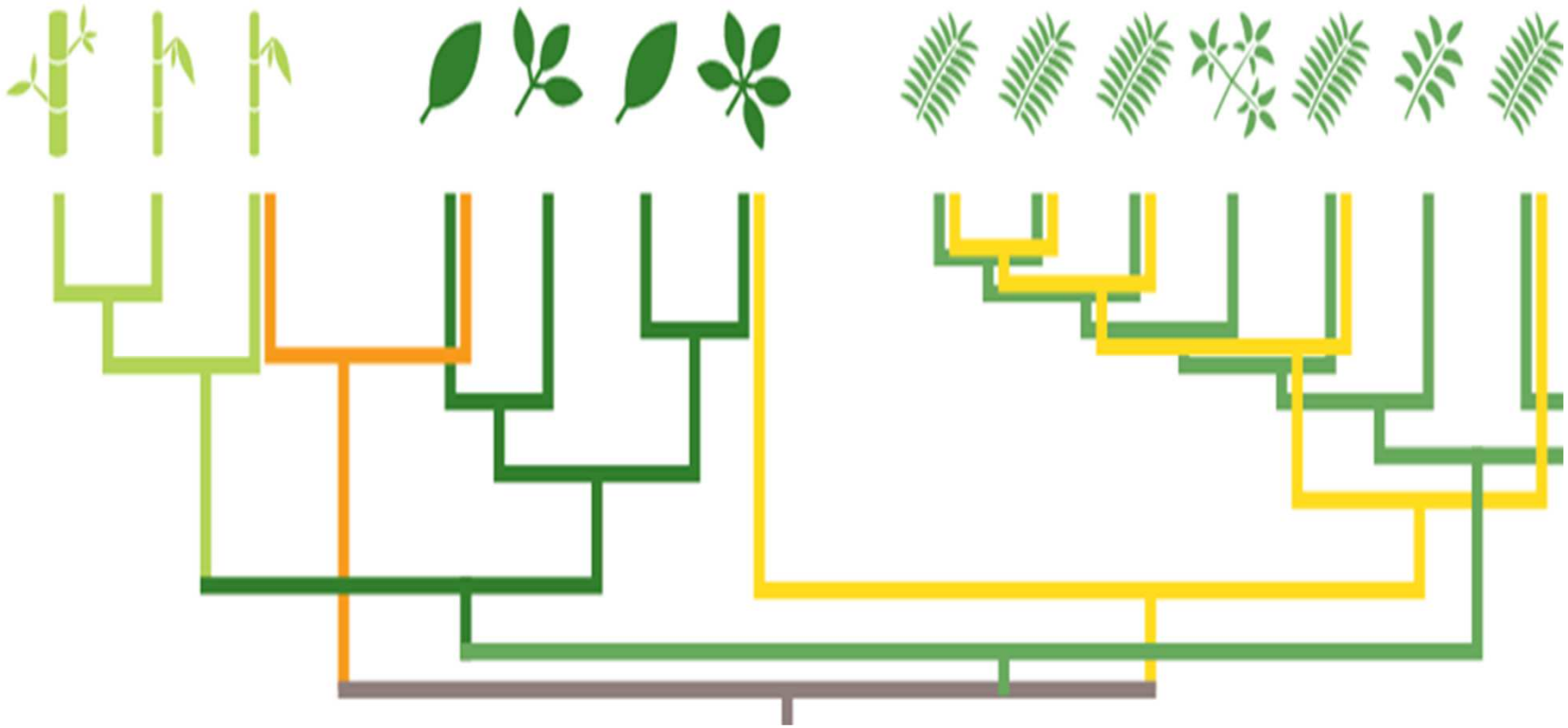


PhotosyntheticPathway
Respiration LeafArea NfixationCapacity
SLA RegenerationCapacity PlantLifespan
WoodDensity GrowthForm
PhenologyType LeafN
LeafP LeafLongevity PhotosyntheticCapacity
MaxPlantHeight SeedMass

iDigBio
Integrated Digitized Biocollections

TRY

Plant Trait Database



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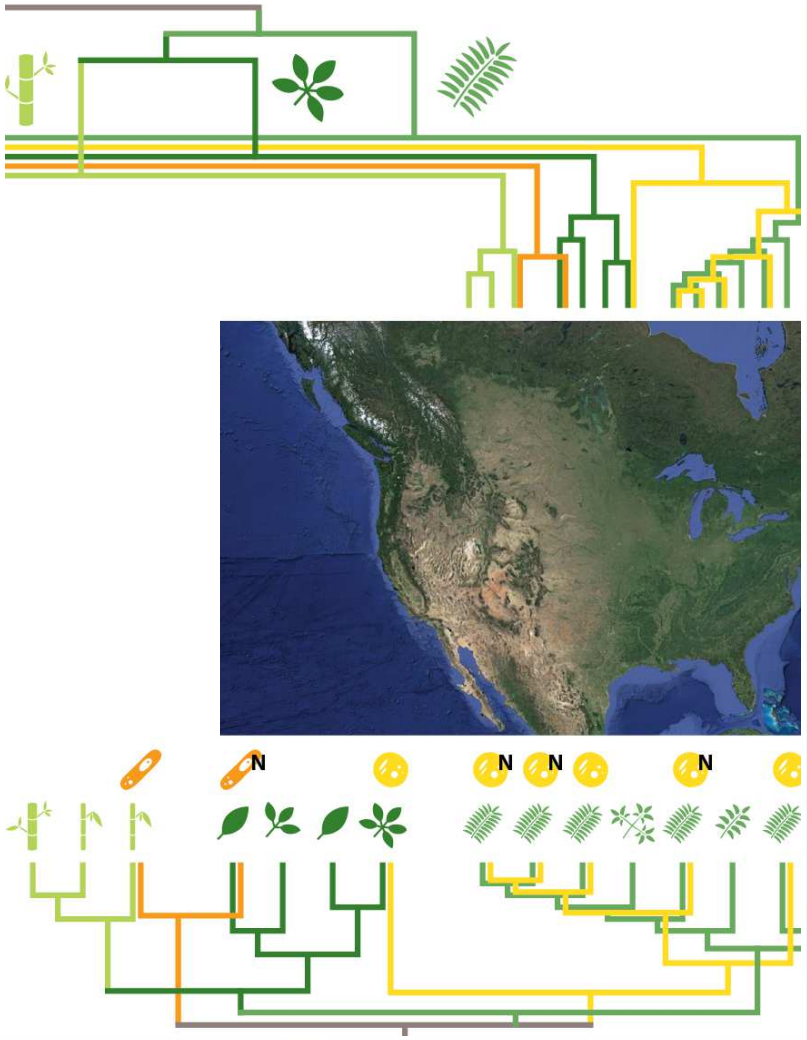
Integrating Phylogenetics and Plant Trait Data

- Community-level phylogenies
  - Comparisons of phylogenetic diversity across spatial scales
  - Correlation of plant functional traits
  - Over- and underdispersion of traits:
    - Are traits phylogenetically constrained or broader properties of communities?
    - Implications for long-term health of communities



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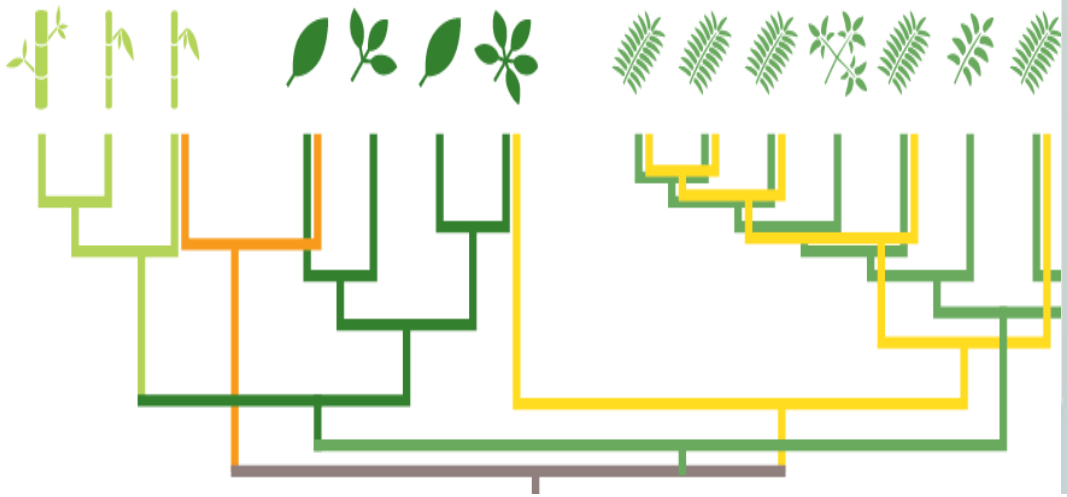
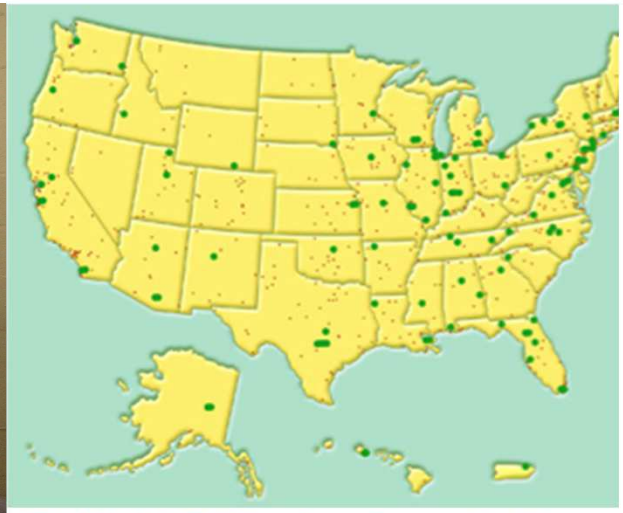
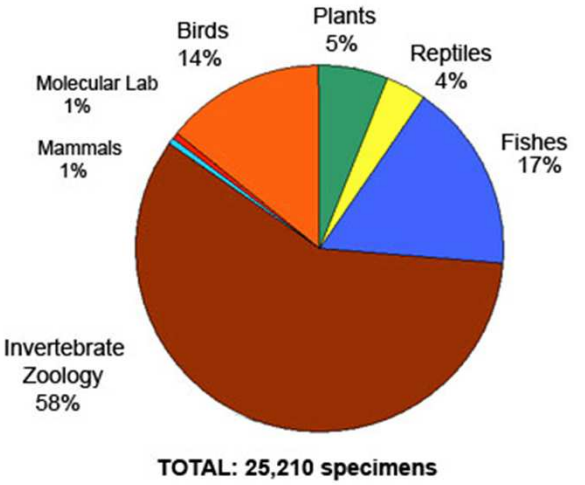
R. K. Godfrey Herbarium (FSU)
HERBARIUM
77581
FLORIDA STATE UNIVERSITY
KODAK Color Control Patches
KODAK Gray Scale
The New York Botanical Garden
Woody Plants of U. S. A.
ACERACEAE Acer rubrum L. Female
Small tree, 8 m. tall, with two stems from base, 15 cm. in diameter.
16709-A April 22, 1979. Tree in full bloom, exclusively female (see no. 16708, a nearby male tree). Tips of calyx and corolla lobes light red as in no. 16708. Stigmas bright red.
16709-B June 4, 1979. Leaves dark green above, pale green below. Fruits pale tan.
Common in bottom of hollow, ungrazed woods of Quercus alba, Fraxinus americana, Populus grandidentata, Carya ovata.
WISCONSIN: Richland Co., 3 miles SE of Richland Center.
T 10 N; R 1 E; SE¼SW¼ sec. 25. alt. 250 m.
Coll.: M. Nee



Linking Collections to Genomics

- Link specimens to GenBank records
- Use of specimens for genetics/genomics
- National network of genetic resources





TOTAL: 25,210 specimens

FLMNH GRR: the Genetic Resources Repository
Florida Museum of Natural History

G·R·R
FLORIDA MUSEUM OF NATURAL HISTORY

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GenBank Records

Welcome to NCBI

The National Center for Biotechnology Information advances science and health by providing access to biomedical and genomic information.

About the NCBI | Mission | Organization | Research | NCBI News

- **Examples of the /specimen_voucher information:**

```
/specimen_voucher="UAM:Mamm:52179"
/specimen_voucher="AMCC:101706"
/specimen_voucher="USNM:field series 8798"
/specimen_voucher="personal:Dan Janzen:99-SRNP-2003"
/specimen_voucher="99-SRNP-2003"
```

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Herbarium DNA and NGS

- Fresh leaf material hard to obtain for many taxa
- DNA from available herbarium material often degraded – Is this a problem?
- Often yes for PCR, but not for NGS
  - Small DNA fragments (e.g., **200-400** bp) required for most NGS protocols!
- Using herbarium material extensively for NGS in Icacinaceae
  - Herbarium samples as old as 80 years have worked fine

G. Stull

1955

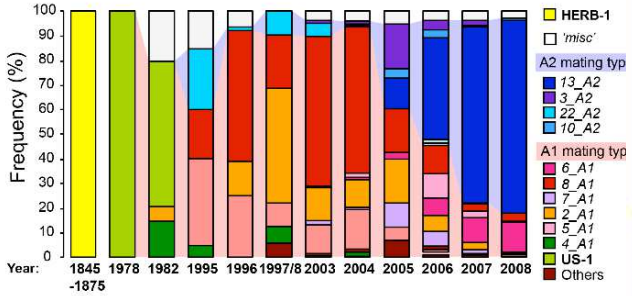
OPEN ACCESS Freely available online

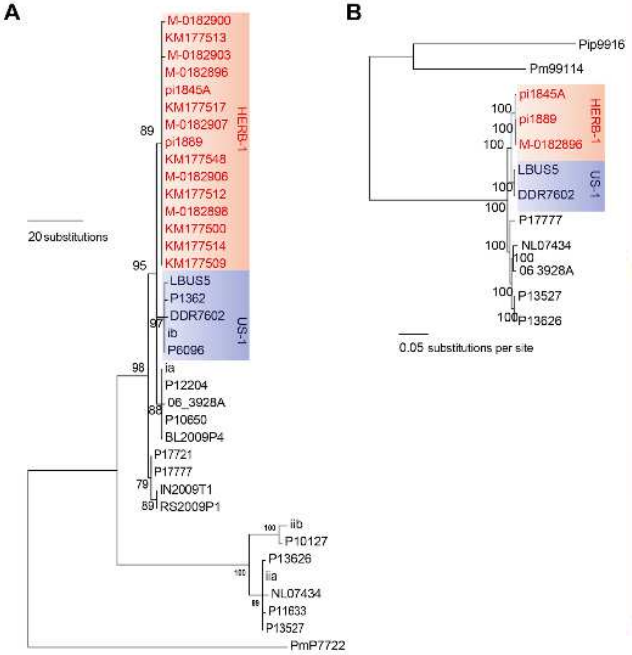
PLOS | PATHOGENS

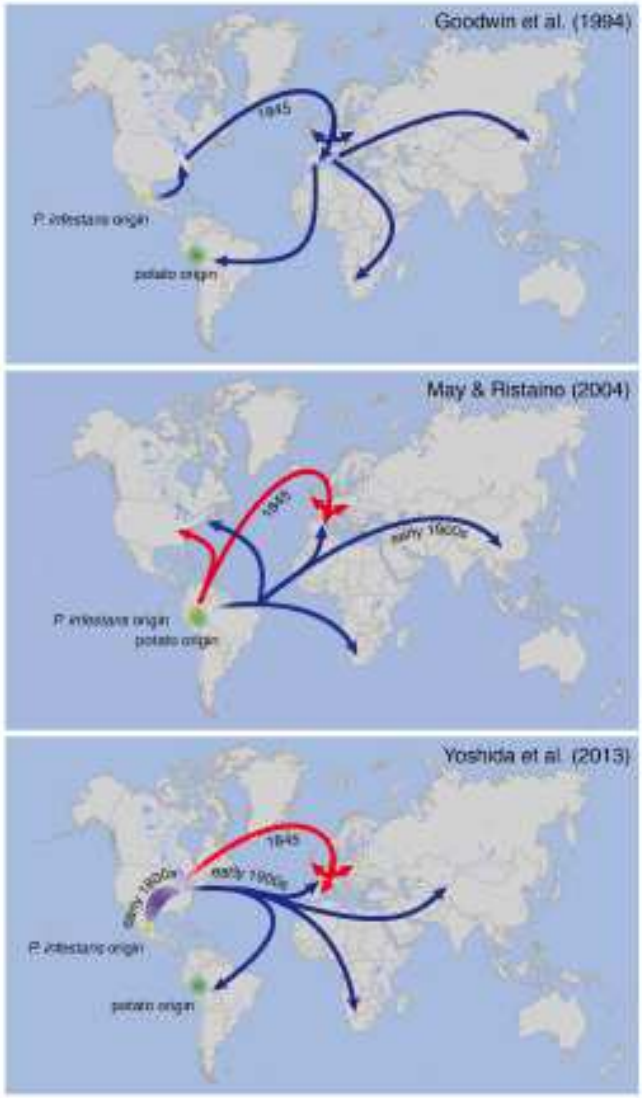
Pearls

Mining Herbaria for Plant Pathogen Genomes: Back to the Future

Kentaro Yoshida[1], Hernán A. Burbano[2]*, Johannes Krause[3], Marco Thines[4,5,6,7], Detlef Weigel[2]*, Sophien Kamoun[1]*







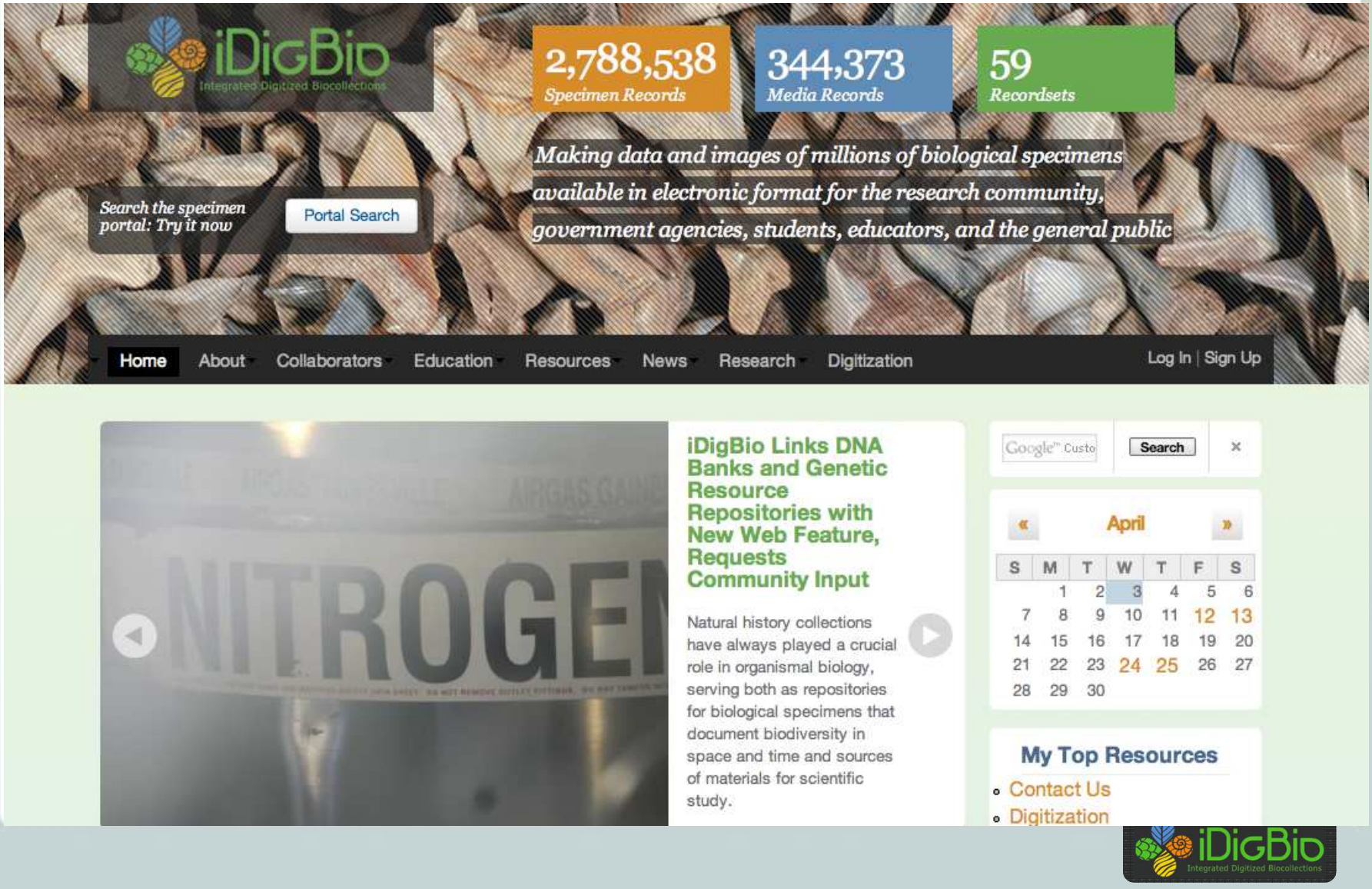
Linking Collections to Genomics

- Participated in NSF-sponsored workshop on DNA banks at Missouri Botanical Garden, Jan. 2013
- Assembled a file of national DNA and tissue banks
- Developed a common web portal to these collections
- DNA resources ultimately connected to specimen data in iDigBio

Index to DNA Banks in US

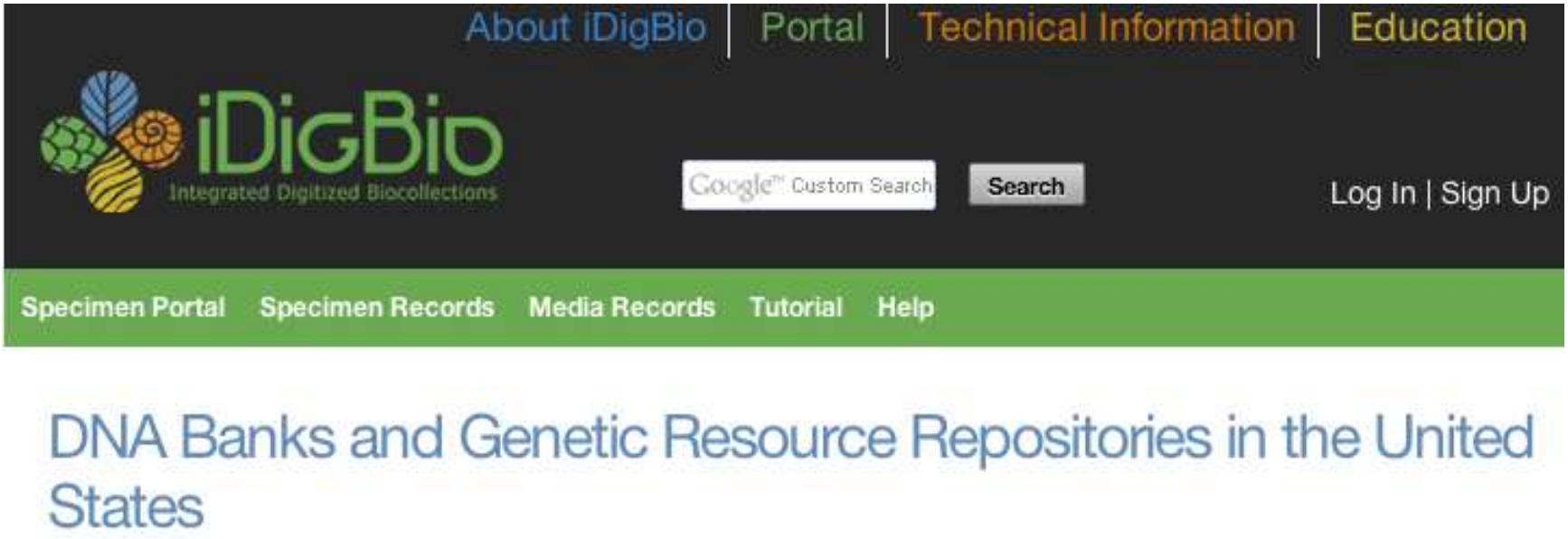
Grant Godden

Index to DNA Banks in US



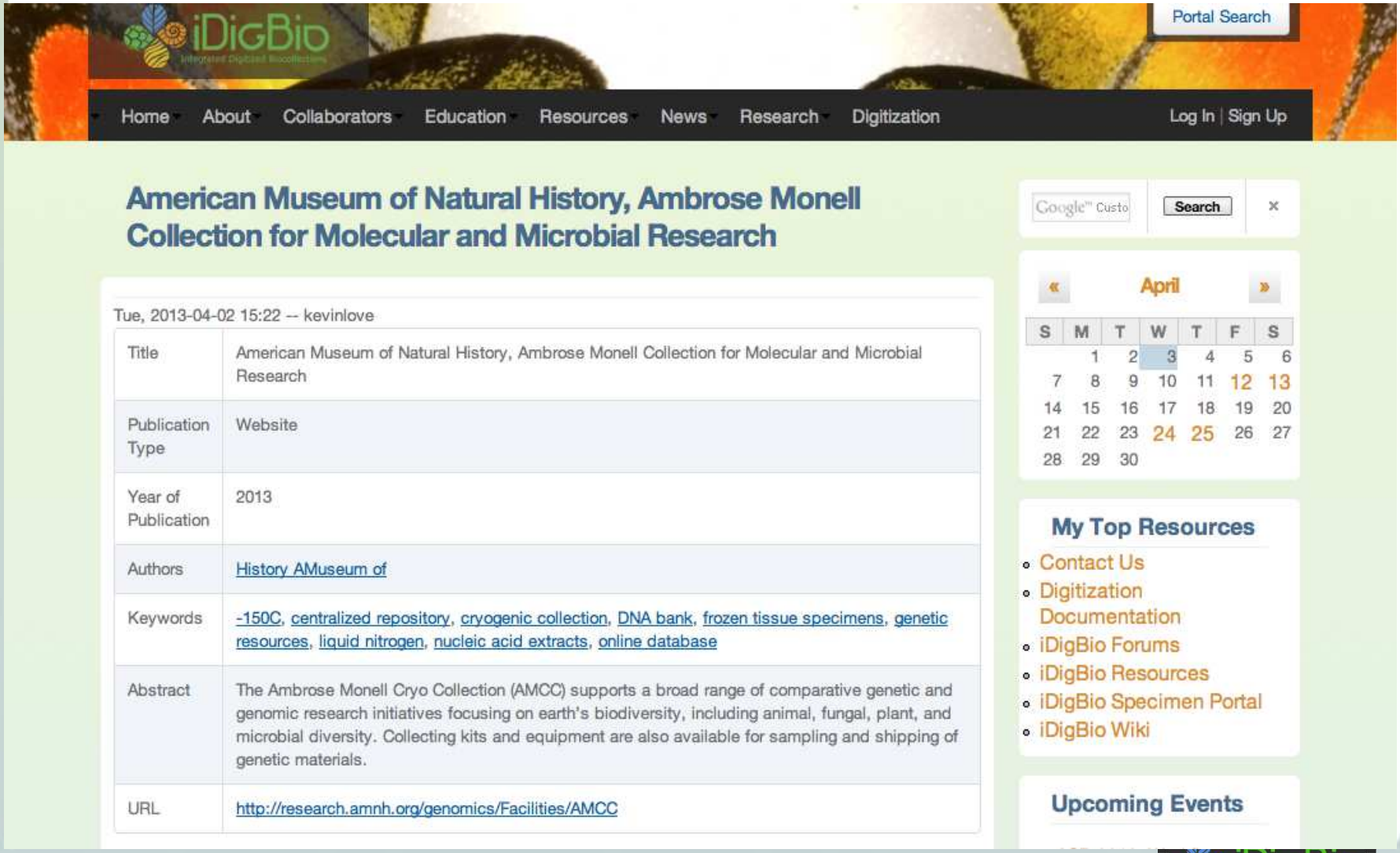
Index to DNA Banks in US

- https://www.idigbio.org/genetic-resources



Index to DNA Banks in US

Index to DNA Banks in US: an example



Summary

- Specimens continue as foundation for systematics
- Emerging tools and infrastructure to link phylogenies with specimens – multitude of applications for diverse research questions
- Multiple connections to molecular data:
  - GenBank records
  - Specimens as sources of genomic data
  - Index to DNA Banks
- Exciting time **now** – integrating phylogenetic, genetic, and ecological data in basic and applied research – and into the **future**!

Acknowledgments

- Joe Miller, PhyloJIVE
- Open Tree of Life, Arbor, Lifemapper collaborators
- D. Soltis, J. Xiang, M. Mack, J. Lichstein – phylogenies, plant traits, specimens
- Grant Godden & Kevin Love for Index to DNA Banks

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