Shaw Nature Reserve

Preserving and documenting diversity

By Garrett Billings
History of Shaw Nature Reserve

• Burned frequently
  – Native Americans
  – Natural fire regimes

• Used almost exclusively as agriculture
  – Encouraged red cedar
  – Greatly impacted soil stability
History of Shaw Nature Reserve

- Land purchased in 1925 due to coal-soot pollution in St. Louis

- 1932 named The Missouri Botanical Garden Arboretum

- Orchid collection
  - By 1943 over 20,000 plants were housed in greenhouses. (mostly orchids)

- 1934 E. Anderson establishes native plant collection

  1937 Louis Brenner lays out wildflower trails

  2000 renamed Shaw Nature Reserve
E. Anderson

- Introgressive hybridization
- Plants, Man and life
- Keen interest in cultivated and economically useful plants
- Studied corn crops, and corn hybridization
E. Anderson

- Established 40 species of wildflowers

- Curator
  1954-1957

- Darwin-Wallace medal of Linnaean Society
Shaw Nature Reserve

- Located on the boundary line of the historic glaciated northern prairies and southern Ozark Plateau
- Meramec river front
- Bedrock primarily dolomite and limestone.
- Clay loam, sand loam and black river bottom soil along limestone bluffs.
Habitats
Prairies

Schizachyrium scoparium

Andropogon gerardii
Glades

- Echinacea
- Dalea
- Oenothera macrocarpa
Woodlands
John Behrer began the construction in 1991
32 acres of wetland
Considered by the Corp of Engineers as a natural wetland equivalent

- Biodiversity hotspots
- Pollutant filters
- Soil erosion control
- Flood control
- Water reservoir
Wetland

**Taxodium distichum**

**Nyssa aquatica**

**Uercus phellos**

**Carex brevior**

**Carex spp.**

**Juncus spp.**

**Scirpus spp.**
Other riparian communities

Meramec river

Pinetum Lake
Collecting Shaw

- Plants were collected, pressed and placed in a dryer.
- Young leaf tissue was collected in coffee filters and later stored in silica gel.
- 65 species were collected.
Checklist

• 1605 specimens
DNA barcoding

- DNA barcoding is a short gene sequence from a standardized region of the genome used to distinguish and characterize species.
Benefits of DNA barcoding

• Forensic analysis
  – Herbal medicines
  – Protection of endangered species
  – Species identification
Development of DNA barcoding

• Needs to be universally effective
  – Standardization
  – Minimalism
  – Scalability

A universal primer is needed

• (i) universality (ease of amplification and sequencing)
• (ii) sequence quality
• (iii) discriminatory power
• Extraction
• Amplification
• Sequencing
Consortium for the barcode of life

- COBL Proposed primers matK and rbcL as potential universal barcodes

Orchid case study:
matK
Lahaye et al found:
Tested 1,036 species of orchids
Resulted in >90% correct species identification.

<table>
<thead>
<tr>
<th></th>
<th>rbcL</th>
<th>matK</th>
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<tbody>
<tr>
<td><strong>Positive</strong></td>
<td>High amplifications and sequencing success</td>
<td>High rate of species discrimination success</td>
</tr>
<tr>
<td><strong>Negative</strong></td>
<td>Low rate of discrimination success</td>
<td>Low amplification and sequence success in many plant groups</td>
</tr>
<tr>
<td></td>
<td>matK</td>
<td>rbcL</td>
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<tr>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Genbank Presence</td>
<td>54% (561/1031)</td>
<td>53% (541/1031)</td>
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<tr>
<td>Species amplified</td>
<td>56% (17/30)</td>
<td>58% (18/31)</td>
</tr>
<tr>
<td>Species with &gt; 80% sequence accuracy</td>
<td>5% (1/17)</td>
<td>88% (15/17)</td>
</tr>
<tr>
<td>Species with &lt; 80% sequence accuracy</td>
<td>94% (16/17)</td>
<td>12% (2/17)</td>
</tr>
<tr>
<td>Species correctly identified to family</td>
<td>52% (9/17)</td>
<td>88% (15/17)</td>
</tr>
<tr>
<td>Species correctly identified to genus</td>
<td>35% (6/17)</td>
<td>76% (13/17)</td>
</tr>
</tbody>
</table>
DNA barcoding databases

Genbank presence

- matK - 54%
- rbcL - 53%

Vouchers?
Take home message

• Currently there is no “universal” barcode that will work for all groups of flowering plants
• Standard primers like matK and rbcL on average tend to identify 70% of taxa, but if correct gene region is chosen for a particular group than >90% can be sequenced species specific
• Different gene regions code better for different plant groups. (imagine that)
• Great strides must be made if a universal barcode will ever be adopted for plants
Acknowledgements

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Sources

• Photos:
  http://people.wku.edu/charles.smith/chronob/ANDE1897.htm (e. anderson)
  http://www.stltoday.com/look-back-smoky-st-louis-nov/image_ba18f484-f5c8-11df-b89d-00127992bc8b.html (coal pollution)

Info-
  http://www.missouribotanicalgarden.org/visit/family-of-attractions/shaw-nature-reserve/about-shaw-nature-reserve.aspx (shaw history)