Symbiota: a specimen-based biodiversity portal platform

Edward Gilbert
Corinna Gries
Nico Franz
Symbiota Software Project

- Open source
- Virtual flora/fauna
  - Specimen search engine
  - Biodiversity inventories
  - Identification keys
- Images, maps, descriptions, common names, etc
Specimen Centric Model

- Baseline data
- Expert reviewed vouchers
- Verifiable
- Proof of occurrence
- Reproducible
- Millions of occurrence records
History - Initial Funding

- NSF Award DBI-0847966
- 2008 – 2011
- Integrate systems
  - Symbiota Keys
  - SEINet
- Data exchange
- Web services
History -> SEINet

- Prototype: 2001
- Specimen search engine
- Java/JSP & MS SQL
- Distributed databases
- Arizona herbaria
  - DES, ARIZ, ASC, ASU
- Taxonomic thesaurus
- Read-only
History -> Symbiota Key

- Interactive Key
- PHP / MySQL
- Character “matrix”
  - DELTA standard
  - Relational database
- Taxonomy
- Static checklists
- Keys for complex lists
- Issue: No specimens
History -> Change or Plans

- SEINet issues
- Unstable
- Problematic infrastructure
- Offline databases
- Limited use of standards
- Solution: merge!
Symbiota - Prototype

- SEINet functionality merged into Symbiota
- Centralized cache of specimen data
- Robust indexing
- Dynamic keys
- Central Taxonomic Thesaurus
Welcome to SEINet

The Southwest Environmental Information Network was created to serve as a gateway to distributed data resources of interest to the environmental research community in Arizona and beyond. Through a common web interface, we offer tools to locate, access and work with a variety of data.

SEINet is more than just a website - it is a suite of data access technologies and a distributed network of departments, museums and agencies that provide environmental information. Initially created to integrate databases within the Arizona State University, SEINet is growing to extend this network to other partners within the Southwest.

To learn more about the features and capabilities available through this site, read Making Good Use Of SEINet or visit the Symbiota Help Pages. Join SEINet as a regular visitor and please send your feedback to seinetadmin@asu.edu. Visit the Data Usage Policy page for information on how to cite data obtained from this web resource.

Development of SEINet, Symbiota, and several of the specimen databases have been supported by National Science Foundation Grants (DBI 9983132, BRC 0237416, DBI 0743827, DBI 0847900)
Point (Lat, Long): 31.81002, -110.41428
31.81002, -110.41428; within 20 miles

Species Count: 1357

Acanthaceae
- Anisacanthus thurberi
- Carlowrightia arizonica
- Carlowrightia linearifolia
- Carlowrightia texana
- Dicliptera resupinata
- Dyschoriste schiedeana
- Elytraria imbricata
- Justicia sonorae
- Ruellia nudiflora
- Tetramerium nervosum

Adoxaceae
- Sambucus nigra

Aizoaceae
- Trianthema portulacastrum

Alismataceae
- Alisma triviale
Taxon: All Species

Display as: Scientific Name

31.81002, -110.41428; within 20 miles

Species Count: 62

Adoxaceae
- Sambucus nigra

Anacardiaceae
- Rhus microphylla
- Rhus virens

Bignoniaceae
- Catalpa bignonioides
- Chilopsis linearis
- Tecoma stans

Cannabaceae
- Celtis reticulata

Cupressaceae
- Juniperus coahuilensis
- Juniperus deppeana

Ericaceae
31.81002, -110.41428; within 20 miles

Species Count: 10

Adoxaceae
- Sambucus nigra

Bignoniaceae
- Catalpa bignonioides
- Tecoma stans

Cupressaceae
- Juniperus coahuilensis
- Juniperus deppeana

Oleaceae
- Fraxinus gooddingii
- Fraxinus velutina

Rubiaceae
- Cephalanthus occidentalis

Sapindaceae
31.81002, -110.41428; within 20 miles

Species Count: 5

Adoxaceae
  Sambucus nigra

Bignoniaceae
  Tecoma stans

Oleaceae
  Fraxinus gooddingii
  Fraxinus velutina

Sapindaceae
  Acer negundo
**Acer negundo** L.

Go to [Encyclopedia of Life...](#)

**Family:** Sapindaceae

**boxelder**, more...

*Negundo aceroides* (L.) Moench, more

**Plant:** tree; to 10 m high, sparsely to densely pubescent on young growth and lower leaf surfaces, usually dioecious; young twigs glabrous to densely pubescent, often more or less glaucous, the epidermis smooth, greenish or reddish, the older twigs more or less rough, gray; buds covered by two reddish, tan, or yellowish valvate scales, these sparsely to densely hairy, the pubescent inner scales greatly elongating as the bud opens

**Leaves:** mainly 3-foliolate, occasionally 3-lobed, 3.5-13.5 cm long, 3.5-18 cm wide, concolorous, the terminal leaflet up to 11 cm long by 8 cm wide, the lateral leaflets up to 9 cm long by 6 cm wide; apex of leaflets acute to acuminate; base of leaflets rounded to cuneate, sometimes oblique in lateral leaflets, sometimes acuminate in terminal leaflets; petiole 2-7.5 cm long, green or reddish; margin of leaflets coarsely toothed or lobed, the teeth acuminate to obtuse

**INFLORESCENCE:** inflorescences many flowered, the staminate umbel-like, the pistillate racemose

**Flowers:** ca. 5 mm long, less than 1 mm wide at base of perianth, the perianth greenish-yellow, with ca. 4 subelliptic segments ca. 0.2-2 mm long, the receptacle blending with filiform pedicel; pedicels 1-4 cm long

**Fruit:** samaras 2.3-3.6 cm long, the wing 0.7-1.4 cm wide, the infructescences up to 15 cm long

**Misc:** Riparian habitats and other wet wooded areas; 900-2750 m (3000-9100
Scientific Community Portals

- Modular framework
- Community-based biodiversity portals
- Distinct datasets
  - Taxonomic scope
  - Geographic scope
- Custom look & feel
  - CSS, config files
SEINet Network

- Integrated Data
- Distributed Network
  - Great Plains
  - InterMountain
  - MABA
  - SEINet – AZ
  - SEINet – NM
  - SERNEC
  - VPlants
Symbiota - Biodiversity CMS

• Read-only user interface
• Password Protected
  ▫ Online Browser-based application
  ▫ Platform independent
  ▫ Globally accessible
  ▫ No special software installation (free)
  ▫ Make use of web services
Additional Features

• Duplicate linking
• Exsiccati
• Loan management
• Genetic linkages
• Specimen comments
• OCR / NLP
• Crowdsourcing

• Versioning of Edits
• Batch georeferencing
• Darwin Core Archive Publishing
• Data Cleaning
• Multiple taxonomic thesauri
Specimen Management

- Images
- Keys
- Species Lists
- Users

Data Snapshots
- Coll 6
- Coll 7
- Coll 8

Live Data

Specify
K-Emu
Specify
Excel
Access

X
Duplication vs Niche Overlap

- Encyclopedia of Life (EOL)
- Specify
- GBIF
- Discover Life
- Navikey / Lucid / Xper2
- Symbiota
  - Community Data Portals
  - Specimen based
  - Biodiversity CMS
Biodiversity Inventories

- Floras & Fauna
- Graduate Research
- Park Service Inventories
- Surveys
- Voucher supported
Arizona Flora

Project Managers: Arizona State University Vascular Plant Herbarium

Arizona is the third or fourth most floristically rich state in the US with perhaps as many as 3900 species of vascular plants. Over the last 60 years an average of ca. 12 new species records have been reported annually.

Research Checklists

- Arizona
- Arizona Spring Flora
- ASU Arboretum - Gold Trail
- ASU Arboretum - Maroon Trail
- Buckeye Hills Recreational Area
- Camp Creek
- Canyon de Chelly National Monument
- Casa Grande Ruins National Monument
- Castle Dome Mountains
- Chiricahua National Monument
- Eagletail Mountains Wilderness
- Escudilla Mountains
- Fort Bowie National Historic Site
- Grand Canyon National Park
- GreenLots - Tucson
- Hart Prairie
- Hassayampa River Preserve
- Hummingbird Springs Wilderness
- Lake Pleasant Regional Park
- Maricopa County, Arizona
- McDowell Mountains Regional Park
- Organ Pipe Cactus National Monument
- Papago Park
- Phoenix Cultivated Plants
- Phoenix Flora
- Pinal Mountains
- Pinaleno Mountains
- Saguaro National Park-Rincon Mountain District
- San Pedro National Riparian Conservation Area
- San Tan Mountain Semi-Regional Park
- Santa Catalina Mountains
- Santa Teresa Mountains
San Pedro National Riparian Conservation Area

Authors: Elizabeth Makings

More Details

Species List

Families: 95
Genera: 359
Species: 618 (species rank)
Total Taxa: 627 (including ssp. and var.)

Page 1 of 2:

ACANTHACEAE

Anisacanthus thurberi
Carlomartia arizonica
Carlomartia linearifolia
Carlomartia texana
Elytraria imbricata
Ruellia nudiflora

AGAVACEAE

Agave palmeri
Yucca sp.
Yucca elata

AIZOACEAE

Triannotha portulacastrum

AMARANTHACEAE

Alternanthera caracasana
Alternanthera pungens
Amaranthus albus
Amaranthus fimbriatus
Amaranthus palmeri
### San Pedro National Riparian Conservation Area

**Authors:** Elizabeth Makings  

---

### Species List

**Families:** 1  
**Genera:** 45  
**Species:** 100 (species rank)  
**Total Taxa:** 105 (including ssp. and var.)

#### POACEAE

- **Achnatherum eminens**
- **Andropogon glomeratus**  
  - rare; Elizabeth Makings (827), Elizabeth Makings (1682)
- **Aristida adscensionis**
  - Elizabeth Makings (824), Elizabeth Makings (594), Elizabeth Makings (762), Elizabeth Makings (1300)
- **Aristida purpurea var. longiseta**
  - Elizabeth Makings (865), Elizabeth Makings (1513)
- **Aristida purpurea var. nealleyi**
  - Elizabeth Makings (803), Elizabeth Makings (1075), Elizabeth Makings (1366)
- **Aristida ternipes**
  - Elizabeth Makings (503)
- **Aristida ternipes var. gentilis**
  - Elizabeth Makings (685), Elizabeth Makings (492), Elizabeth Makings (688), Elizabeth Makings (488)
- **Aristida ternipes var. ternipes**
  - Elizabeth Makings (1214), Elizabeth Makings (1330)
- **Arundo donax**
  - Elizabeth Makings (1650), Elizabeth Makings (813)
- **Avena fatua**
  - Elizabeth Makings (229)
- **Bothriochloa barbinoda**
  - Elizabeth Makings (512), Elizabeth Makings (1040), Elizabeth Makings (472)
- **Bothriochloa ischaemum**
  - Elizabeth Makings (1272), Elizabeth Makings (1659)
- **Bothriochloa laguroides ssp. torreyana**
  - Elizabeth Makings (822), Elizabeth Makings (1024), Elizabeth Makings (1048), Elizabeth Makings (423)
- **Bouteloua barbata**
  - Elizabeth Makings (1385), Elizabeth Makings (599), Elizabeth Makings (646)
- **Bouteloua condensoides**
Family: Poaceae
Taxon: Aristida adscensionis L.
Collector: Elizabeth Makings (#762)
Date Collected: 07 September 2001
Habitat: alluvial terrace, old agricultural field with scattered sacaton
Associated Species: Sporobolus wrightii, Solanum eleagnifolium, Machaeranthera gracilis, annuals Conyza coulteri, Chloris virgata, Xanthocephalum gymnospermoideis
Description: Common annual 60 cm
Locality: USA; Arizona; Cochise County
Upper San Pedro River floodplain, "Cottonwood" site, approx 1 mile south of Hwy 90, ~100m west of San Pedro
31.8456993 -110.2279968
Elevation: 1239m.

For more information on this specimen, please contact Leslie Landrum (les.landrum@asu.edu)
San Pedro National Riparian Conservation Area

Authors: Elizabeth Makings

Species List

Families: 1
Genera: 45
Species: 100 (species rank)
Total Taxa: 105 (including ssp. and var.)

POACEAE

Achnatherum eminens
   Elizabeth Makings (1538)
Andropogon glomeratus
   rare; Elizabeth Makings (827), Elizabeth Makings (1682)
Aristida adscensionis
   Elizabeth Makings (824), Elizabeth Makings (594), Elizabeth Makings (762), Elizabeth Makings (1300)
Aristida purpurea var. longiseta
   Elizabeth Makings (865), Elizabeth Makings (1513)
Aristida purpurea var. nealleyi
   Elizabeth Makings (803), Elizabeth Makings (1075), Elizabeth Makings (1366)
Aristida ternipes
   Elizabeth Makings (503)
Aristida ternipes var. gentilis
   Elizabeth Makings (685), Elizabeth Makings (492), Elizabeth Makings (688), Elizabeth Makings (488)
Aristida ternipes var. ternipes
   Elizabeth Makings (1214), Elizabeth Makings (1330)
Arundo donax
   Elizabeth Makings (1650), Elizabeth Makings (813)
Avena fatua
   Elizabeth Makings (229)
Bothriochloa barbinonis
   Elizabeth Makings (512), Elizabeth Makings (1040), Elizabeth Makings (472)
Bothriochloa ischaemum
   Elizabeth Makings (1272), Elizabeth Makings (1659)
Bothriochloa laguroides ssp. torreyana
   Elizabeth Makings (822), Elizabeth Makings (1024), Elizabeth Makings (1048), Elizabeth Makings (423)
Bouteloua barbata
   Elizabeth Makings (1385), Elizabeth Makings (599), Elizabeth Makings (646)
Bouteloua chondrosoioides
### Possible Voucher Conflicts

List of specimen vouchers where the current identifications conflict with the checklist. Voucher conflicts are typically due to recent annotations of specimens located within collection. Click on Checklist ID to open the editing pane for that record.

**Conflict Count: 21**

<table>
<thead>
<tr>
<th>Checklist ID</th>
<th>Collector</th>
<th>Specimen ID</th>
<th>Identified By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abutilon palmeri</td>
<td>Elizabeth Makings (1331)</td>
<td>Abutilon abutiloides</td>
<td>C. J. S. Davis (Dec 2011)</td>
</tr>
<tr>
<td>Abutilon palmeri</td>
<td>Elizabeth Makings (1277)</td>
<td>Abutilon abutiloides</td>
<td>C. J. S. Davis (Dec 2011)</td>
</tr>
<tr>
<td>Abutilon palmeri</td>
<td>Elizabeth Makings (1317)</td>
<td>Abutilon abutiloides</td>
<td>C. J. S. Davis (Dec 2011)</td>
</tr>
<tr>
<td>Chamaesyce stictospora</td>
<td>Elizabeth Makings (1404)</td>
<td>Chamaesyce prostrata</td>
<td>Liz Makings (June 2012)</td>
</tr>
<tr>
<td>Cyperus odoratus</td>
<td>Elizabeth Makings (569)</td>
<td>Cyperus esculentus</td>
<td>Liz Makings</td>
</tr>
<tr>
<td>Eleocharis parishii</td>
<td>Elizabeth Makinos (1049)</td>
<td>Eleocharis palustris</td>
<td>Liz Makinos</td>
</tr>
</tbody>
</table>
“My Profile”

SEINet Home
- Search Collections
- Imago Library
- Plant Games
- Links

Flora Projects
- Arizona
- Colorado Plateau
- New Mexico
- Intermountain
- NPS Flora
- USFWS Flora
- MABA Flora
- Sonoran Desert
- Teaching Checklists

Dynamic Floras
- Dynamic Checklist
- Dynamic Key

Sitemap

Species Checklists

Management

Checklists
- Sedona/Oak Creek Canyon
- Tent Rocks/Cottonwood Basin area
- Hart Prairie
- San Francisco Peaks
- Verde Valley Botanical Area

Inventory Project Administration
- Arizona Flora
- Colorado Plateau
- Plant Atlas of Arizona Projects (PAPAZ)
- Arizona Native Plant Society Checklists

Create a New Checklist

Checklist Name:
Authors:
Locality:
Plant Atlas of Arizona Project

- Arizona Native Plant Society
- Grand Canyon Trust
- Desert Botanical Garden
- U.S. Forest Service
- Northern Arizona University
- Museum of Northern Arizona
My Profile

SEINet Home
- Search Collections
- Image Library
- Plant Games
- Links

Flora Projects
- Arizona
- Colorado Plateau
- New Mexico
- Intermountain
- NPS Flora
- USFW Flora
- MABA Flora
- Sonoran Desert
- Teaching Checklists

Dynamic Floras
- Dynamic Checklist
- Dynamic Key

Sitemap

Welcome Max Licher!

Logout

My Profile

SEINet
Southwest Environmental Information Network

Species Checklists  Specimen Management  Edit Profile

Management

Checklists
- Sedona/Oak Creek Canyon
- Tent Rocks/Cottonwood Basin area
- Hart Prairie
- San Francisco Peaks
- Verde Valley Botanical Area

Inventory Project Administration
- Arizona Flora
- Colorado Plateau
- Plant Atlas of Arizona Projects (PAPA)
- Arizona Native Plant Society Checklists

Create a New Checklist:
Checklist Name:
Authors:
Locality:

Help
Personal Specimen Management

- Data entry
- Data Management
- Label Printing
- Cloud management
  - Password Protected
  - Web browser
  - Platform independent
  - Globally accessible
  - No special software
- Initially “Observations”
Voucher Network

GenBank #

Original Observation

Physical Specimens

ASC

MNA

Anno 1

Anno 2
Acknowledgments

• National Science Foundation
• Collection managers
• Corinna Gries, Thomas Nash, Nico Franz, Leslie Landrum, Mary Barkworth, Michelle McMahon, Neil Cobb
• Paul Morris, David Lowery, Ben Brandt, Daryl Lafferty
• STRI, Filtered Push, Specify, GeoLocate, iDigBio
• Arizona State University - GIOS and SOLS