



# SEINet: Two Decades of Bio-collaboration Building a North American Specimen Network

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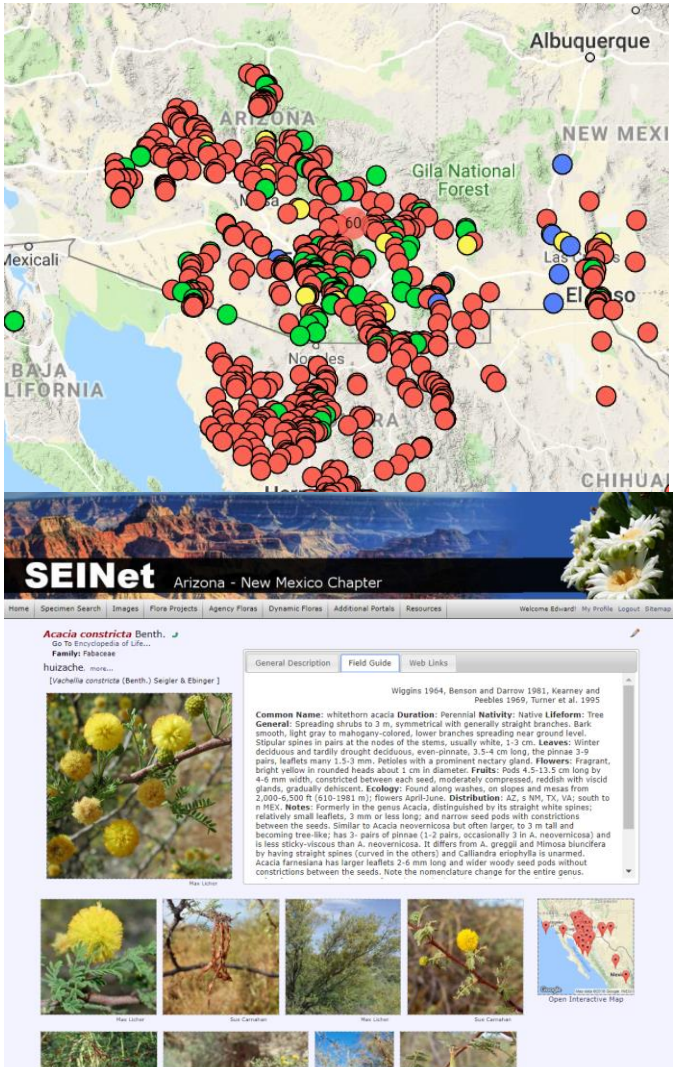
Gil Nelson



National Science Foundation  
WHERE DISCOVERIES BEGIN

# SEINet - 2000 to present

- Vascular plants
- North America
- Virtual flora
  - 13.7M specimens
  - 7.6M images
  - Distribution maps, species lists, keys, descriptions, etc
- Field research, wildlife managers, plant inventories, amateur biologist
- 20,000 / month



The screenshot displays the SEINet Arizona - New Mexico Chapter website. At the top, a map shows the distribution of *Acacia constricta* Benth. with numerous colored dots (red, green, blue, yellow) indicating collection sites across Arizona and New Mexico. Key locations like Albuquerque, Gila National Forest, and El Paso are labeled. Below the map, the SEINet logo and navigation links are visible. The main content area features a detailed species page for *Acacia constricta* Benth., including a photograph of the plant's yellow flowers and a comprehensive description of its morphology, ecology, and distribution. The description notes that it is a spreading shrub to 3 m, with bipinnate leaves and stipular spines. It is found along washes on slopes and mesas from 2,000 to 5,200 ft (610-1,581 m) in Arizona and New Mexico. The page also includes a grid of smaller images showing different parts of the plant and a small inset map of the species' range.

# SEINet version 1.0 - 2000 to 2008

- Southwest Environmental Information NETwork
- JSP, MS SQL
- Distributed specimen DBs
  - ASC, ASU, ARIZ, DES
- Pros: progressive, lightweight
- Cons: connectivity, slow-ish
- NSF-ABI: 2000-2002
  - Peter McCartney, Corinna Gries
  - Grad students: Ed Gilbert, Robin Schroeder
- NSF-BRC: 2003-2008
  - Landrum, McLaughlin, Ayer

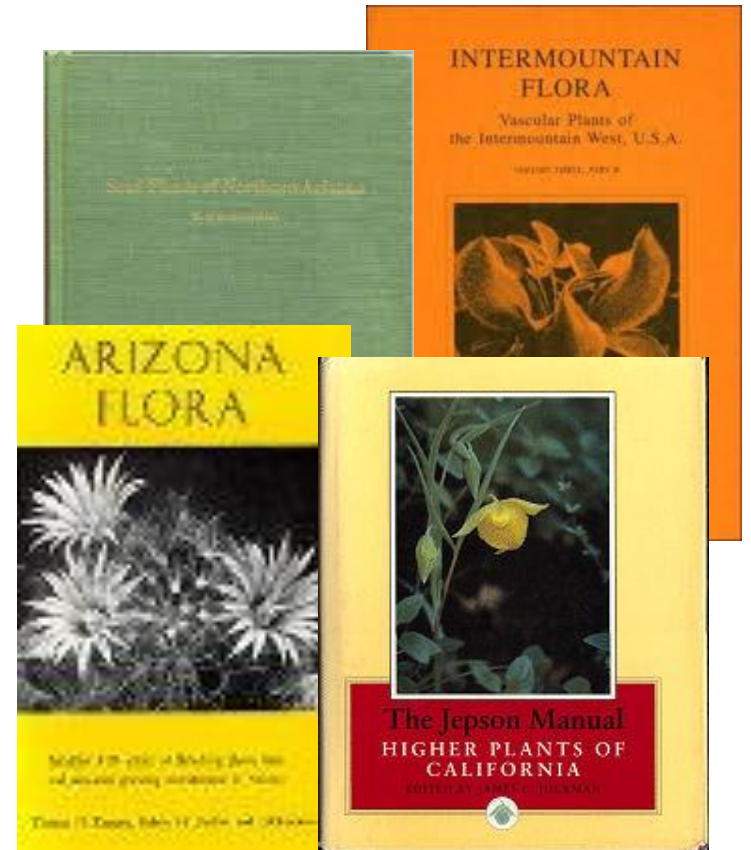
# West Fork of Oak Creek Flora

- Flora and Vegetation of the West Fork of Oak Creek Canyon
- Master thesis
  - 1999-2002
- 10mi N. of Sedona
- Over 500 taxa



# Traditional Floristic Treatments

- Taxonomic information (synonyms, family, vernacular names, etc)
- Descriptions
- Images or illustrations
- Distribution maps
- Identification keys
- Voucher information



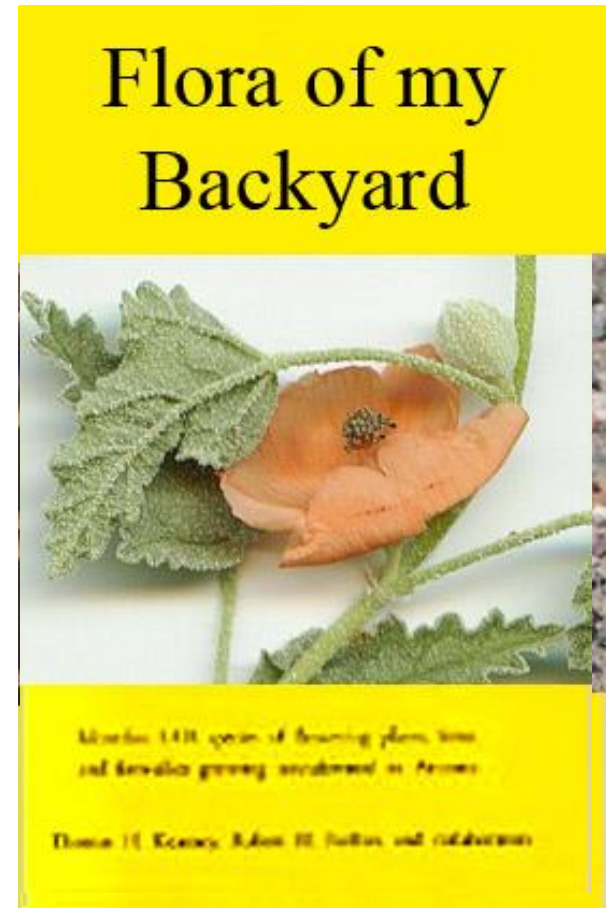
# Virtual Floras / Virtual Herbaria

- Inexpensive
- Numerous
- Images/Illustrations
- Continuously Updatable
- Flexible
- Collaborative Efforts
- A Living Document

The image shows a screenshot of a web browser displaying the 'Flora of North America' website. The browser window title is 'Acourtia wrightii in Flora of North America @ efloras.org - Mozilla Firefox'. The address bar shows the URL 'http://www.efloras.org/florataxon.aspx?flora\_id=1&taxon\_id=250066009'. The website content includes the 'Flora of North America' logo, a search bar, and a navigation menu. The main content area displays the entry for 'Acourtia wrightii' (A. Gray) Reveal & R. M. King, Phytologist, Brownfoot. The entry includes a description of the plant's characteristics, such as 'Plants 30-120 cm. Leaves cau-line; sessile; blades oblong sagittate or clasping, margins dentate to denticulate, faces fimbriate-glandular, apices obtuse to acute, abaxial faces glandular-puberulent; Florets 8-12; corollas pink; pappi bright white, 9-12 mm. 2n = 5'. Below the entry is a 'Related Objects' section. To the right, a 'LIAS - NavKey Module for Identification - Dacampiaceae - Mozilla Firefox' window is open, showing an interactive key for identifying species of Dacampiaceae. The key includes sections for 'Identification', 'Options', and 'About', with a list of 'Character states available' such as 'lifestyle (mandatory)', 'substrate preference', and 'thallus-substrate interaction'. At the bottom of the screenshot, a banner for 'Northern Arizona Flora' is visible, featuring a collage of various plants and the text 'A Photographic, Annotated Catalog of Northern Arizona Vascular Plants'. The banner includes a navigation menu with buttons for 'Home', 'Ferns', 'Gymno-sperms', 'Angiosperms Dicolts', 'Angiosperms Monocots', 'Image Index', 'References', 'Articles', 'Maps', 'Glossary', and 'Links'.

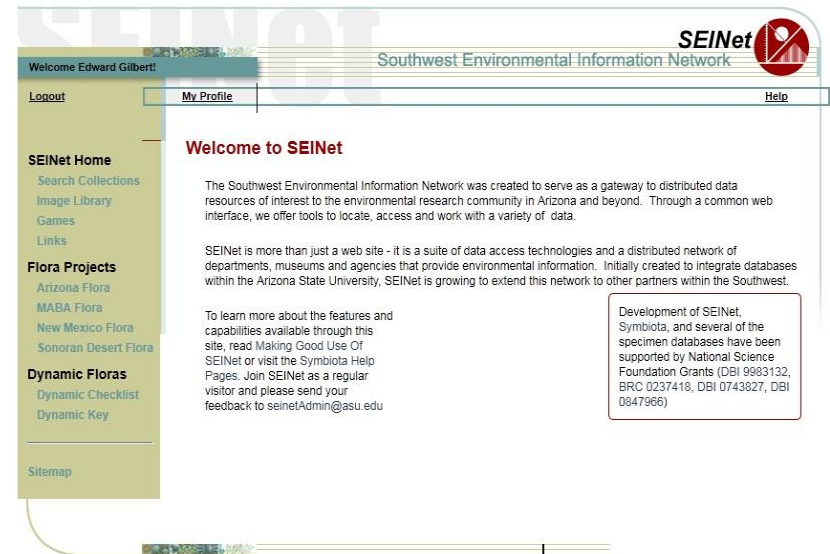
# Potential of Virtual Environment

- Arizona Flora
- Annuals of the Grand Canyon
- Poaceae of Pima Co.
- Asteraceae within 30km of  $34.2^{\circ}$ ,  $-112.4^{\circ}$
- My Backyard Flora



# SEINet version 2.0 - 2008 to 2011

- NSF-ABI: 2008 to 2012
  - Corinna Gries
  - Tom Nash
  - Edward Gilbert
- PHP & JavaScript
- MySQL backend
- Data cache model
  - 30 collections
  - NAVA, DES, USON, URC, UNM...
- Improved connectivity, faster





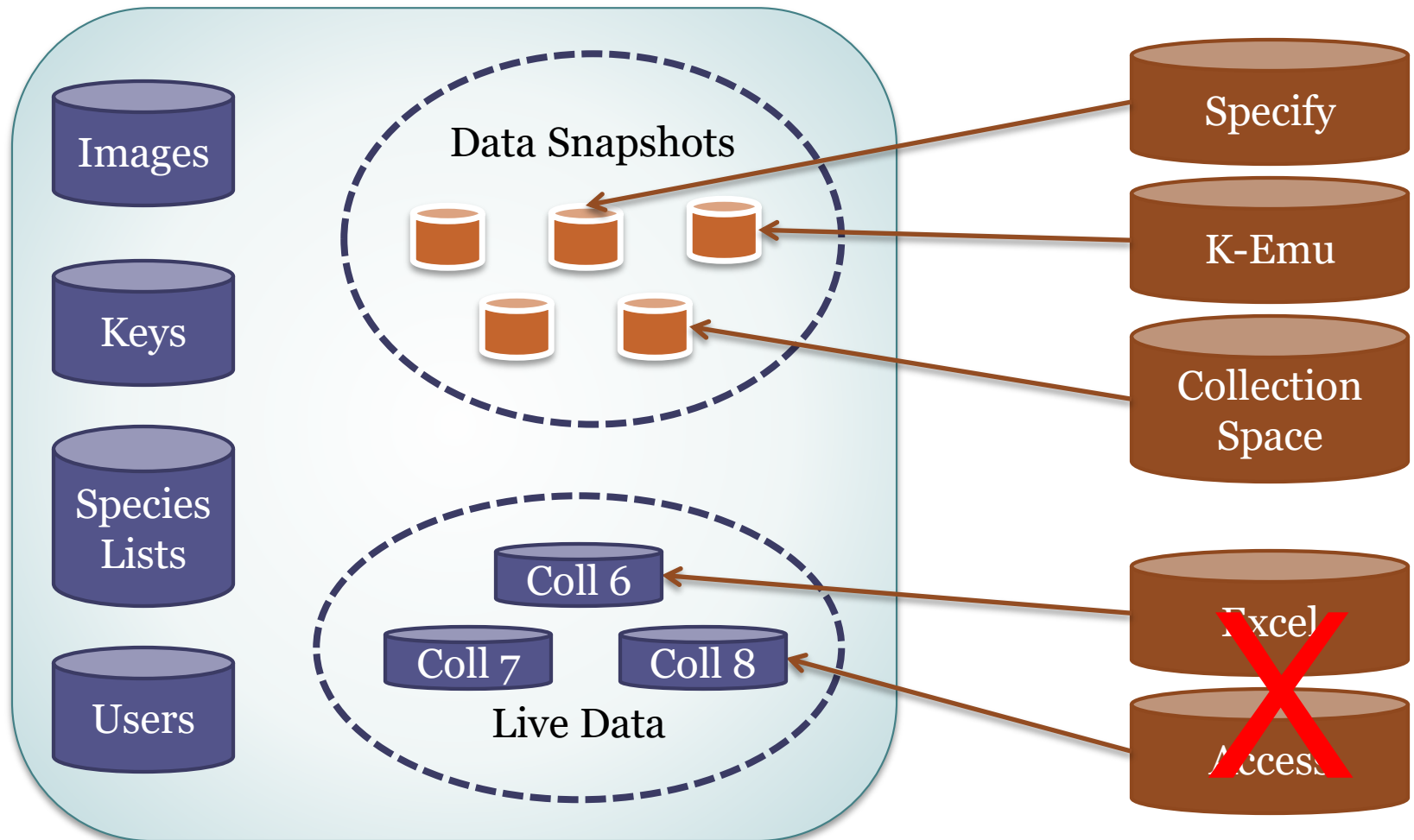
# Content Management System (CMS)

- Read-only user interface
- Password Protected
  - Browser-based application
  - Platform independent
  - Globally accessible
  - No special software installation (free)
  - Make use of web services
  - Data protection (backups)

The screenshot shows a web-based data entry form with the following sections:

- Collector Info:** Includes fields for Catalog Number (1281888), Occurrence ID, Collector, Number, and Date. There is a 'Dupes' button and a section for 'Associated Collectors' and 'Other Catalog Numbers'.
- Latest Identification:** Includes fields for Scientific Name, Author, ID Qualifier, Family, Identified by, and Date Identified.
- Locality:** Includes fields for Country, State/Province, County, and Municipality. There is a 'Locality' text field, a 'Locality Security' checkbox, and fields for Altitude, Longitude, Uncertainty, Datum, Elevation in Meters, and Verbatim Elevation.
- Misc:** Includes fields for Habitat, Associated Data, Description, and Notes.
- Duration:** Includes fields for Type Status, Disposition, Reproductive Condition, Establishment Means, Owner Code, Basis of Record, Preserved Specimen, and Language. There is also a 'Cultivated' checkbox.
- Other:** A section for additional information.

# Publishing: Snapshot vs Live



# Symbiota Software Project

- Darwin Core compliant
- Open source software
- Virtual flora/fauna
  - Specimen search
  - Biodiversity inventories
  - Identification keys
- Images, distribution maps, species descriptions, taxonomy, common names, etc

Smithsonian Tropical Research Institute

Welcome to the Marine Life of Panama portal

We are working to create a single access point for knowledge about the diversity and distribution of marine organisms in Panama generated from over 40 years of marine biology research at STRI. Currently, the portal provides access to specimen records and related geo-spatial data covering fish, algae, marine invertebrates and various other marine taxa (e.g., sea snakes, seagrasses, etc.).

The portal currently includes the ability to create check lists for the entire country or for one of the 4 major marine biogeographic regions (Bocas del Toro and San Blas on the Caribbean coast and the Bay of Panama and Gulf of Chiriqui on the Pacific coast). Georeferenced species records can be displayed on a map with associated observation data. A multilingual glossary tool, TaxaGloss, can be used to clarify the meaning of morphological terms. Soon, we hope to incorporate identification tools like tabular keys.

**Sponge of the Day**  
What is this Sponges?  
Click here to test your knowledge

**Fish of the Day**  
What is this Fish?  
Click here to test your knowledge

**Diadema apillurum**. Image by: Marcos Guerra.

**Agoseris aurantiaca** (Hook.) Greene

Family: Asteraceae  
orange agoseris

**Flora of North America** | General Descriptions

**Gen. l. Based in Fl.**

Stems 0. Leaves erect to decumbent; petioles blades 7-28 cm, linear-lanceolate to oblanceolate, pinnatifid, lobes 2-4 pairs, linear to lanceolate, inconspicuous to subequaling lobes, rarely lacinate, rarely serrate. Peduncles ± elongating after anthesis, margins ciliate, faces glabrous or villous. Involucres 2.5-3 cm at maturity. Phyllaries in 2-3 series, g purple-black spots, blotches, and/or midrib; unequal, margins ciliate, faces glabrous or villous. Receptacles 15-100; corollas usually orange or white, tubes (4-)7-9 mm, ligules 4-12 × 1-3 mm, dimorphic, 8-18 mm, bodies cylindrical to fusiform, gradually tapered to slender bases (2-15-10 mm strongly ridged, straight, glabrous or scabrous 36.

Map data ©2011

Latitude decimal: eg 34.57  
Longitude decimal: eg -112.38  
Scale: 0-14.5 Kilometers

# Symbiota Data Portals

- CMS - biodiversity
- Custom look & feel
  - CSS, config files
- Themed datasets
  - Taxonomic scope
  - Geographic scope
- Community portals
- 30-60 public portals

The screenshot displays the Mycology Collections Portal website. At the top, the title "MYCOLOGY COLLECTIONS PORTAL" is centered. Below the title is a navigation bar with links for Home, Explore, Crowdsourcing, Checklist Projects, Other Resources, and Acknowledgements. A "Log In / New Account / Sitemap" link is also present. The main content area features a "Fungus of the Day" section with a photograph of orange mushrooms and a "What is this fungus?" quiz. To the right, a "News and Events" sidebar lists recent updates, including NSF Press Releases and a MacC record update. At the bottom, there are two "Click here to test your knowledge" buttons.

# SEINet vers. 3.0 - 2011 to present

- NSF-ADBC: 2011 to present
  - 12 of 20 TCN use Symbiota
  - 4 are connected to SEINet
- ASU => iDigBio (UFL) servers
- Biodiversity CMS
- Current statistics
  - 313 collections
  - 13.7 million specimens
  - 216 live datasets (6.5m spec)
  - 7.6 million images
  - 1900+ data managers

# SEINet Regional Portal Networks

- Consortia of regional herbaria
- ~~Southwest Environmental Information Network~~
- 13 Distributed Network
  - SERNEC
  - Mid-Atlantic
  - Midwest / Great Lakes
  - Southern Rocky Mountain
  - NANSH
  - TORCH
  - Northern Great Plains
  - InterMountain

# Digitization Services

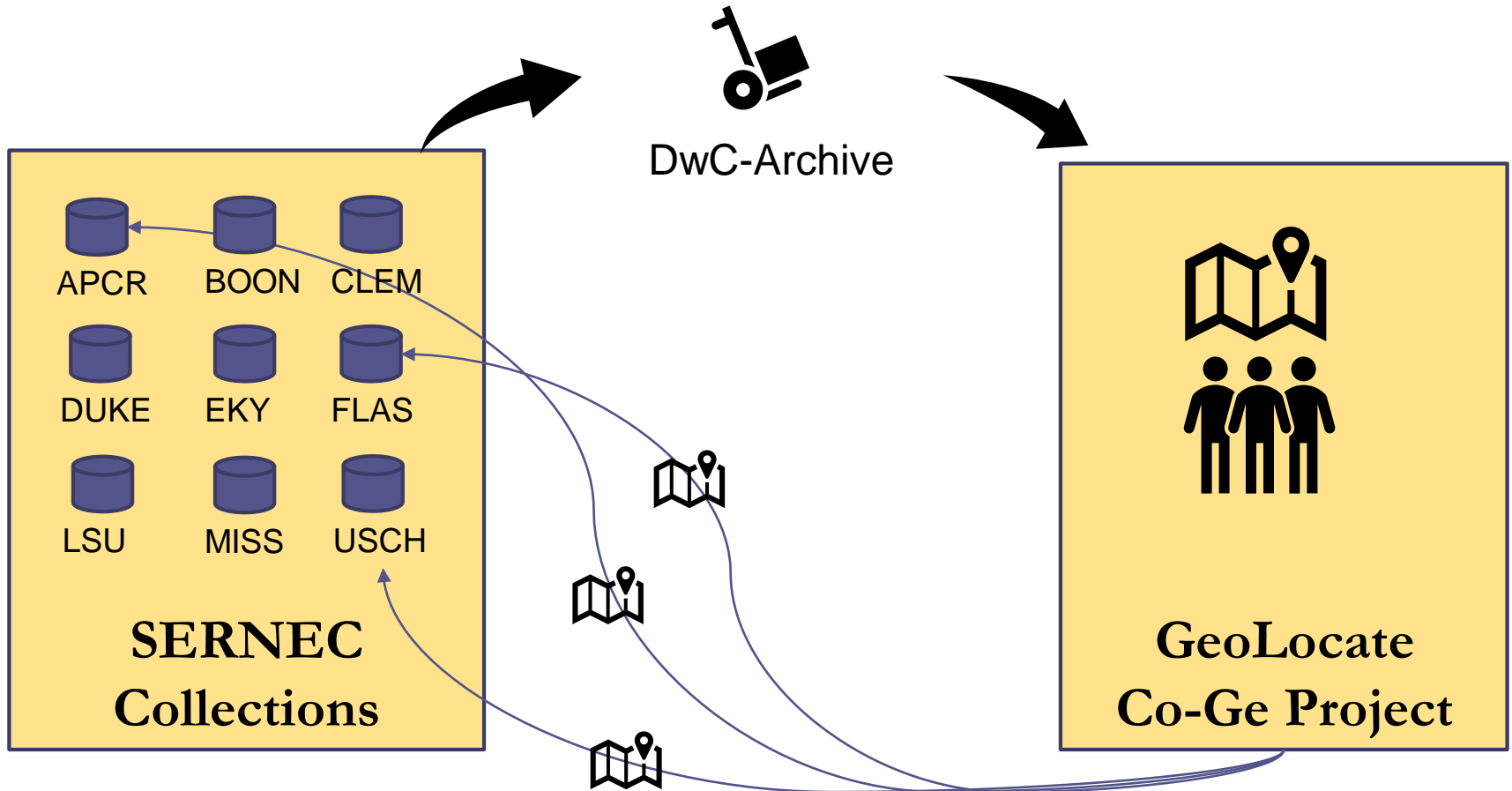
- Exsiccati
- Loan management
- Genetic linkages
- Specimen comments
- OCR / NLP
- Crowdsourcing
- Versioning of edits
- Batch georeferencing
- GeoLocate collaborations
- Darwin Core Archive publishing
- Pensoft publishing
- Duplicate linking
- Vouchered inventories
- Multiple taxonomic thesauri

# SEINet vers. 4.0 - 2018 to...

- Mobilization of specimen data
  - Digitization – specimen and images
  - Open-Data – iDigBio, GBIF
- Interoperability
  - Bi-directional data flow
- Bio-collaboration
  - Field research
  - Regional floras
  - Outreach and education
  - Wildlife managers
- Long-term Sustainability



# GeoLocate CoGe Interoperability



# Support Grassroot Collaborations

- 1900+ data managers
- 1700+ floras/inventories
- 600 checklist editors
  - Jesus Sanchez, Steve Buckley
- 100+ field researcher
- 40,000 field images
- 300+ photographers
  - Patrick Alexander, Max Licher, Sue Carnahan, Liz Making



# Personal Specimen Management

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

General Observations (SEINet)  
Home >> Personal Management >> Editor

Occurrence Data | Determination History | Images | Admin

Collector info  
Catalog Number: 3024 | Other Numbers: | Collector: M. Licher | Number: 3024 | Date: 2011-03-27  
Associated Collectors:

Latest Identification  
Scientific Name: *Medicago minima* | Author: (L.) L.  
ID Qualifier: | Family: Fabaceae  
Identified By: | Date Identified:

Locality  
Country: USA | State/Province: Arizona | County: Yavapai | Municipality:  
Locality: Tent Rocks, SE of Camp Verde, south side of tuff formations  
 Locality Security  
Latitude: 34.496667 | Longitude: -111.748972 | Uncertainty (meters): 10 | Datum: NAD83 | Elevation in Meters: 1030 | Verbatim Elevation: 3370ft  
Verbatim Coordinates: 34° 29' 48.07" N 111° 46' 56.33" W | Georeferenced By: | Georeference Protocol:  
Georeference Sources: | Georef. Verification Status: | Georeference Remarks:

Misc.  
Habitat: Dry wash channel at base of tuff formations in Desert Scrub habitat, with widely scattered junip  
Substrate:

Plants of Arizona  
Scrophulariaceae  
*Castilleja exilis* A. Nels.  
USA, Arizona, Yavapai County, Mesquite Spring, Cottonwood Basin SE of Camp Verde. 34° 29' 02.5" N 111° 46' 16.7" W [NAD83] Elev: 930m. (3040ft)  
Damp bank at spring location, N facing slope. Riparian zone in desert scrub habitat.  
Annual herb, 45 to 65 cm, green bracts with red tips; infrequent  
Associated species: *Solidago altissima*, *Dalea candida*, *Epipactis gigantea*, *Schoenoplectus americanus*, *Toxicodendron rydbergii*, *Mimulus cardinalis*, *Salix laevigata*, *Fraxinus velutina*, *Salix gooddingii*, *Andropogon glomeratus*  
M. Licher 2792 16 July 2010  
Northern Arizona University Herbarium



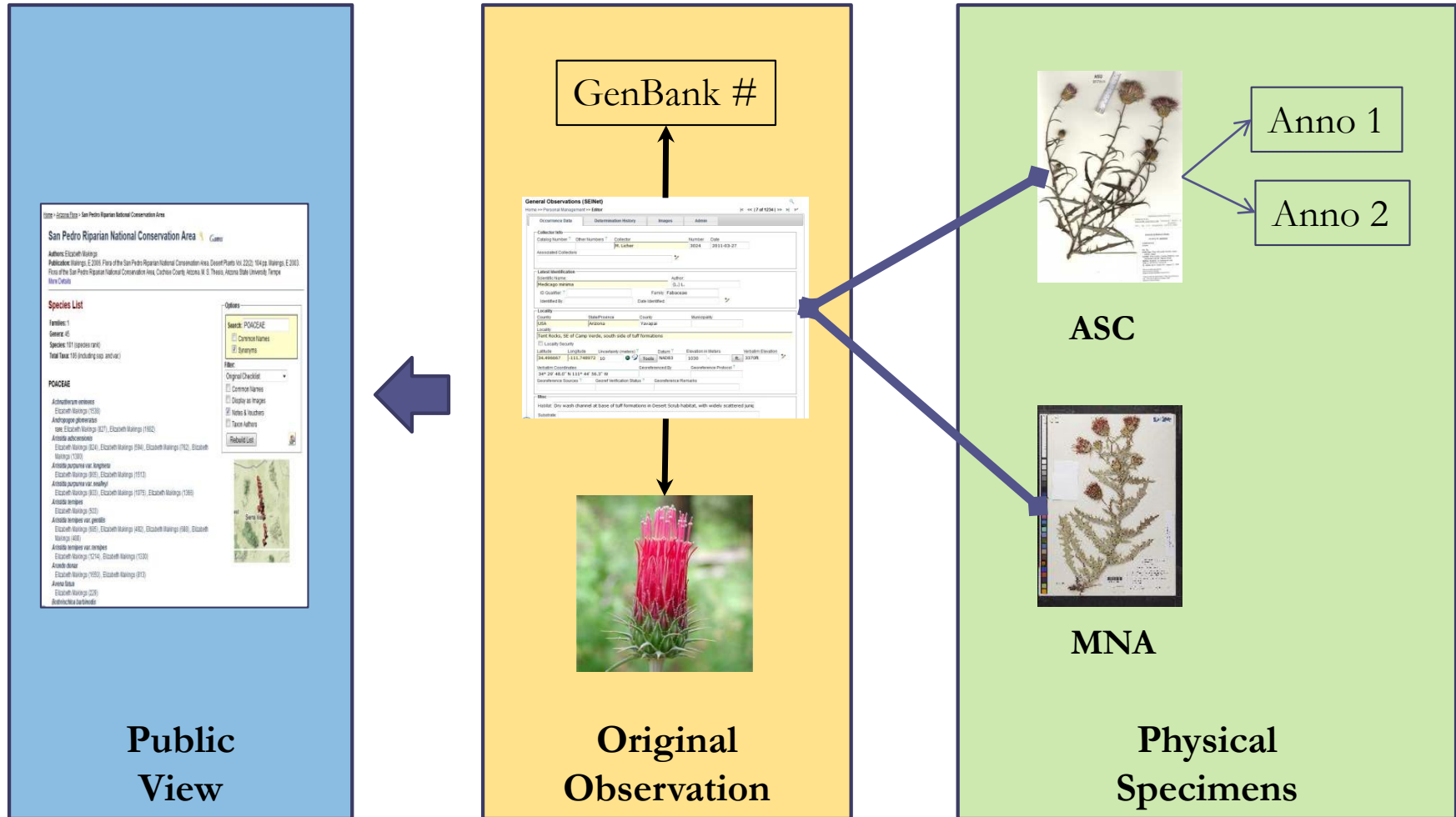
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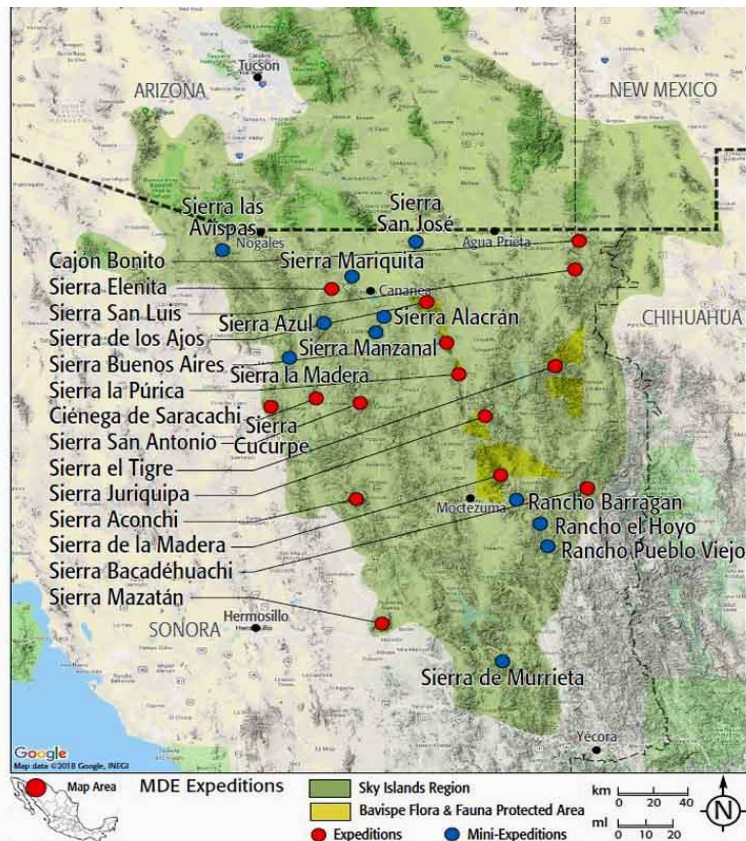


Plants of Arizona  
Poaceae  
*Eragrostis cilianensis* (All.) Vign. ex Janchen  
USA, Arizona, Yavapai County, Confluence of Mesquite and Cottonwood Springs, Cottonwood Basin SE of Camp Verde. 34° 28' 59.2" N 111° 46' 22.1" W [NAD83] Elev: 920m. (3020ft)  
Sandy riparian creek bed without surface water in desert

# Voucher Network



# Madrean Discovery Expeditions



Welcome, and Thank You for Visiting the Madrean Discovery Portal

Flora Database



Click here to access hundreds of thousands of plant records in the Sky Island region, build species checklists, view existing checklists, view species images, and customize taxonomic keys for areas of interest.

Fauna Database



Click here to access hundreds of thousands of animal records in the Sky Island region, build species lists, view existing species lists, and find species images.



# Acknowledgments

- National Science Foundation
  - ADBC and iDigBio
- Herbaria, collection managers
- Regional TCN projects
- Individual content providers
- SEINet Steering Committee
  - Gil Nelson, Ed Gilbert, Leslie Landrum, Anna Monfils, Zack Murrell, Richard Rabeler, Patrick Sweeney, Barbara Thiers
- Arizona State University – GIOS, SOLS, BioKic
- Robin Schroeder, Ben Brandt, etc

