

# American Crossroads

Digitizing the Vascular Flora of the South-Central United States  
Texas Oklahoma Regional Consortium of Herbaria  
(TORCH TCN)

Diego Barroso, Project Manager  
ADBC Summit – September 21<sup>st</sup>, 2021



# South-Central US

- Oklahoma & Texas:

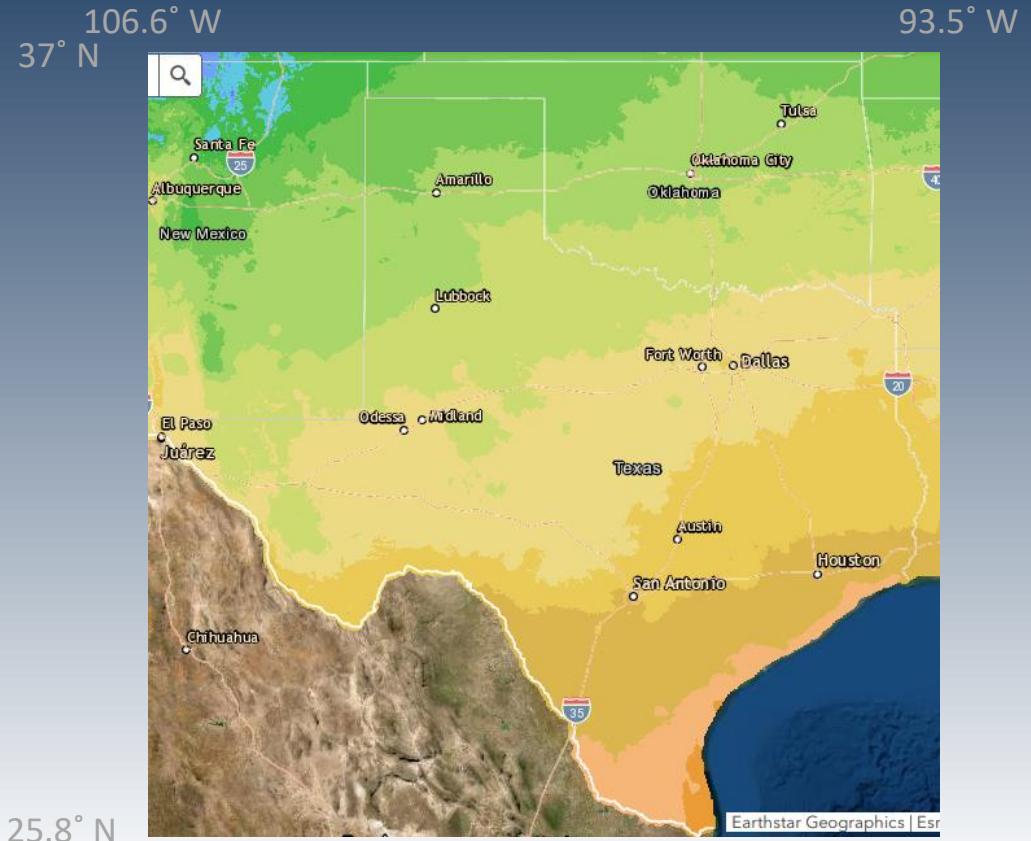
876,859 km<sup>2</sup>

11% of contiguous US

- “Crossroads” of North American ecological and biological diversity (edges of many plant species distributions)
- Key to understanding continent-wide patterns of biome evolution

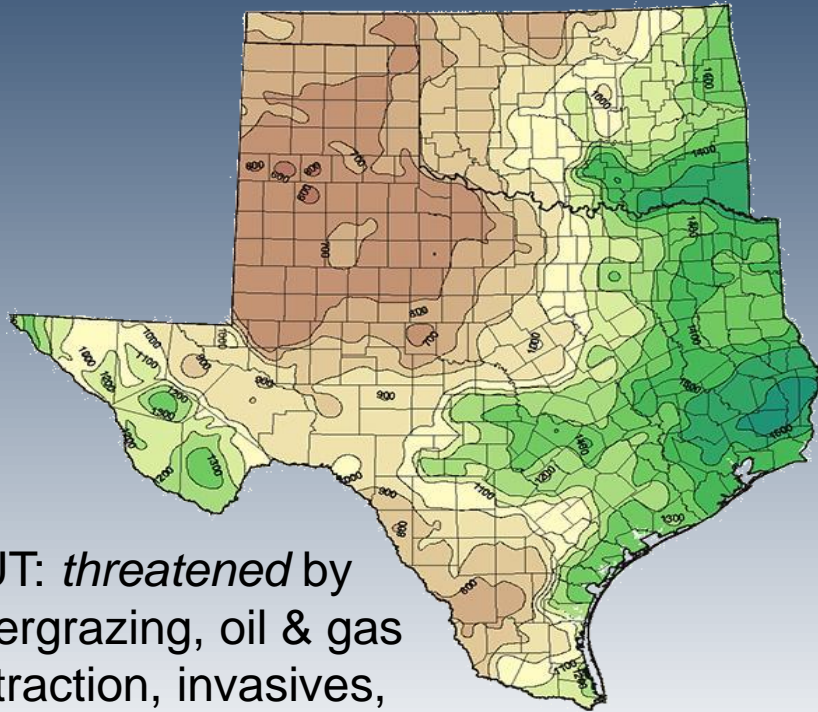
# Environmental Gradients

- 4 EPA Level-I Eco-regions & 17 Level-III Eco-regions
- 9 USDA plant hardiness half-zones (6a-10a)



# Plant diversity

- 4945 native vascular plant species
- 31% of all native plant species in the U.S. & Canada



BUT: *threatened* by overgrazing, oil & gas extraction, invasives, urbanization, etc.

[www.bonap.org](http://www.bonap.org)

# TORCH TCN

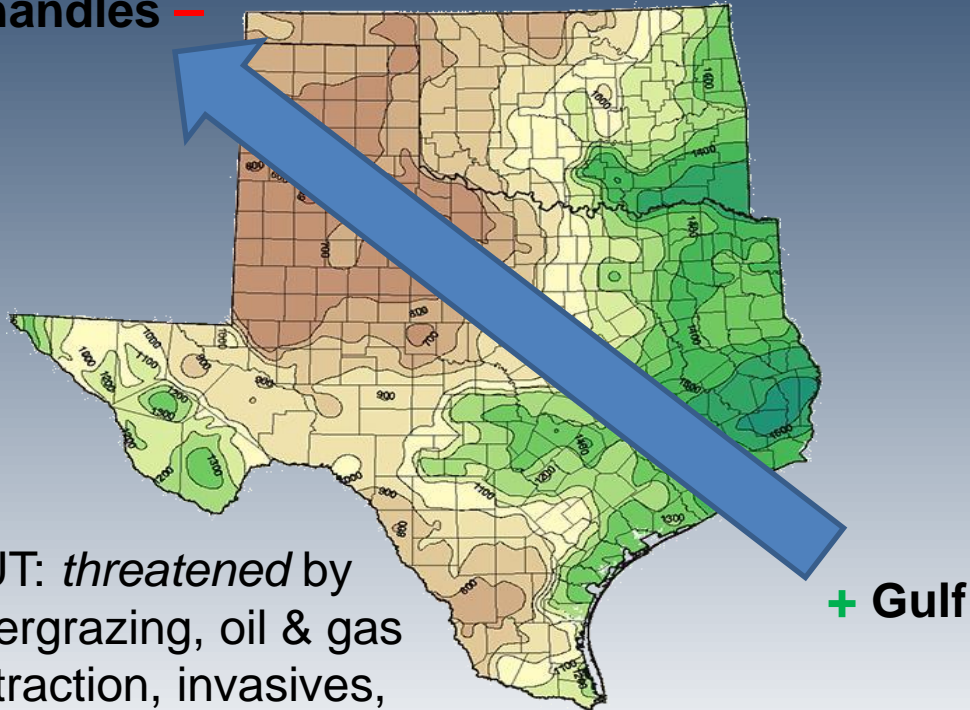
## Research Hypotheses

- Geographic patterns in phylogenetic diversity:
  - Diversity will decline with increasing latitude (tropical lineages drop out) and decreasing precipitation
- Vegetation responses to climate change will be large and species-specific

# Plant diversity

- 4945 native vascular plant species
- 31% of all native plant species in the U.S. & Canada

Panhandles —



BUT: *threatened* by overgrazing, oil & gas extraction, invasives, urbanization, etc.

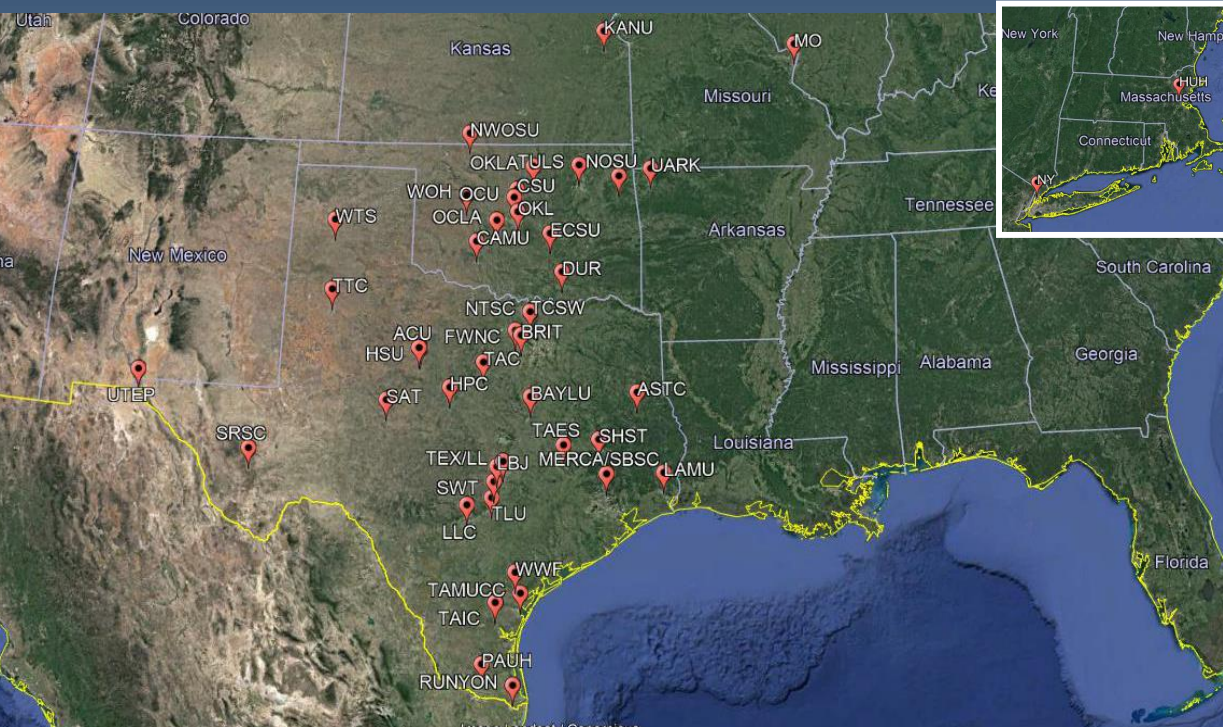
www.bonap.org

# TORCH TCN

## Research Hypotheses

- Geographic patterns in phylogenetic diversity:
  - Diversity will decline with increasing latitude (tropical lineages drop out) and decreasing precipitation
- Vegetation responses to climate change will be large and species-specific

# TORCH TCN: Documenting the plant diversity of Texas & Oklahoma



- 4-year grant to digitize almost 2 million specimens collected within our 2 states.
- 1.7 million of these from 41 TORCH herbaria, and 0.3 million from 5 herbaria outside OK & TX (plus U.S. National Herbarium).

# TORCH TCN Organization

5 collaborative leads (L), 10 subawards (S), 31 data providers



BRIT (L)

P.I. Fritsch\*

I.C. Rehman\*

T.I. Best\*

BAYLU (S)

SHST (S)

TTC (S)



OKL (L)

P.I. Moore\*

P.I. Hoagland\*

MO (S)

NOSU (S)



OKLA (L)

P.I. Fishbein\*

D.M. Barrett\*

NY (S)

KANU (S)



TAES (L)

P.I. Spalink\*

HUH (S)

TAMUCC (S)



TEX-LL (L)

P.I. Yatskievych\*

I.C. Horning\*

UTEP (S)

(\* + P.M. Barroso) = TORCH Executive Committee with ~ monthly meetings

# TCN Objectives

- To disseminate digitized specimen data through our Symbiota portal <http://portal.torcherbaria.org>
- Develop, implement, and share innovative strategies to increase workflow efficiency (emphasis on automation)
- To recruit and engage students and citizen scientists in project-based broader-impact activities

# TORCH Web Portal

<https://portal.torcherbaria.org>

**TORCH**

The Texas Oklahoma Regional Consortium of Herbaria

[Home](#) [Search](#) [Images](#) [Checklists & Floras](#) [Interactive Tools](#)

[Log In](#) [New Account](#) [Sitemap](#)

## Welcome to TORCH Data Portal

The Texas Oklahoma Regional Consortium of Herbaria (TORCH) was developed to advocate for and to organize approximately 4 million plant specimens across more than 50 herbaria in the two-state region. Learn more about TORCH and its members at [torcherbaria.org](http://torcherbaria.org).

The TORCH data portal provides access to specimen data and associated images from our herbaria to facilitate botanical research for the purpose of conservation, management, and education. This is an open access portal powered by Symbiota ([symbiota.org](http://symbiota.org)). Our data records are aggregated by iDigBio ([idigbio.org](http://idigbio.org); the National Resource for Advancing Digitization of Biodiversity Collections, funded by the National Science Foundation). New records are made available as specimens are digitized (imaged, databased, and georeferenced) by participating herbaria. If you are interested in assisting with digitization efforts, please contact the appropriate curator or collections manager.

To learn more about the features and capabilities of the Symbiota software used by this portal, visit the [Symbiota Help Pages](#).

Search Taxon

Search



HIDE CAPTION

*Asclepias brachystephana*. Image by: Patrick Alexander.



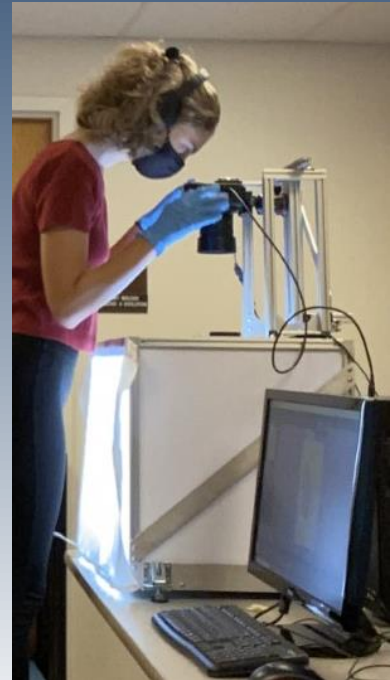


# TORCH Innovations – Imaging Station

- Custom LED lightbox and camera stand developed by Jason Best, TORCH Technological Innovator.
- To date, 7 light boxes have been built & delivered (2 to be itinerant)



J. Best and D. Rivas assembling lightbox at BRIT (pre-COVID)



Lightbox in use by S. Hubbard at OKLA

# Users → TORCH DigiHub → TACC

- Start with Nextcloud on Synology NAS
- Use current TACC scripts, but locally (allowing for cron jobs, root permissions) to:
  - 1) Create JPG derivatives
  - 2) Sort all images into folders
  - 3) Generate URL csv for linking to Symbiota (manually)

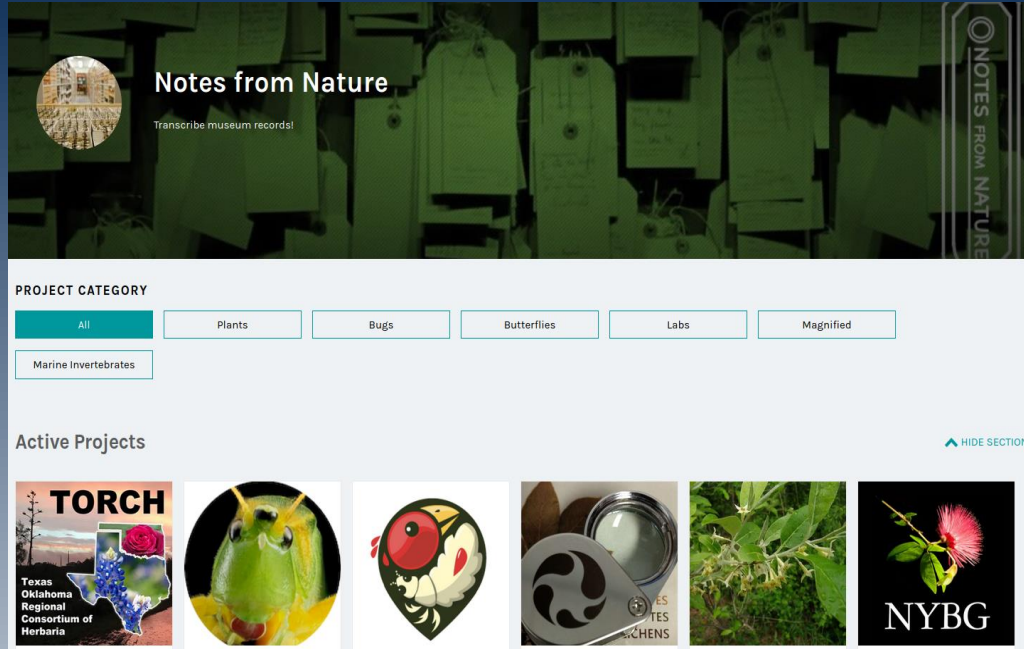
Funding available to hire a full-stack developer for ~9 months, to lay groundwork and build basic product, which can continue to be enhanced over time.

A user upload via Filezilla or browser (drag-n-drop) will trigger:

- 1) QC: checks image quality, filenames (barcodes), pairs
- 2) Creates web derivatives, sorts, generates URLs
- 3) Pushes images to TACC storage at TEX
- 4) Logging (Db) & reporting

**Goal: a distributable Docker image or VM appliance that the community can download and use locally.**

# TORCH Community Engagement & Broader Impacts



- After WeDigBio Lite (April 2020), **started weekly #ArmchairBotanist sessions** to engage volunteers
- Now, **1733 registered volunteers** & 16 Expeditions (15 BRIT & 1 OKLA (Plant Ecology course), with plans for TAES Agrostology course. **Volunteers have completed 39k subjects (32k in YR 2).**

- Statewide organizations: Master Naturalists, Master Gardeners, and native plant societies
- Incentives: volunteer hours for certification; interaction with researchers and institutions; acknowledgment by community; opportunities for remote work (especially during COVID-19).
- Better accuracy in data transcription, and valuable “boots-on-the ground” experience (georeferencing, e.g.)

# TORCH Summer Internship 2022



- 8 to 10-week Digitization Internships for 16-20 undergraduate students (COVID permitting):
- 70% digitization, 20% research project, 10% enrichment activities and networking
- Projects to be taxon-based or delimited by geographic area, and presented (poster session) at TORCH meeting August 8<sup>th</sup>, just prior to TPCC 2022 at BRIT (Aug. 9<sup>th</sup> & 10<sup>th</sup>)

# During TORCH Year 2...

- 89 people across 15 different institutions contributed at least 1 person-month's worth of work to the TORCH TCN.
- 393,000 specimens imaged
- 162,000 new specimen records (120,000 full + 42,000 skeletal)
- 126,000 records georeferenced
- 24 of 46 participating institutions have a presence on the TORCH Symbiota Portal, contributing 1.1 million records from TX and OK (3.75 million total). For TX & OK records, 48% have images and 29% have coordinates.
- 8 publications + 1 in review; 19 presentations & posters (J. Rodriguez (TAMUCC) won GERS Undergrad Presentation Award).

# Thank you! to:



National Science Foundation



Integrated Digitized Biocollections

Lead and Subaward PIs

Staff and Student Digitizers

Volunteers

Symbiota, NfN/Biospex, WeDigBio

**Baylor University (BAYLU)**  
Robert Doyle, Professor, Dept. of Biology  
Joseph White, Professor, Dept. of Biology

**Botanical Research Institute of Texas (BRIT)**  
Diego Barroso, TORCH TCN Project Manager  
Jason Best, Director of Biodiversity Informatics  
Peter Fritsch, Vice President of Research;  
Director of the Herbarium  
Tiana Rehman, Collections Manager

**Harvard University (HUH)**  
Charles Davis, Professor, Dept. of Organismic  
and Evolutionary Biology; Director, Harvard  
University Herbaria

**Missouri Botanical Garden (MO)**  
James Solomon, Curator of Vascular Plants

**The New York Botanical Garden (NY)**  
Barbara Thiers, Vice President for Science  
Administration; Director, Steere Herbarium

**Northeastern State University (NOSU)**  
Elizabeth Waring, Assistant Professor, Dept. of  
Biology

**Oklahoma State University (OKLA)**  
Mark Fishbein, Professor and Herbarium  
Director, Dept. of Plant Biology, Ecology, and  
Evolution

Clay Barrett  
TORCH TCN Data Manager

**Sam Houston State University (SHST)**  
Justin Williams, Professor and Curator,  
Dept. of Biological Sciences

Will Godwin, Professor Emeritus, Dept. of  
Biological Sciences

**Texas A&M University-College Station (TAES)**  
Daniel Spalink, Assistant Professor; Director  
of the Tracy Herbarium

**Texas A&M University-Corpus Christi (TAMUCC)**  
Barnabas Daru, Assistant Professor, Dept. of  
Biology; Director of the Ruth O'Brien  
Herbarium

**Texas Tech University (TTC)**  
Matt Johnson, Assistant Professor, Dept. of  
Biological Sciences; Director, Reed Herbarium

**University of Florida (FLAS)**  
Rob Guralnick, Associate Curator, Dept. of  
Natural History

**University of Kansas (KANU)**  
Craig Freeman, Scientist, Kansas Biological  
Survey; Senior Curator, McGregor Herbarium

**University of Oklahoma (OKL)**  
Abigail Moore, Assistant Professor and  
Curator, Bebb Herbarium, Dept. of  
Microbiology and Plant Biology

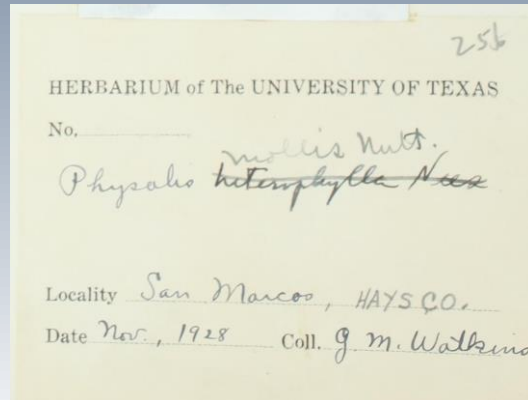
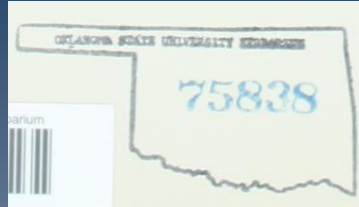
Bruce Hoagland, Professor, Coordinator of the  
Oklahoma Natural Heritage Inventory, Dept. of  
Geography and Environmental Sustainability

**University of Texas at Austin (TEX/LL)**  
George Yatskievych, Curator and Lecturer,  
Plant Resources Center, Dept. of Integrative  
Biology

Amber Horning, Collections Manager

**University of Texas at El Paso (UTEP)**  
Michael Moody, Associate Professor,  
Department of Biology; Co-curator, UTEP  
Herbarium

# TORCH Innovations – Computer Vision for object detection and data extraction (linking legacy databases)



- Tensorflow Model trained on ~50 images per herbarium stamp
- Finds Accession Stamp and Number, barcode, Main Label, Annotation Labels
- OVPD: 380k records; TAES: 233k records

Developed by TORCH Data Manager Clay Barrett at OKLA