Fishes of Texas Project: update and future

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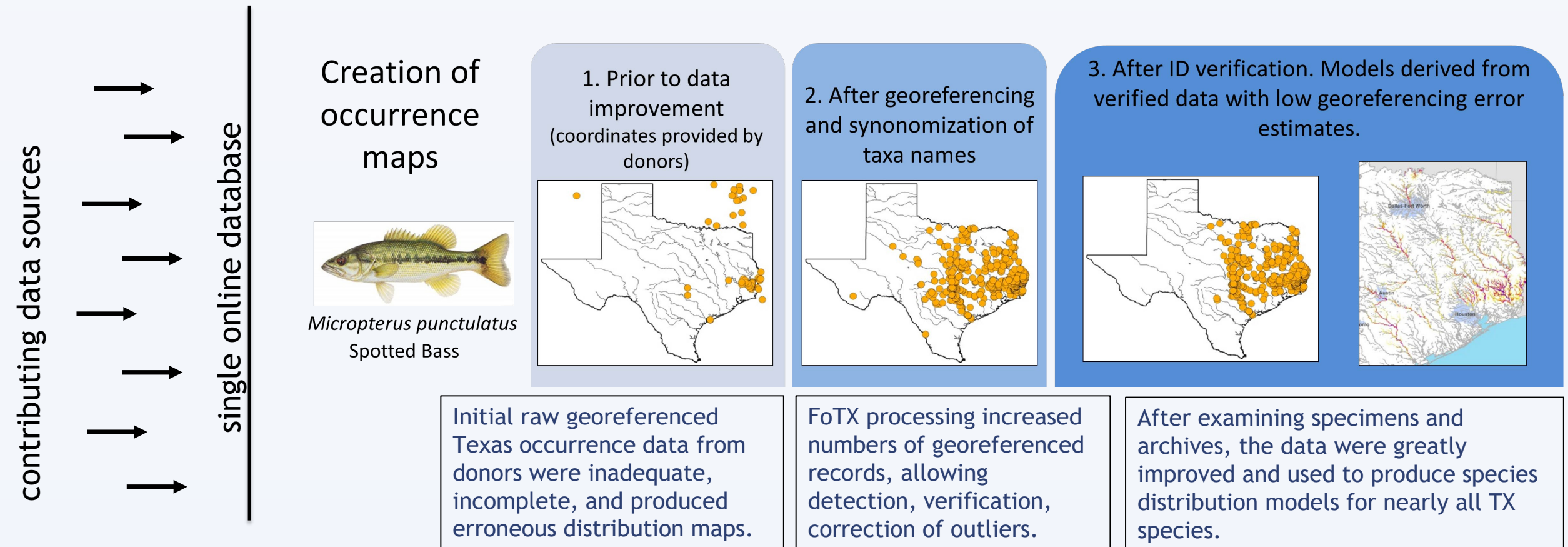
www.fishesoftexas.org

WHAT IS FISHES OF TEXAS?

Fish occurrence data are widely scattered and mostly not published as data readily utilizable by computers. Global biodiversity aggregating services (e.g. GBIF, iDigBio, Fishnet) now aggregate and serve whatever data are submitted to them in the standard Darwin Core format, but their data are often replete with errors, minimally normalized, lacking content across standard fields, and served via generic mapping services lacking linkages to local and aquatic ecology-relevant resources (i.e., for fishes, they are ignorant of hydrography). In contrast, Fishes of Texas (FoTX) includes the same data and much more, including unpublished data from more diverse sources. FoTX's rigorous quality-control measures, including specimen-based ID verifications, checking of legacy georeferencing, and flagging suspicious records has combined to greatly reduce errors. The custom FoTX website provides interactive exploration and data summarization, within the context of geopolitical and, now geographically-expanded hydrographic coverages, thus facilitating visualization and discovery of conservation-relevant histories and trends over time. The site allows viewing of derivative products, such as niche models, estimates of native ranges, checklists, data dashboards, and Native Fish Conservation Areas. The site also serves extensive image collections, collectors' field notes, and links to digitized, formerly inaccessible unpublished agency reports. Finally, core FoTX data fields are also published to GBIF as Darwin Core to make it available to the world.

PAST (ORIGINAL VERSION)

Case study of FoTX data processing

Creation of occurrence maps

1. Prior to data improvement (coordinates provided by donors)
2. After georeferencing and synonomization of taxa names
3. After ID verification. Models derived from verified data with low georeferencing error estimates.

Micropterus punctulatus Spotted Bass

Initial raw georeferenced Texas occurrence data from donors was inadequate, incomplete, and produced erroneous distribution maps.

FoTX processing increased numbers of georeferenced records, allowing detection, verification, correction of outliers.

After examining specimens and archives, the data were greatly improved and used to produce species distribution models for nearly all TX species.
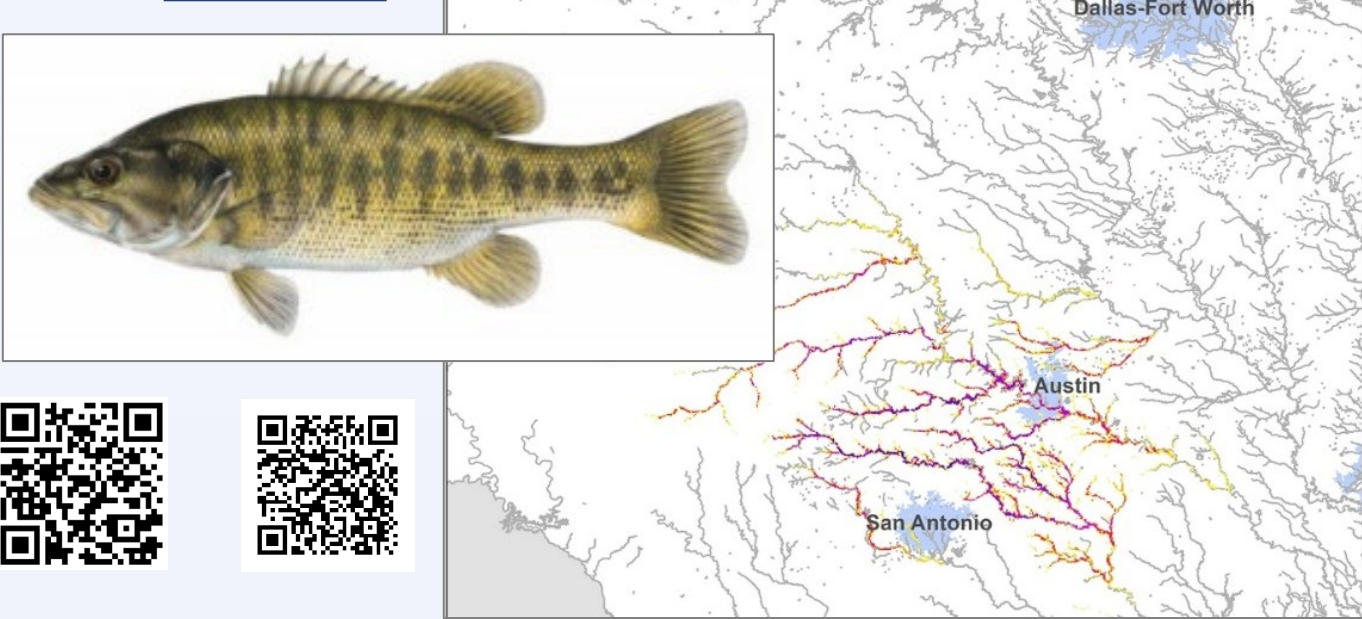
FoTX website links to all products and data directly produced by the project, all permanently archived with DOIs in the globally indexed UT Digital Repository.
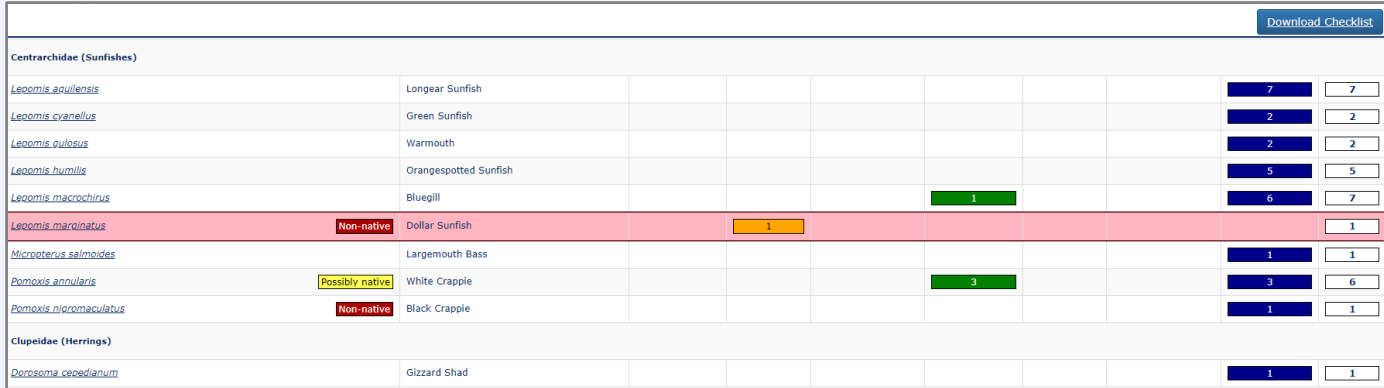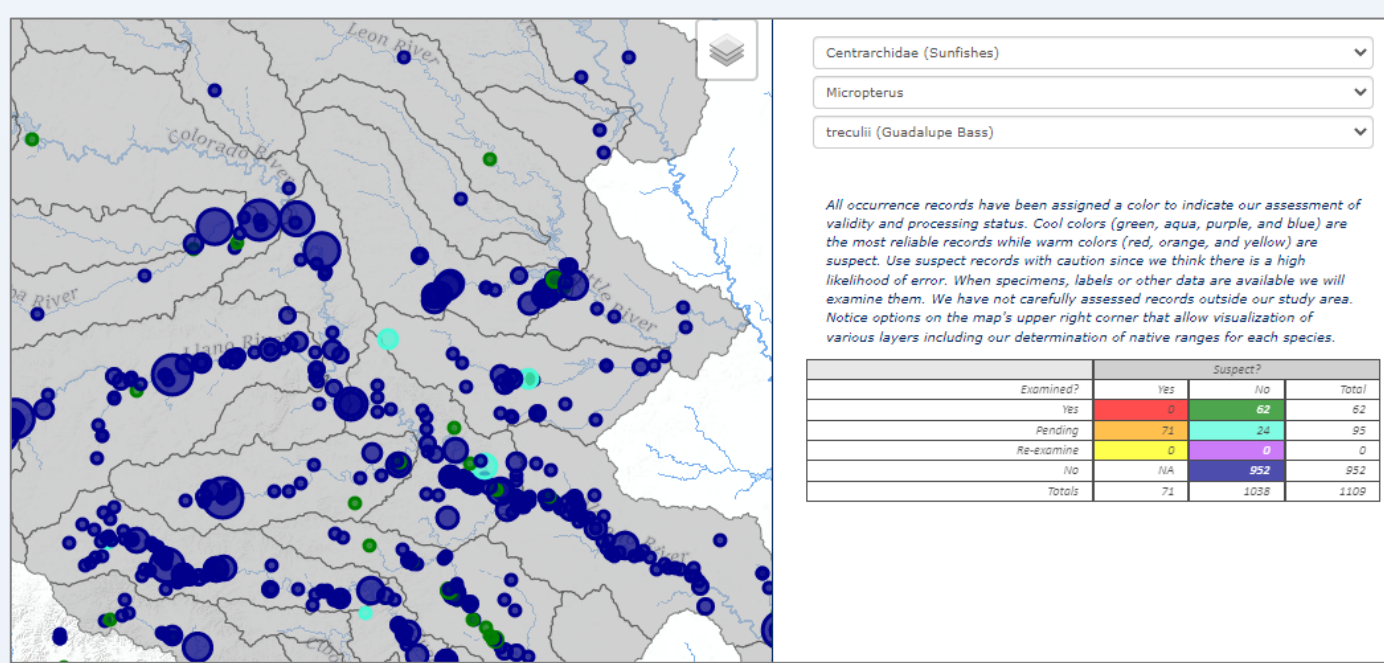
Native Ranges (new version shown)

Macrhybopsis tetranema (Peppered Chub)

Models
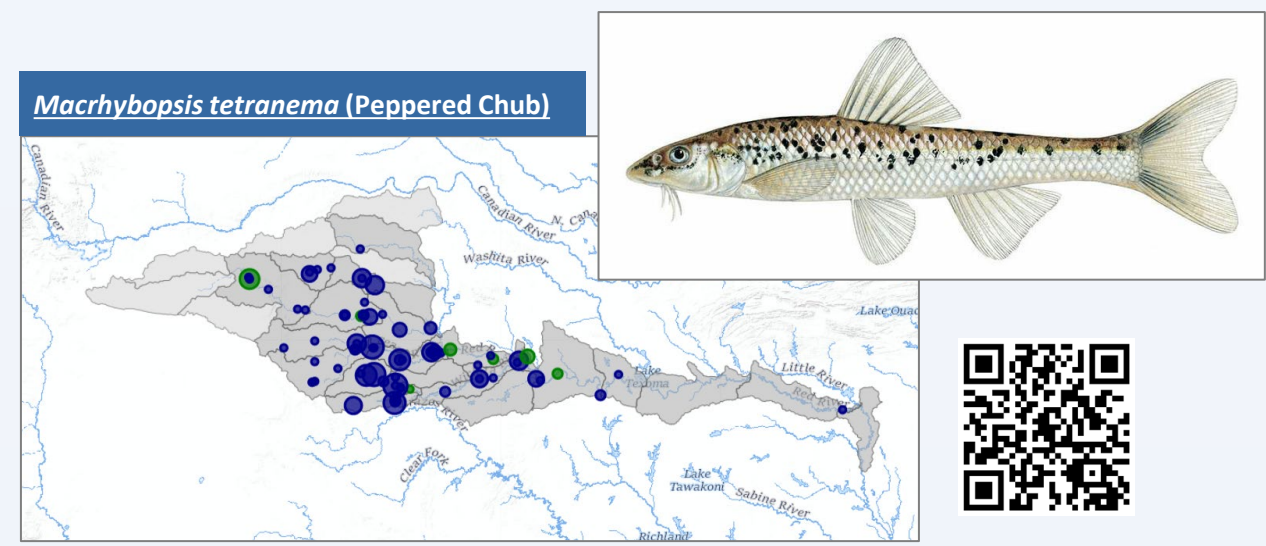
Micropterus treculii (Guadalupe Bass)

Regional/Hydrological Checklists (new version shown)

Occurrence Data with Map Viewer (new version shown)

Uses in Conservation and Research

Bioassessment:

Conservation Assessment:

Climate Change:

Discoveries:

Native Fish Conservation Areas:

New major basin range extensions

- New state records, e.g.: *Campostoma spadiceum*, *Notropis boops*, *Pimephales notatus*, *Ictiobus cyprinellus*, *Moxostoma albidum*, *M. duquesnei*, *Prietella phreatophila*
- Confirmation of occurrences not previously rigorously documented in Texas, e.g.: *Ictiobus niger*, *Moxostoma* spp.
- Documentation of the spread of recent non-natives, e.g.: *Xiphophorus variatus*, *Lucania goodei*, *Gobiosoma bosc*
- >33 species occurrences in major river basins where previously undocumented (see some examples in table to right)

Data Dashboards | Hubbs et al. ID Keys | Search Grey Literature (pdfs)

ACKNOWLEDGEMENTS

Though external funding recently ended, internal support from UT since 1998 continues:

Former sponsors of FoTX included:

TEXAS PARKS & WILDLIFE PROUD PARTNER | TCEQ | U.S. FISH & WILDLIFE SERVICE | Great Plains Landscape Conservation Cooperative | Desert Landscape Conservation Cooperative

BIODIVERSITY CENTER and TEXAS ADVANCED COMPUTING CENTER of THE UNIVERSITY OF TEXAS AT AUSTIN

And many hundreds of individuals contributed specimens, data, expertise, corrections, images, illustrations, etc.
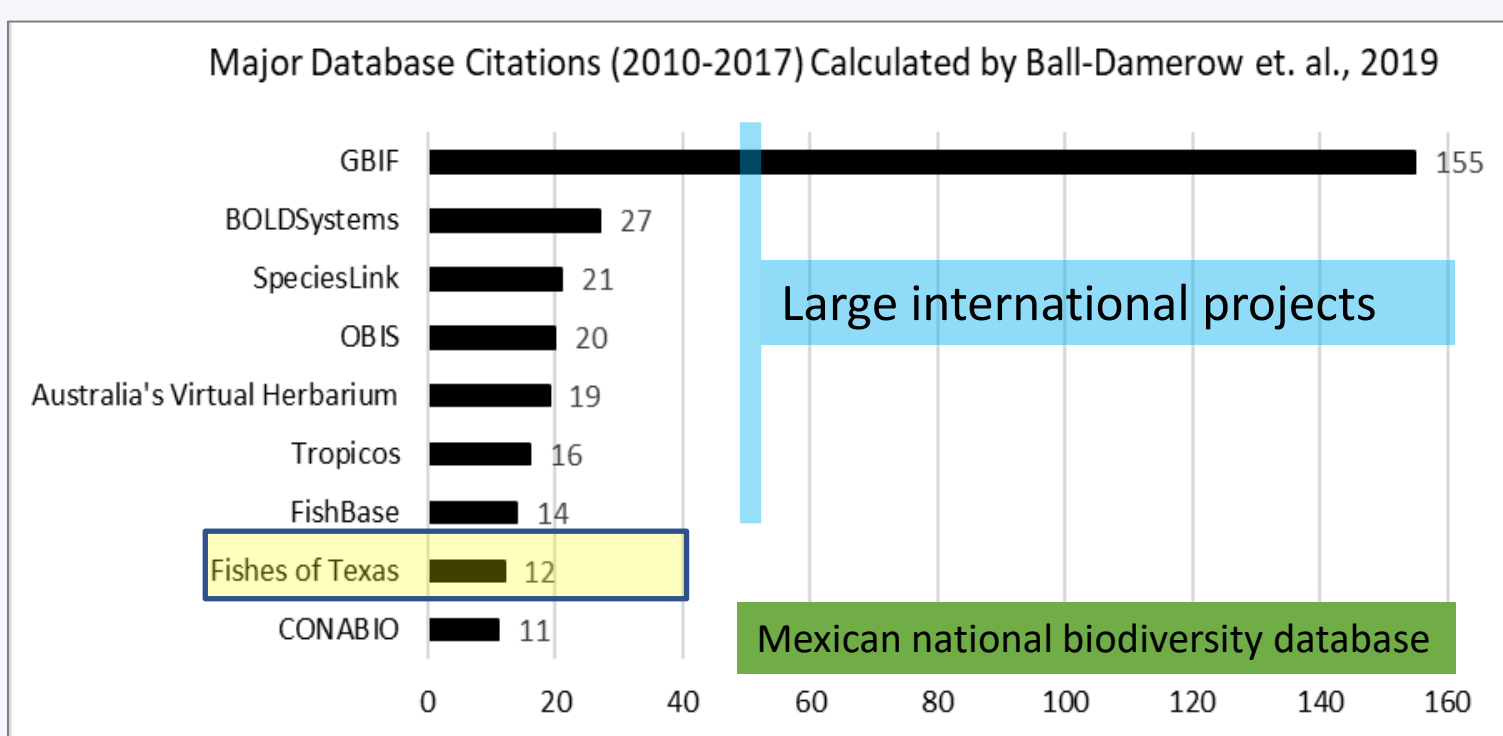

PRESENT (NEW VERSION)

DATA DISSEMINATION

FoTX data are being widely utilized.

	Averages 2020-2022
Included in GBIF downloads	2,742 annually
FoTX annual website visits	7,666 (77% from new users)
FoTX daily website visits	21
Google Scholar citations estimate	218 annually
Registered users	1,057 currently

FoTX data are now included in at least:

iDigBio	USGS Nonindigenous Species Database
Map of Life	TPWD NDD
Encyclopedia of Life	Nature Serve dashboard
Fish Map	SARP's Connectivity Tool

FoTX was 8th ranked in a 2019 _global_ analysis of 347 primary biodiversity research databases

Major Database Citations (2010-2017) Calculated by Ball-Damerow et. al., 2019

Large international projects

Fishes of Texas 12

Mexican national biodiversity database

Ball-Damerow JE, Brenskelle L, Barve N, Soltis PS, Sierwald P, Bieler R, et al. (2019) Research applications of primary biodiversity databases in the digital age. PLoS ONE 14(9): e0215794. https://doi.org/10.1371/journal.pone.0215794 (Image adapted from this study.)

MAJOR UPDATES

Work on cleaning both old and new data has continued. Since the previous version, we examined another 975 specimens, georeferenced or re-georeferenced another 17,156 records, and added 6,123 more specimen images (now 16,126 total images). FoTX now has 7 times more georeferenced occurrences than the previous version (including 3 times more from Texas freshwaters).

The figures below show numbers of records in the new version by both data type and institution type in the new version.

Numbers of records by data types

Numbers of records by types of contributing institutions
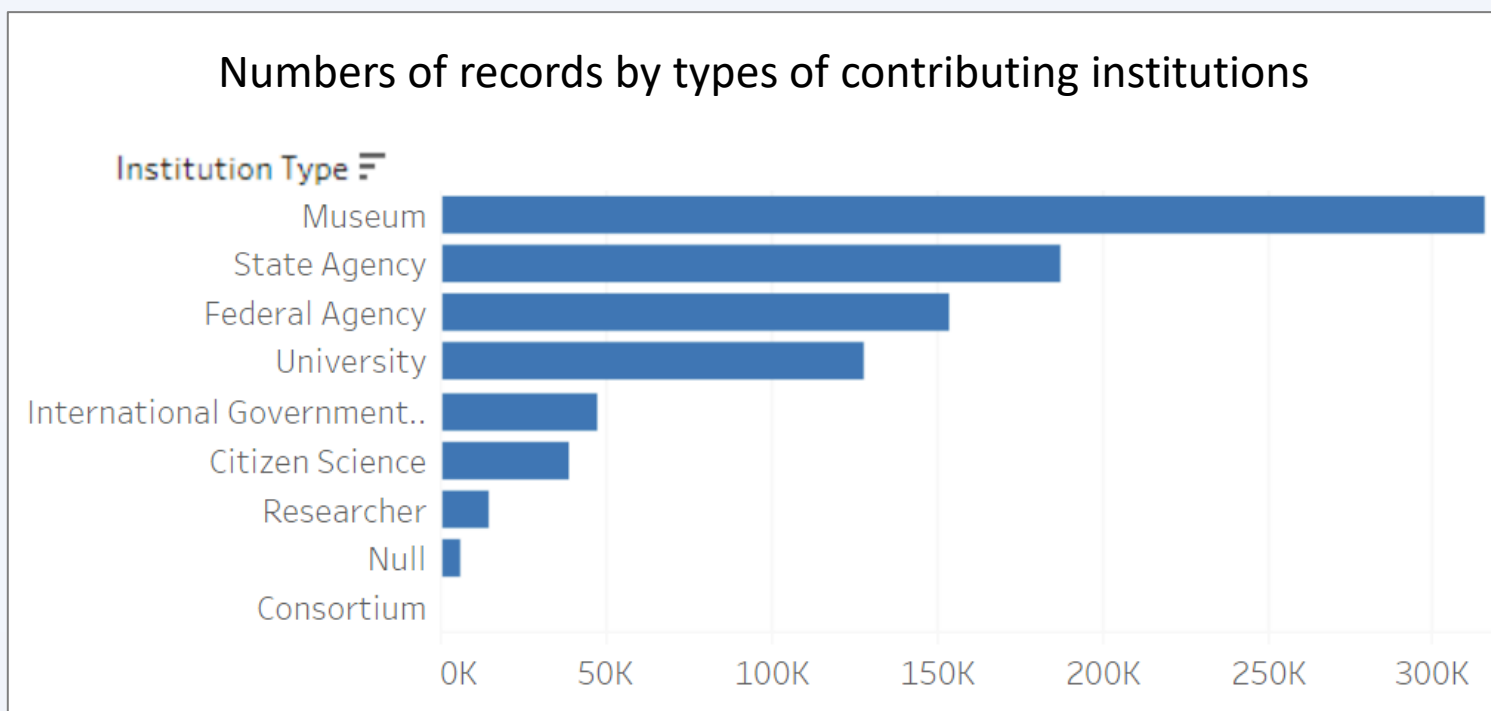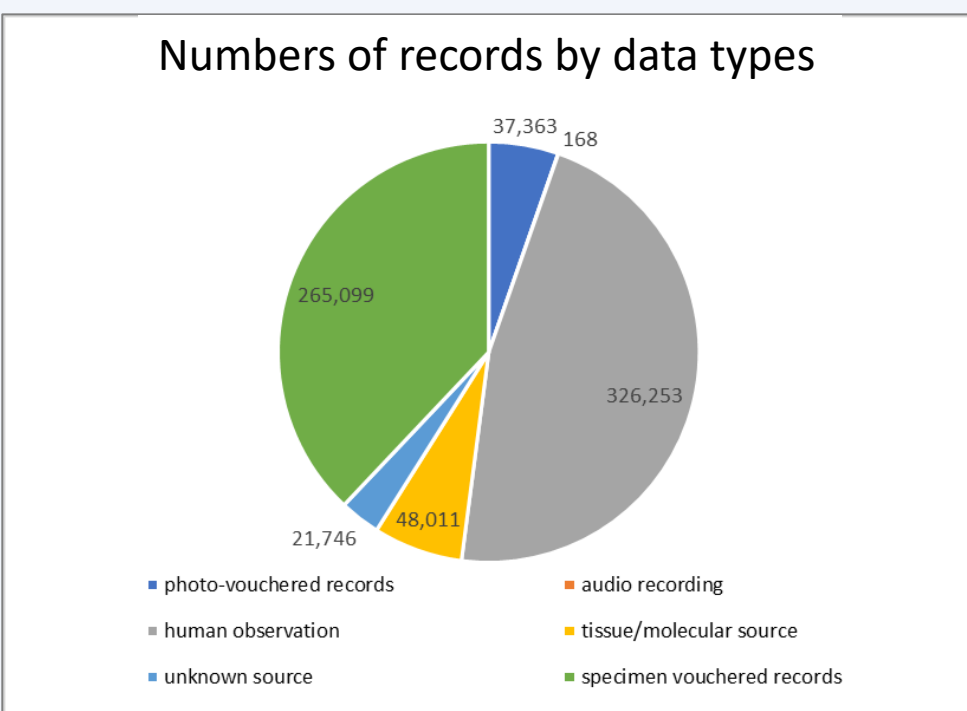
Left below: The previous version's scope included only HUCs intersecting Texas (colored). Transparent HUCs were added in the new version. Right: all georeferenced records, with those in Texas in yellow.
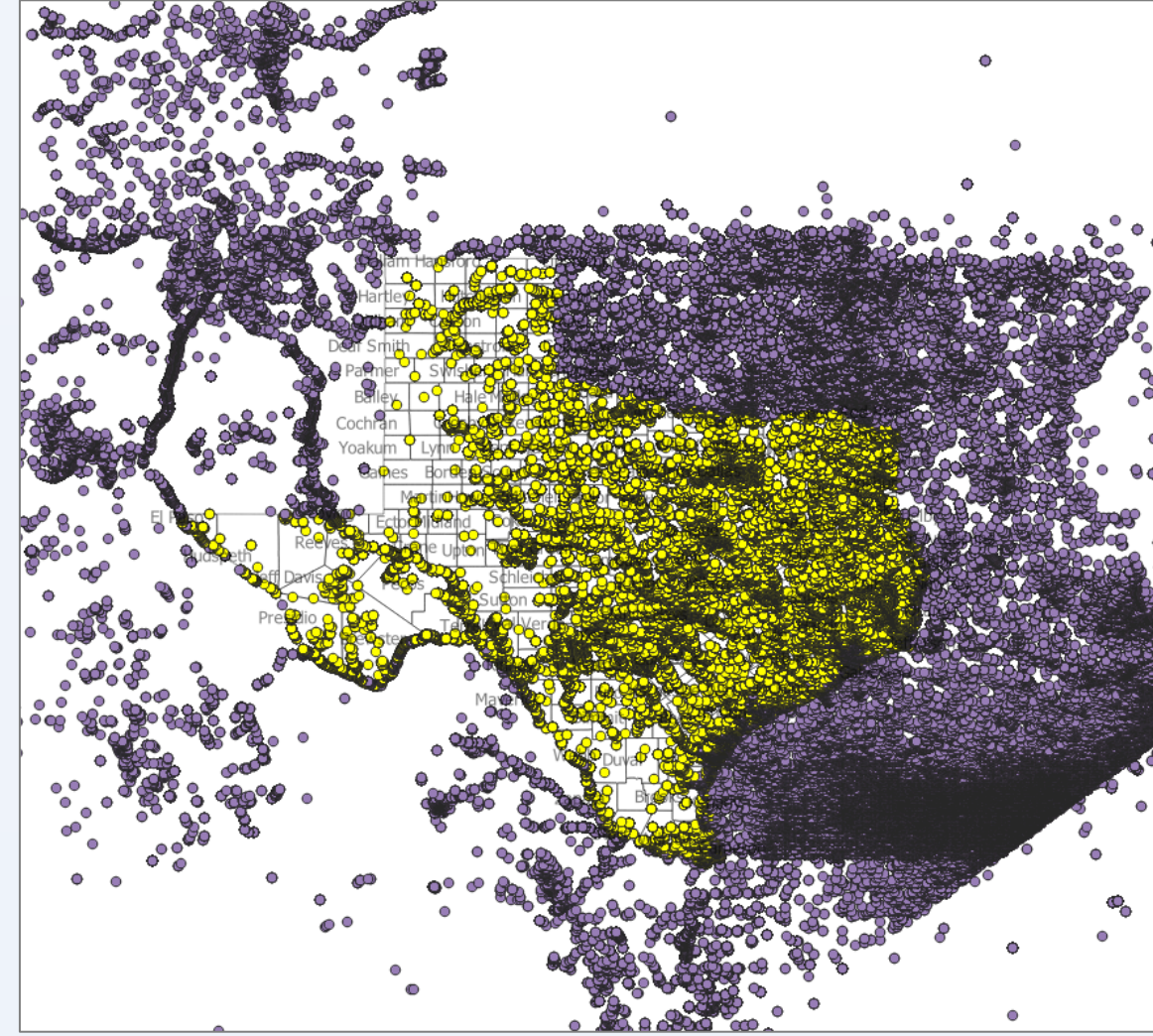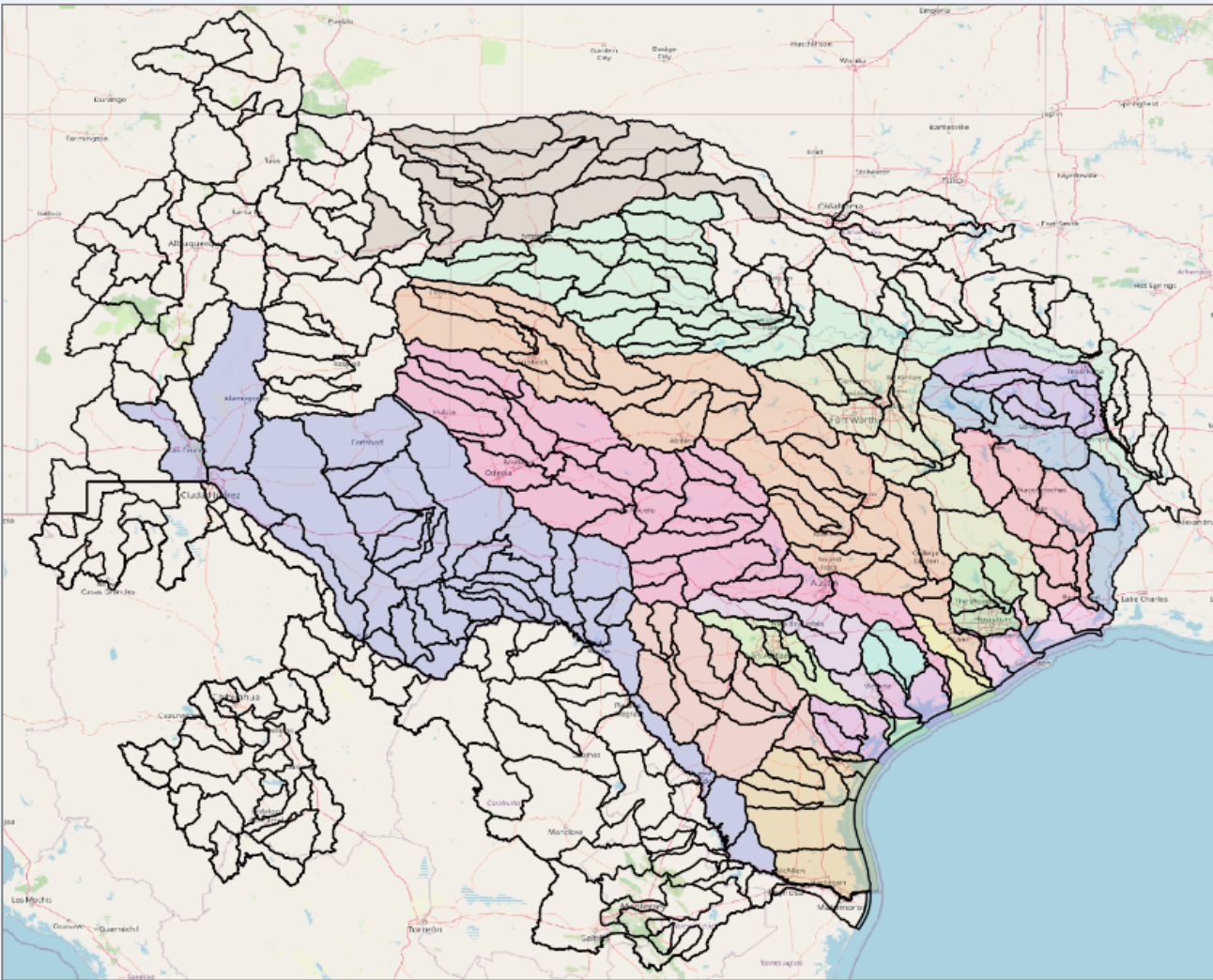
	Pre-2022	New (Track 3) dataset	Current	% increase from pre-2022
N occurrence records	196,951	698,640	895,591	355%
Georeferenced (%)	53.2%	90.5%	82.3%	604%
Texas inland (%)	40.2%	21.8%	25.8%	193%
Suspect (%)	0.6%	1.9%	1.6%	1,173%
From captive populations (%)	0.4%	0.1%	0.2%	68%
With >= 1 photo (%)	1.7%	0.2%	0.5%	42%
With fieldnotes (%)	1.2%	0.0%	0.3%	No change
TX counties with records (254 total)	236	243	251	lacking Upton, Cochran, Jim Hogg
N institutions contributing data	44	140	154	318%
N specimens examined	6,602	0	6,602	No change
N native species in study area	545	762	782	140%
Most recent collection	2010	2019	2019	9 years later
Earliest collection	1830-1853	1716	1716	114 years earlier

Via both the expanded geographic scope and incorporation of recent taxonomic revisions, 237 new native species (including from both Gulf and freshwaters) were added.

Via expert consensus meetings, we updated our "suspect" and "need to examine" records. At the same time, we re-determined native ranges for all native species.

See extensively updated and improved documentation for further details:

DASHBOARDS

Improved and expanded Tableau dashboards allow data exploration, with options to see the underlying data as you view. Explore the data interactively to see data gaps, how the data have accumulated over time, aspects of uncertainty associated with the data, and who and what institutions have made this possible.

See all of our dashboards
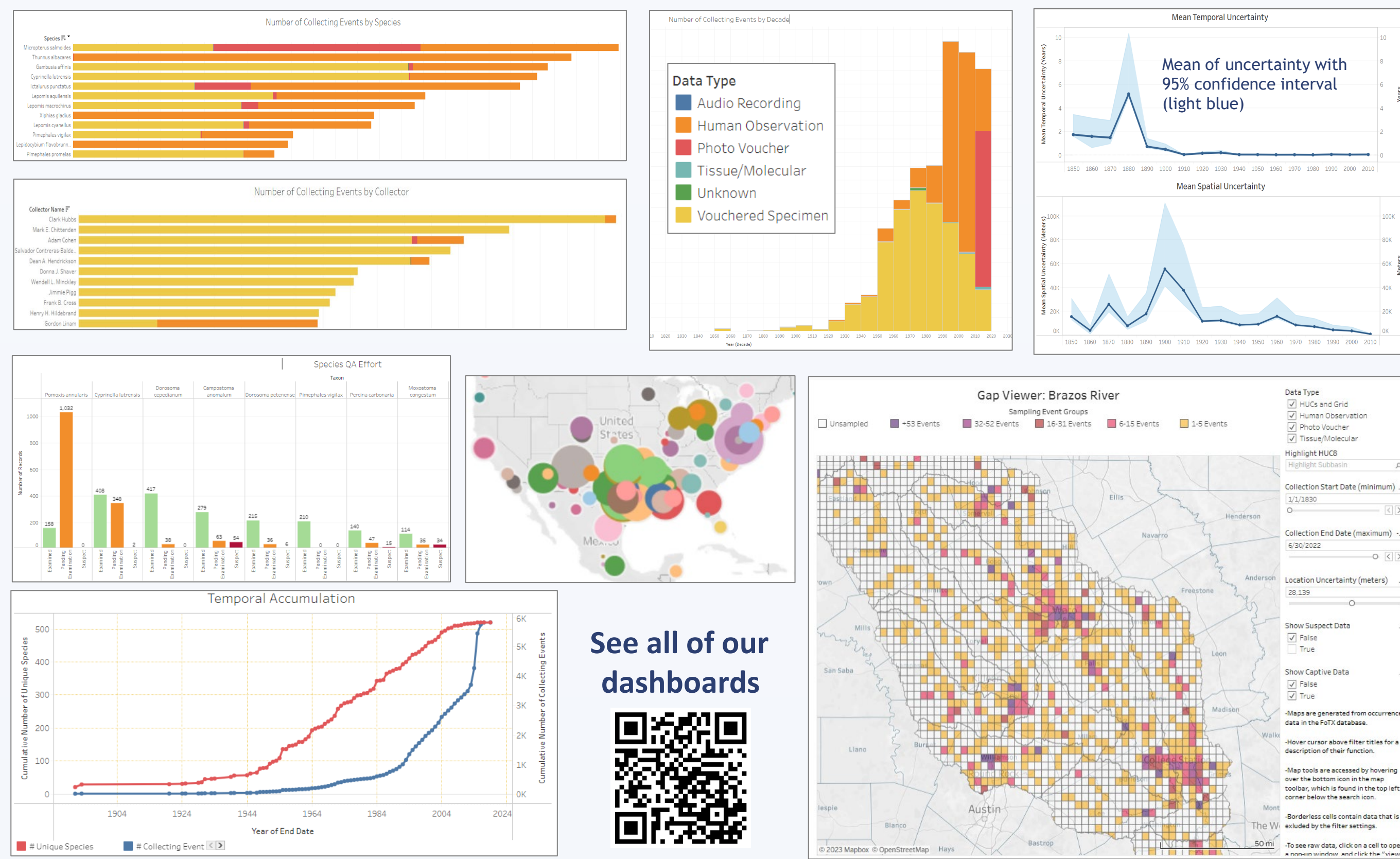
FUTURE?

Multiple projects are using FoTX data, including one by Drs. Jane Rogosch and Diane Bouille at Texas Tech University that is updating niche models and Native Fish Conservation Areas in Texas.

Meanwhile, we are exploring new ways to continue maintaining, and even further develop, FoTX. We are lucky to have recently had an offer of free assistance from University of Texas Austin alum (Nick Kaufmann) and his associated group of retired data scientists, who could help us with some of the following, and maybe more. Please provide your suggestions.

scan code for poll or fill out paper form

Take our poll: help guide future work! Rank the following items:
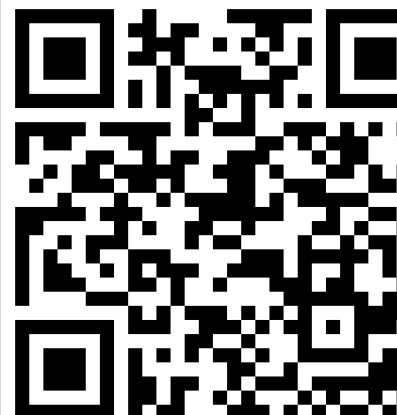
1. **Map time slider**: Add a slider tool to website maps to allow visualization of occurrences through time and space, revealing distribution shifts, apparent extirpations, etc.
2. **Improved checklists**: Incorporate new checklists based on native status and, perhaps, modeled probabilities.
3. **Dynamic linkages to donor databases**: Automated and regular updates of the fastest growing databases (iNaturalist, GBIF, TNHCi (UT Austin), TCWC (TX A&M) would allow new data to be seen as they are added by the data owners (no more waiting sometimes years for data to show up). This would include automation of logical algorithms based on prior data to flag incoming records as suspect.
4. **Dynamic trend analyses**: Preliminarily developed by FoTX in collaboration with Dennis Wylie (UT Austin statistician), this tool analyzes FoTX data to quantify and visualize the changing prevalence of species within drainages.
5. **Dynamic SDMs**: Existing code can be implemented allowing users to customize species distribution models using FoTX data.
6. **Basic taxa-level improvements**: Add species conservation rankings (IUCN, Nature Serve, TX SGCN, USFWS), and, in the taxon-tree, include common names and (perhaps) taxa silhouette finding aids (e.g. Phylopic).
7. **Species accounts**: Improved community-developed species accounts and image collections using Wikipedia. Could include a diverse global network of volunteers working virtually (coordinated by TX Chapter AFS?).
8. **ID keys**: Community-developed keys to species identification. By using Wikipedia a diverse global network of volunteers working virtually (coordinated by TX Chapter AFS?) could improve on scattered legacy keys.
9. **Focus on data**: Continue to work on cleaning and specimen-based validation of existing data.
10. **Other suggestions?**

GET INVOLVED NOW

- Use and cite FoTX and its data:
Hendrickson, Dean A., and Adam E. Cohen. 2022. Fishes of Texas Project Database (Version 3.0). http://doi.org/10.17603/C3WC70. Accessed (insert date).
- Donate specimens (the highest quality data) to your favorite collection that publishes its data
- Post your fish observations to iNaturalist
- Comment in FoTX specimen and taxa pages in the FoTX website (requires registration)
- Become a Wikipedia species page editor for your favorite Texas (or regional) species

FUTURE FUNDING

THE UNIVERSITY OF TEXAS AT AUSTIN + ???

CONTACT

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