

# Georeferencing Natural History Collections Data: The GEOLocate Project

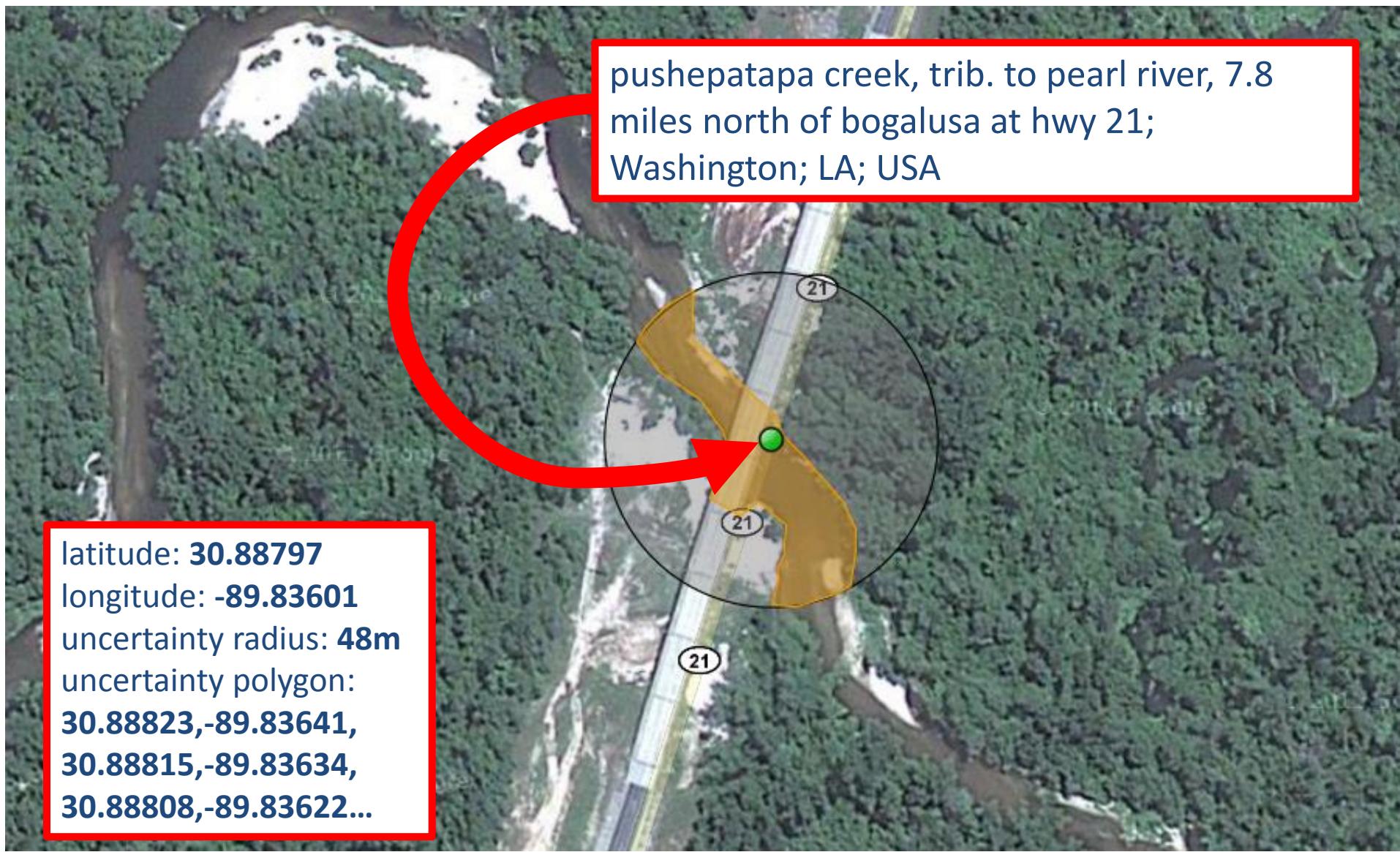
Nelson E. Rios



Tulane  
University

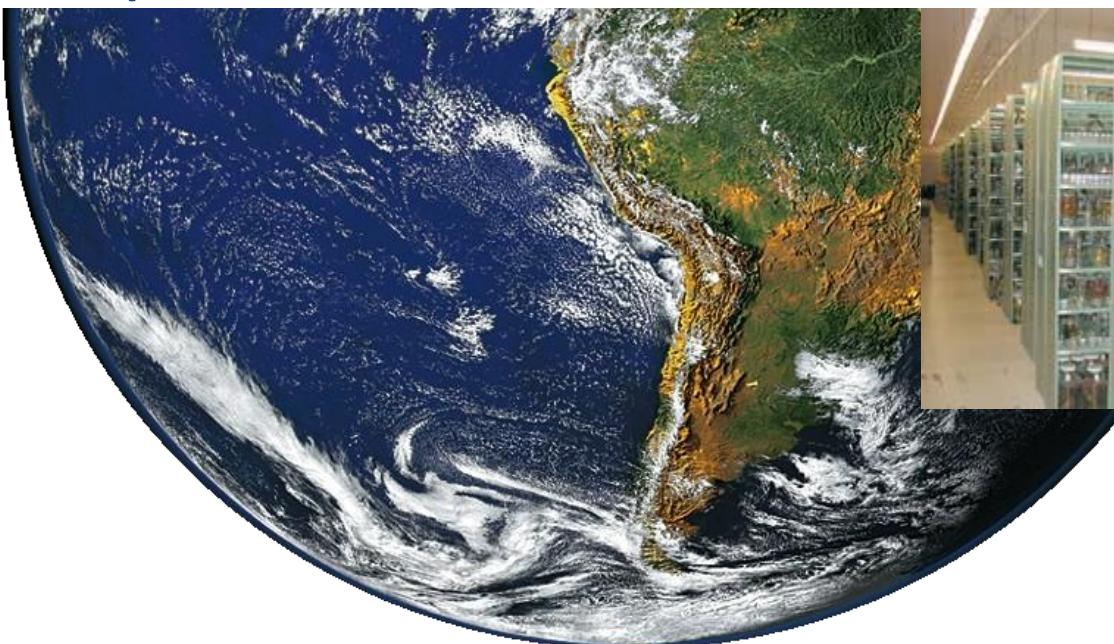
iDigBio  
Wet Collections Workshop  
Lawrence, Kansas  
5-6, March 2013

# What is Georeferencing





3 billion specimens with  $\frac{1}{2}$  billion collecting events



# Traditional Methods





# GEOLocate

Home | Standalone App | Java Client | Web Application | Collaborative Georeferencing | Developer Resources | Workshops | Support and Contacts

GEOLocate Web Application

Georeference a locality description

Locality String:

Country:  County:

State:  Enable Water Body Matching

Enable Hwy/River Crossing Detection

Locate required for U.S. location

Click here to georeference localities from an uploaded CSV file.

Results

Instructions

Help us improve this site

Locality Data	Powerline crossing sample
Latitude	27.400000
Longitude	-95.300000
Location	Estimated location based on the locality string.
Georeference	Georeference

kml export

Software & services for  
georeferencing of natural history  
collections data

batch processing

geographic visualization  
google, bing, openstreet, wms

collaborative georeferencing

automated georeferencing

verification & correction

multi-lingual

interoperability  
soap & rest api

training

uncertainty determination

# Typical GEOLocate Workflow

1

## Data Entry & Preparation

2

## Automated Processing

3

## Manual Verification

*pushepatapa creek, trib. to pearl river,  
7.8 miles north of bogalusa at hwy 21;  
Washington; LA; USA*

*Georeferencing Algorithm*

*Visualize, verify & adjust output  
coordinates & uncertainties*



*latitude: 30.88797  
longitude: -89.83601*

*uncertainty radius: 48m*

*uncertainty polygon:  
30.88823,-89.83641,  
30.88815,-89.83634,  
30.88808,-89.83622...*

# Options: Web vs. Desktop?



## Web Based Clients

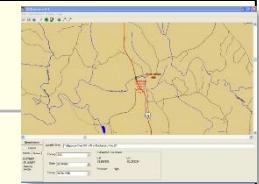


The following web based clients based web clients are available to allow you to georeference data directly from your web browser:

- User input georeferencing client
  - Simply type in your locality description and get back georeferenced results. Start here if you are new to GEOLocate.
- File based input (batch) georeferencing client
  - Allows you to upload a .csv file and batch process it.
- Collaborative georeferencing client
  - Utilizes the collaborative georeferencing framework. Ideal for largescale multi-institution projects projects.
- Embeddable client
  - A streamlined web client for the purpose of embedding in other web applications.  
[Sample link](#) of how an external application on another domain might use this client.  
[Documentation link](#) on how to craft URLs for this client.



## GEOLocate Standalone Desktop Application (version 3.xx)



[Features](#) | [Frequently Asked Questions](#) | [Updates](#) | [Downloads](#)

# Georeferencing Example: Desktop App

**GEOlocate v. 2.1**

File Georeference Display Help

F G Z S P

A map showing the Tallapoosa River and Highway 27 in Georgia. A red dot marks the georeferenced location near Abernathy Mill. The river flows generally eastward, with several tributaries joining it from the north and west. Highway 27 runs roughly parallel to the river. A small blue area is highlighted in the bottom left corner of the map.

Locality String: Tallapoosa River 5.0 mi N of Buchanan, Hwy 27

Calculated Coordinates:

Lat:	33.863438
Lon:	-65.213334

Precision: High

Georeference  
Correct  
Coords Options  
33.876607  
-65.168067  
Haralson,  
Georgia  
County HARALSON

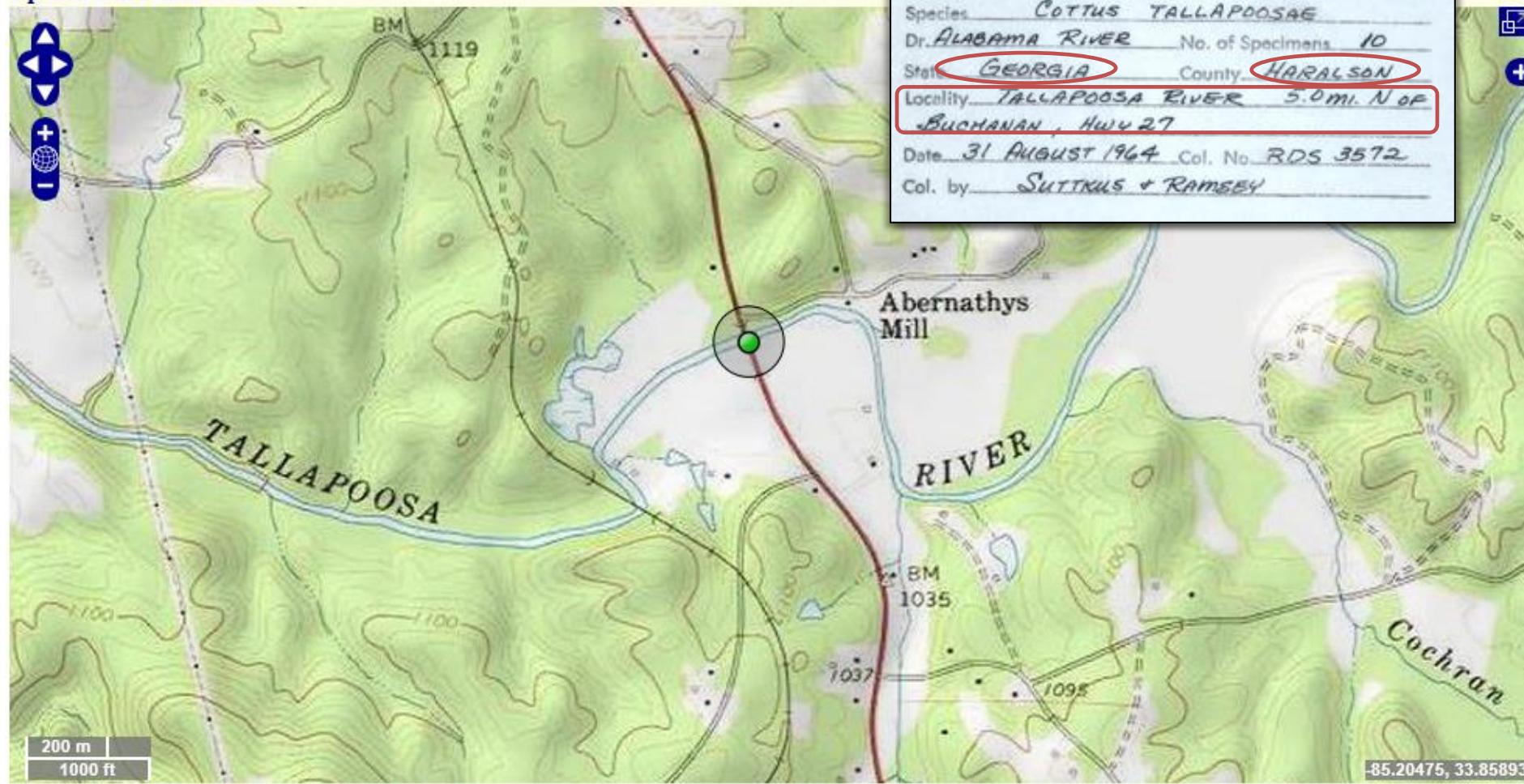
**PARATYPES**  
TULANE UNIVERSITY COLLECTIONS

Family No. 385 Cat. No. 34409  
Species COTTUS TALLAPOOSAE  
Dr. ALABAMA RIVER No. of Specimens 10  
State GEORGIA County HARALSON  
Locality TALLAPOOSA RIVER 5.0 mi. N of  
BUCHANAN, Hwy 27  
Date 31 AUGUST 1964 Col. No. RDS 3572  
Col. by SUTTKUS + RAMSEY

A detailed view of the georeferenced location on the Tallapoosa River. The river is shown flowing along a road, with Highway 27 running parallel to it. A green dot marks the exact georeferenced spot. Labels include "Garner Road" and "Tallapoosa River".

 GEOLocate Web Application


1 possible location found.



Workbench    1 possible location found

Georeference     Options     Draw polygon     Place marker     Measure

Locality String: Tallapoosa River 5.0 mi. N of Buchanan, Hwy 27

Country: UNITED STATES OF AMERICA

State: Georgia

County: Haralson

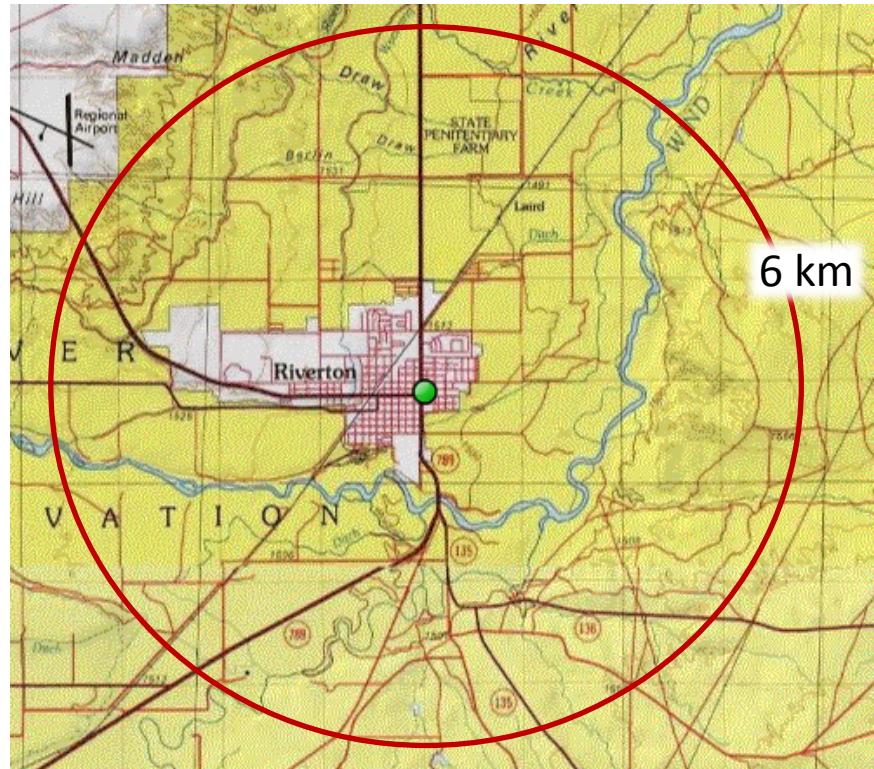
latitude: 33.863438     longitude: -85.213334     uncertainty: 90 m     error polygon

33.863438	-85.213334	90	Unavailable
-----------	------------	----	-------------

# Algorithm Performance

## Versus Known U. S. Localities

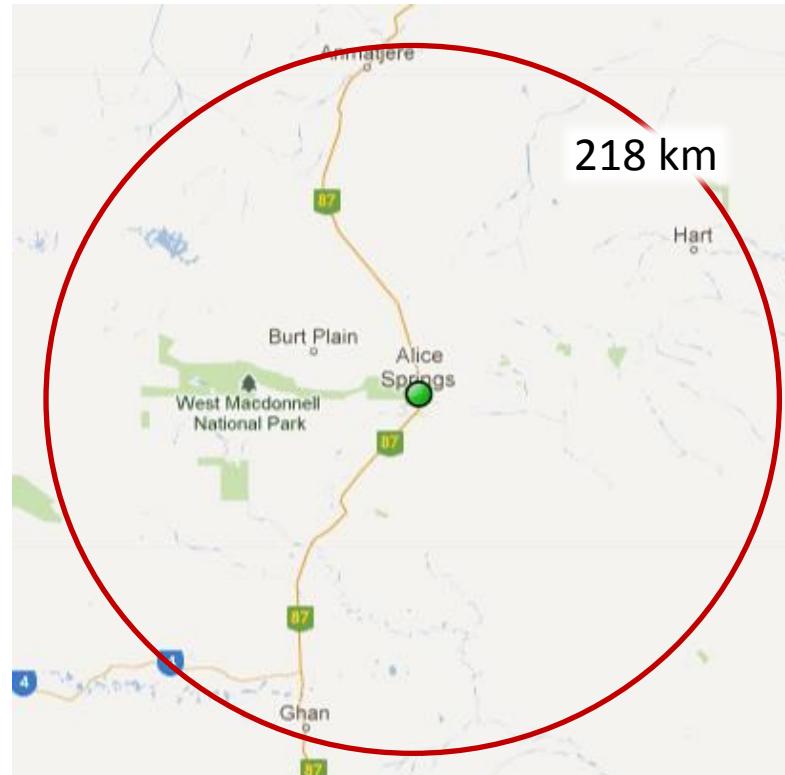
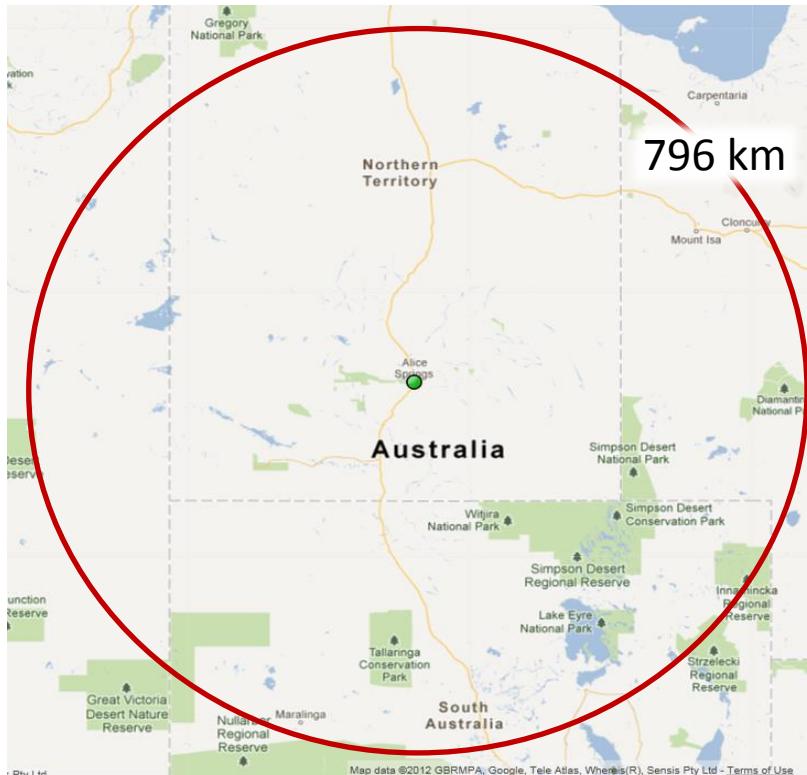
	% Found	Mean Dist. Off	Standard Error
GEOLocate	95%	6.1 km	2.1 km



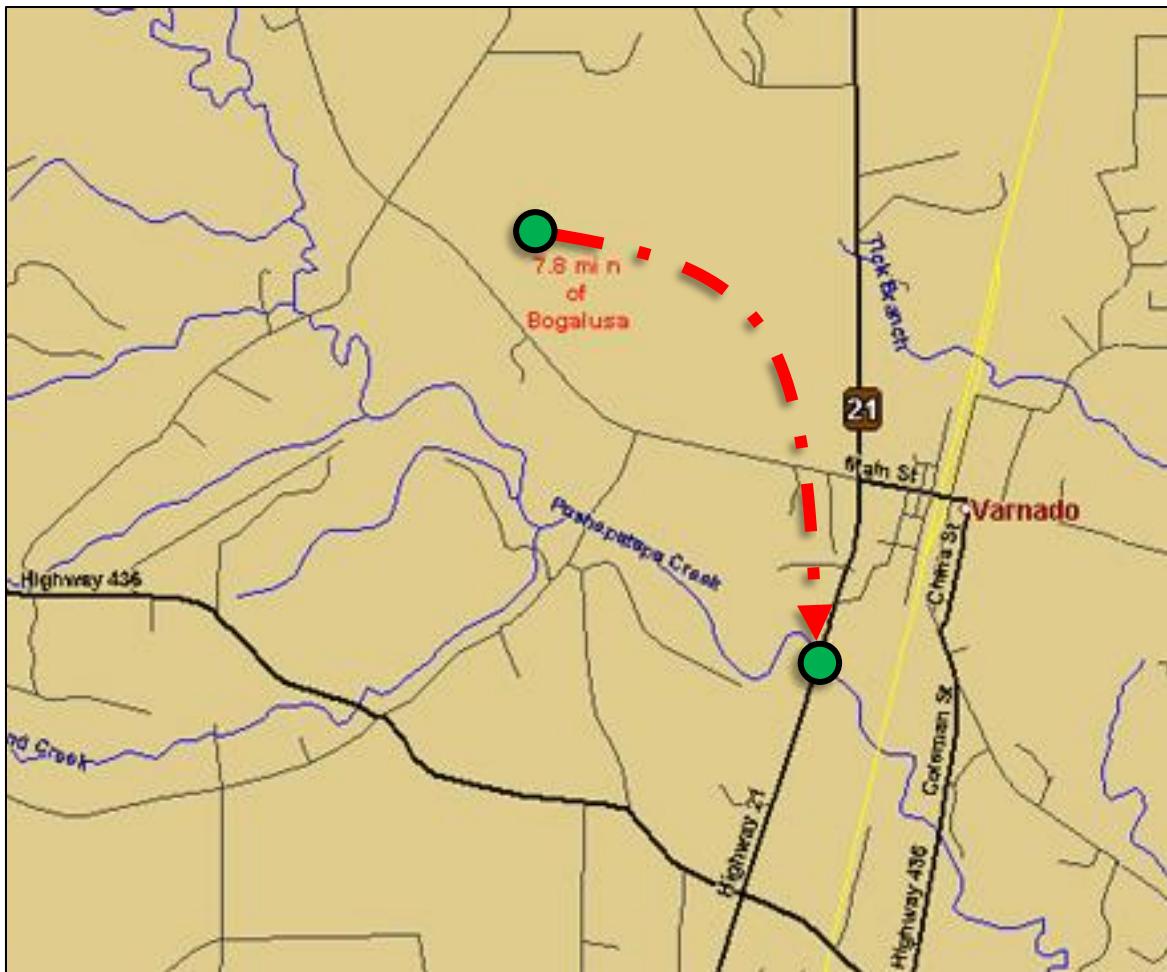
# Algorithm Performance

## Versus Known Australian Localities

	% Found	Mean Dist. Off	Standard Error
GEOLocate	86 → 97%	796 → 218 km	154 → 48 km



# Verification & Adjustment of Automated Outputs

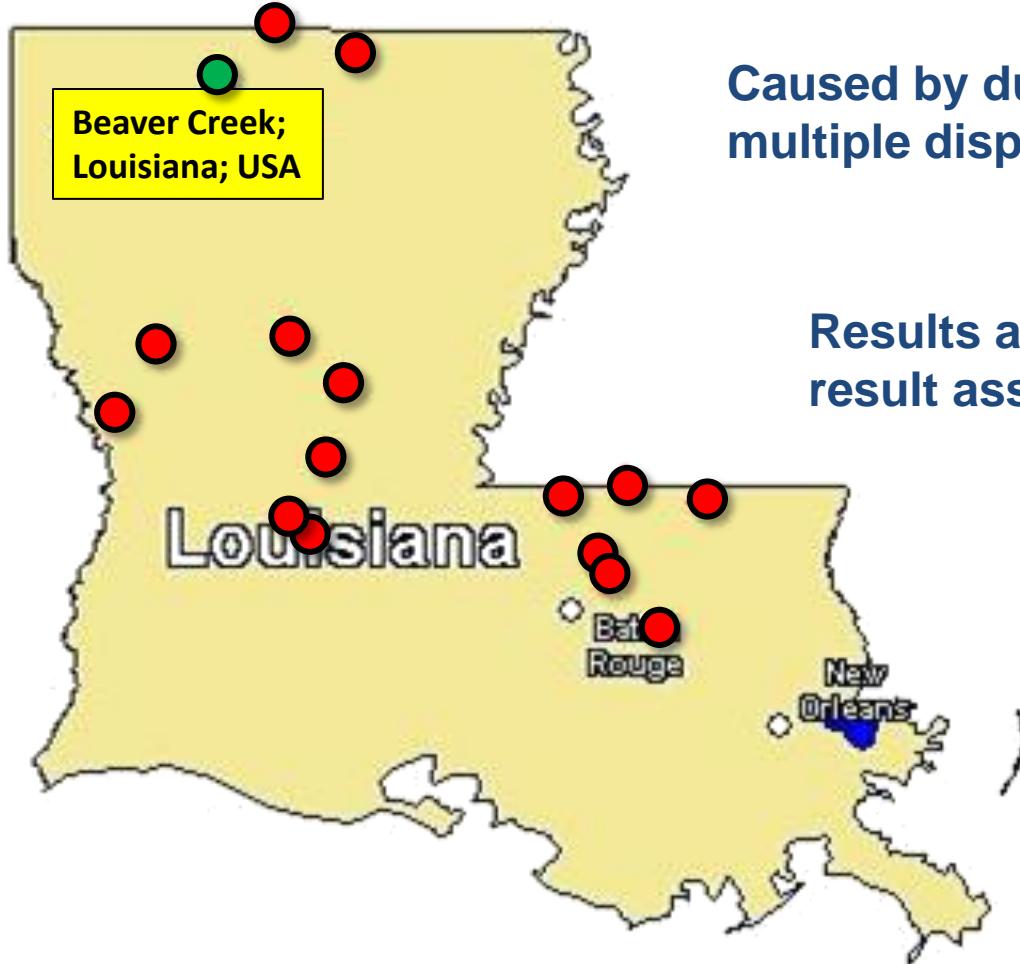


Computed coordinates  
are displayed on digital  
maps

Manual verification of  
each record

Drag and drop  
correction of records

# Multiple Result Handling



Caused by duplicate names, multiple names & multiple displacements

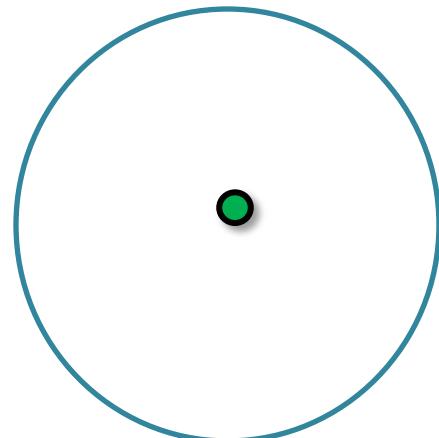
Results are scored and most “accurate” result assigned to active marker (green)

All results are recorded and displayed as static markers (red)

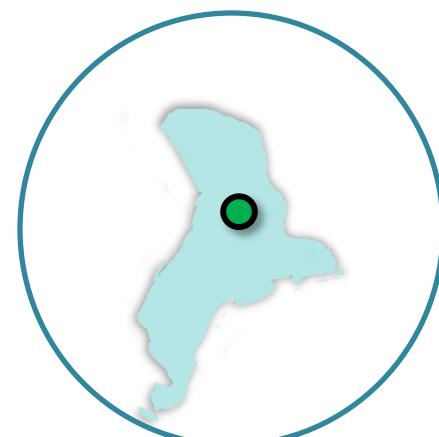
# Measuring Uncertainty



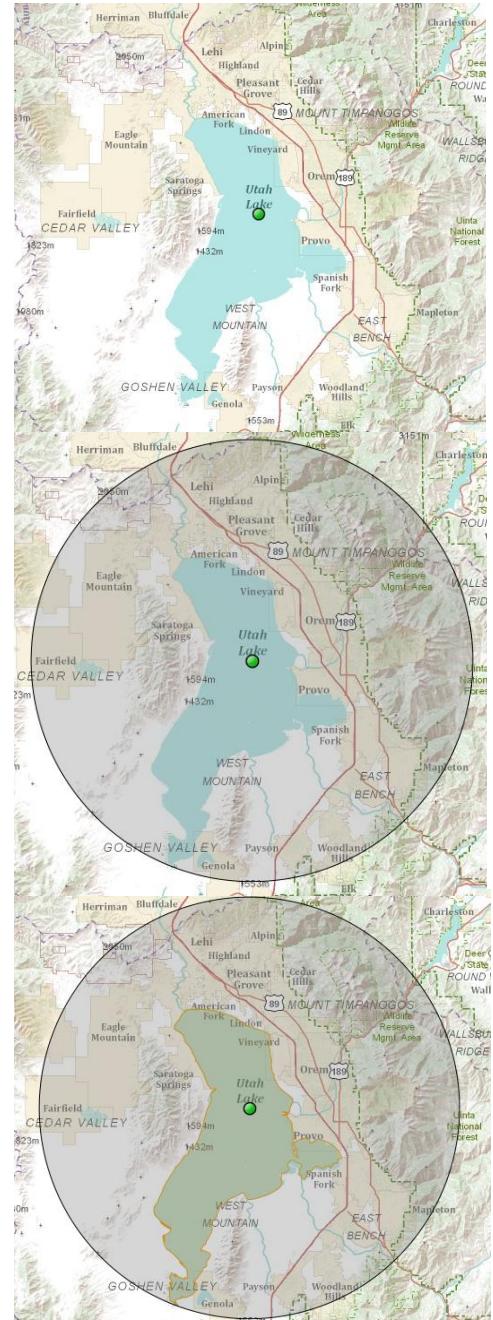
Point



Point & Radius



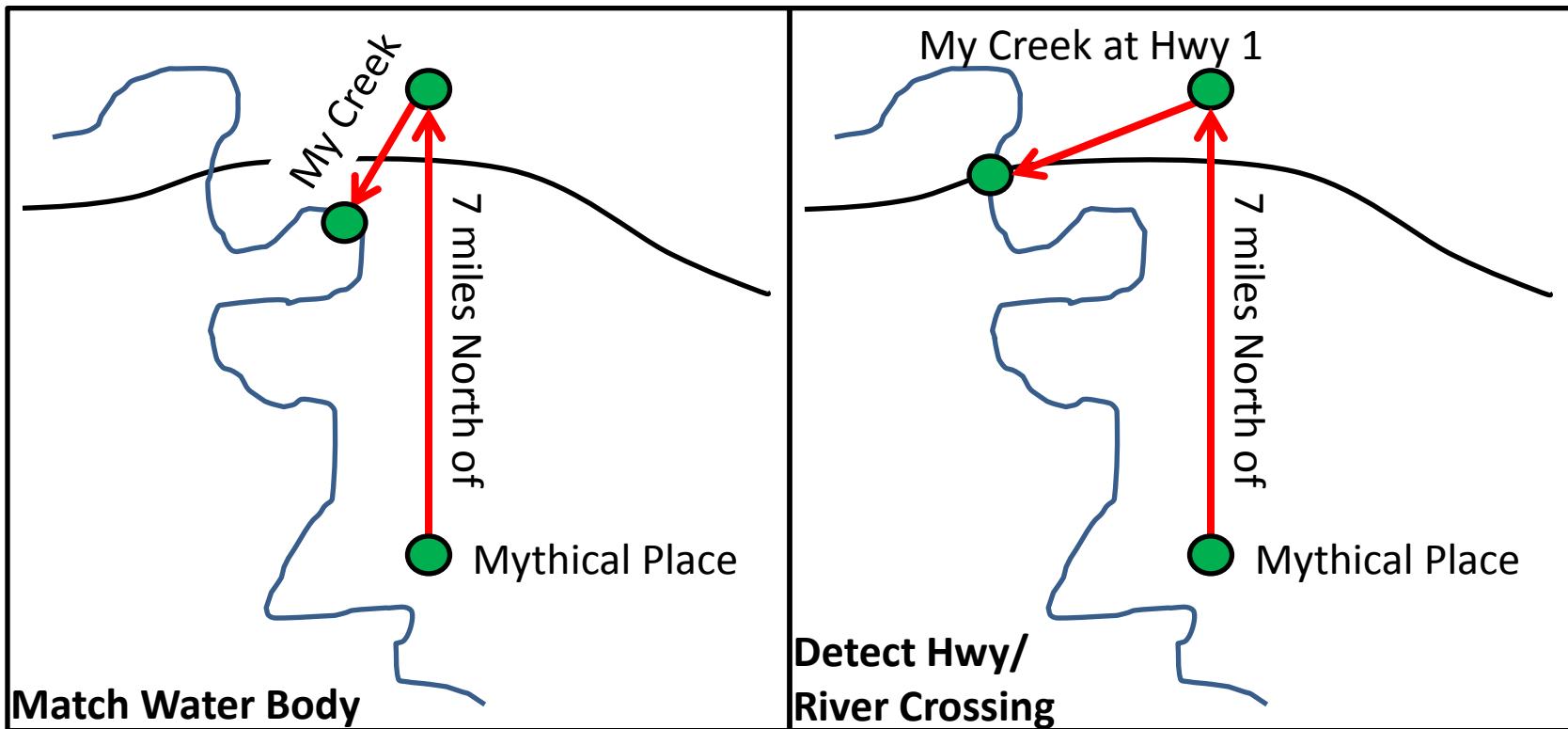
Point, Radius & Polygon



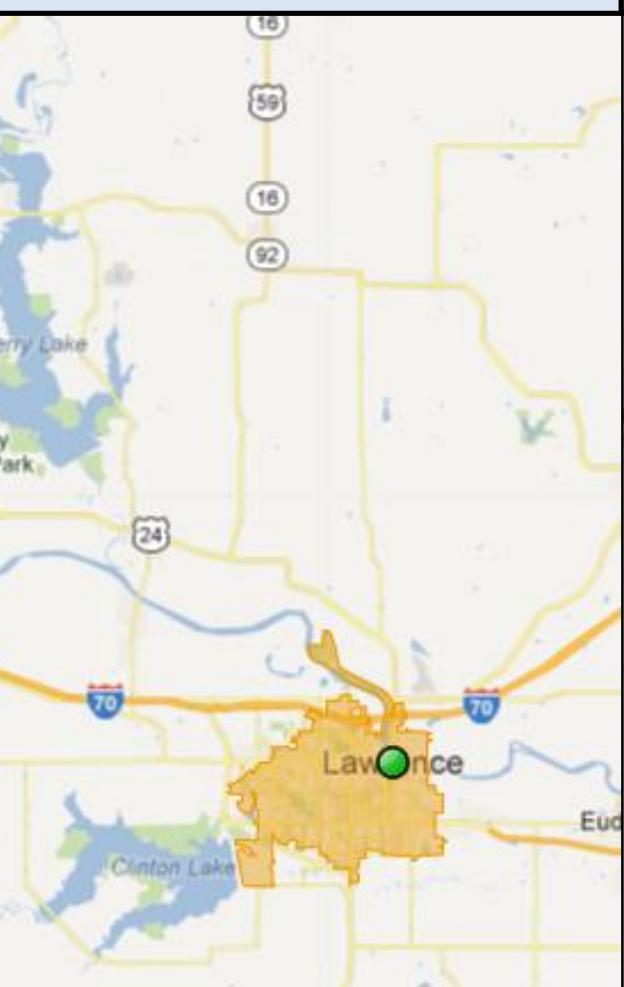
## Georeferencing options

- Match Water Body |  Detect Hwy/River Crossing |  Do Uncertainty  
 Do Error Polygon |  Displace Polygon |  Restrict to Lowest Adm. Unit

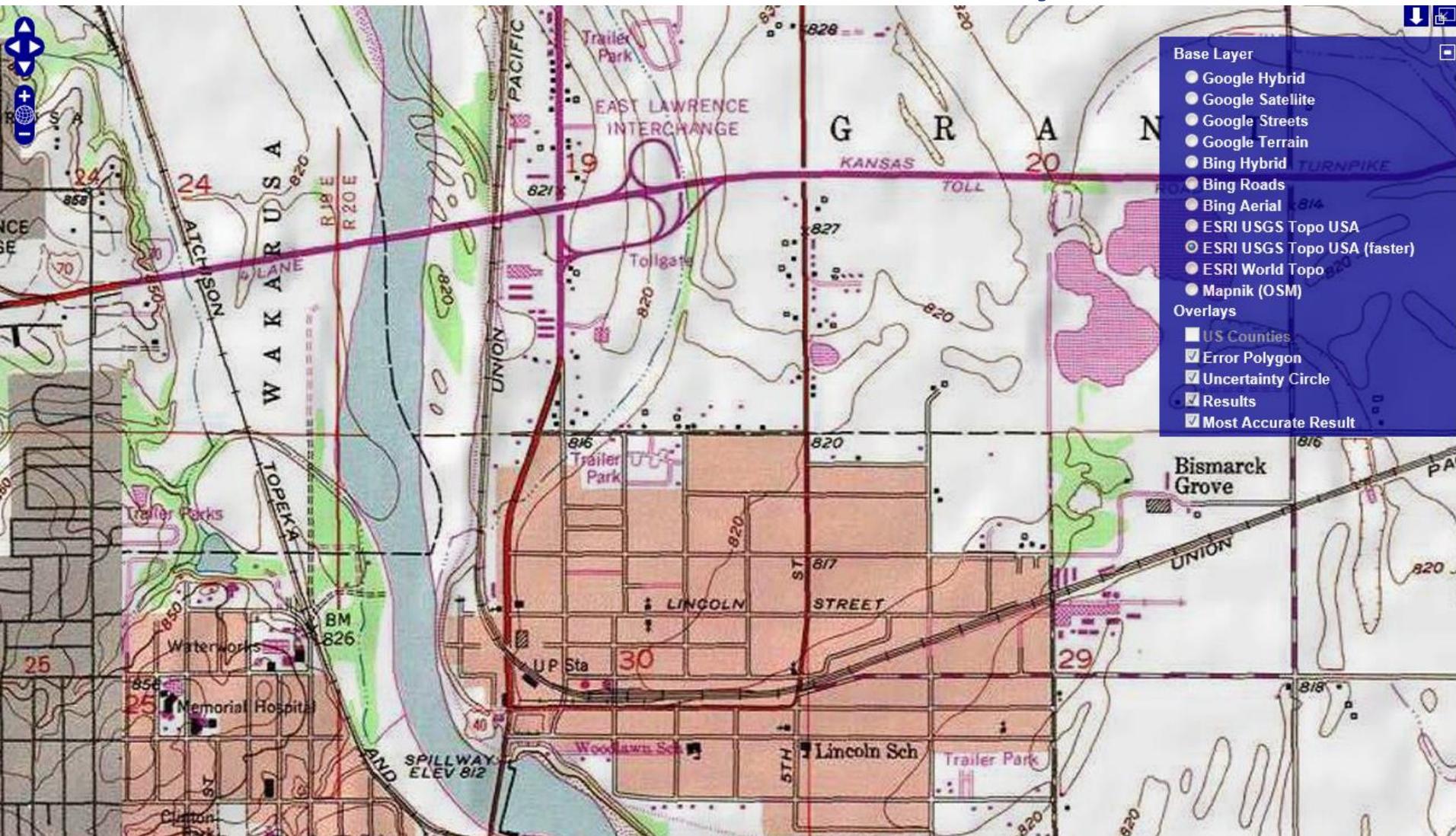
Language: English ▾



# Generating Polygons:

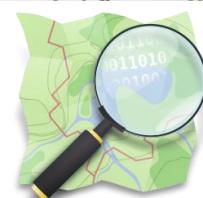
Lawrence, KS	15 mi N of Lawrence, KS no displacement	15 mi N of Lawrence, KS displaced polygon
 A map of Lawrence, Kansas, showing the city boundaries in orange. Major roads are labeled with route numbers: 16, 59, 92, 24, 70, and 10. Perry Lake and Perry Park are visible to the west. Clinton Lake is to the south. A green dot marks the center of Lawrence.	 A map showing a 15-mile radius centered on the point 15 miles north of Lawrence, Kansas. The resulting polygon is a perfect circle, indicated by a green dot at its center. Major roads 16, 59, 92, 24, 70, and 10 are shown. Perry Lake and Perry Park are to the west, and Clinton Lake is to the south.	 A map showing a 15-mile radius centered on the point 15 miles north of Lawrence, Kansas. The resulting polygon is highly distorted and irregular, indicating a significant displacement or corruption in the data. The green dot from the first map is still present at the center of the displaced polygon. Major roads 16, 59, 92, 24, 70, and 10 are shown. Perry Lake and Perry Park are to the west, and Clinton Lake is to the south.

# Visualization: Base Layers



# Google

bing





# Core Features

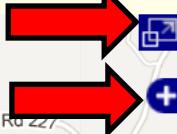
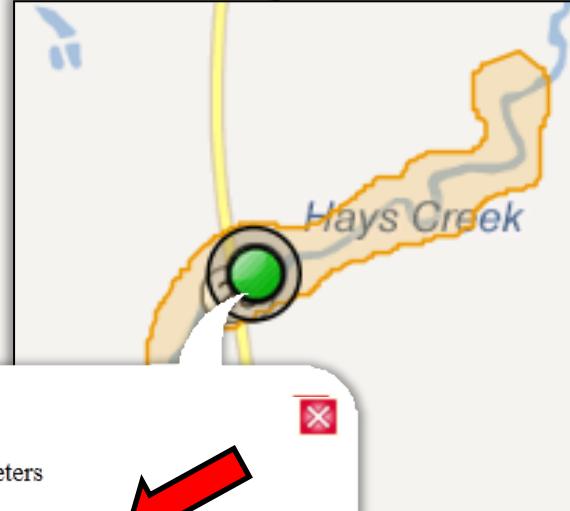


1 possible location found.

Par Rd 106  
1056

Lon: -90.190633  
Lat: 30.88792  
Uncertainty: 90 meters  
[Edit uncertainty](#)  
Parse pattern: HAYS CREEK AT HWY 25

Lon: -90.190633  
Lat: 30.88792  
Uncertainty: 90 meters  
[Edit uncertainty](#)  
[Expand uncertainty to polygon](#)  
Parse pattern: HAYS CREEK AT HWY 25



Workbench    1 possible location found

|  Draw polygon  Place marker  Measure

Locality String: Hays Creek, 3 mi. n of Franklinton on hwy. 25

Country: UNITED STATES OF AMERICA

State: La

County: Washington

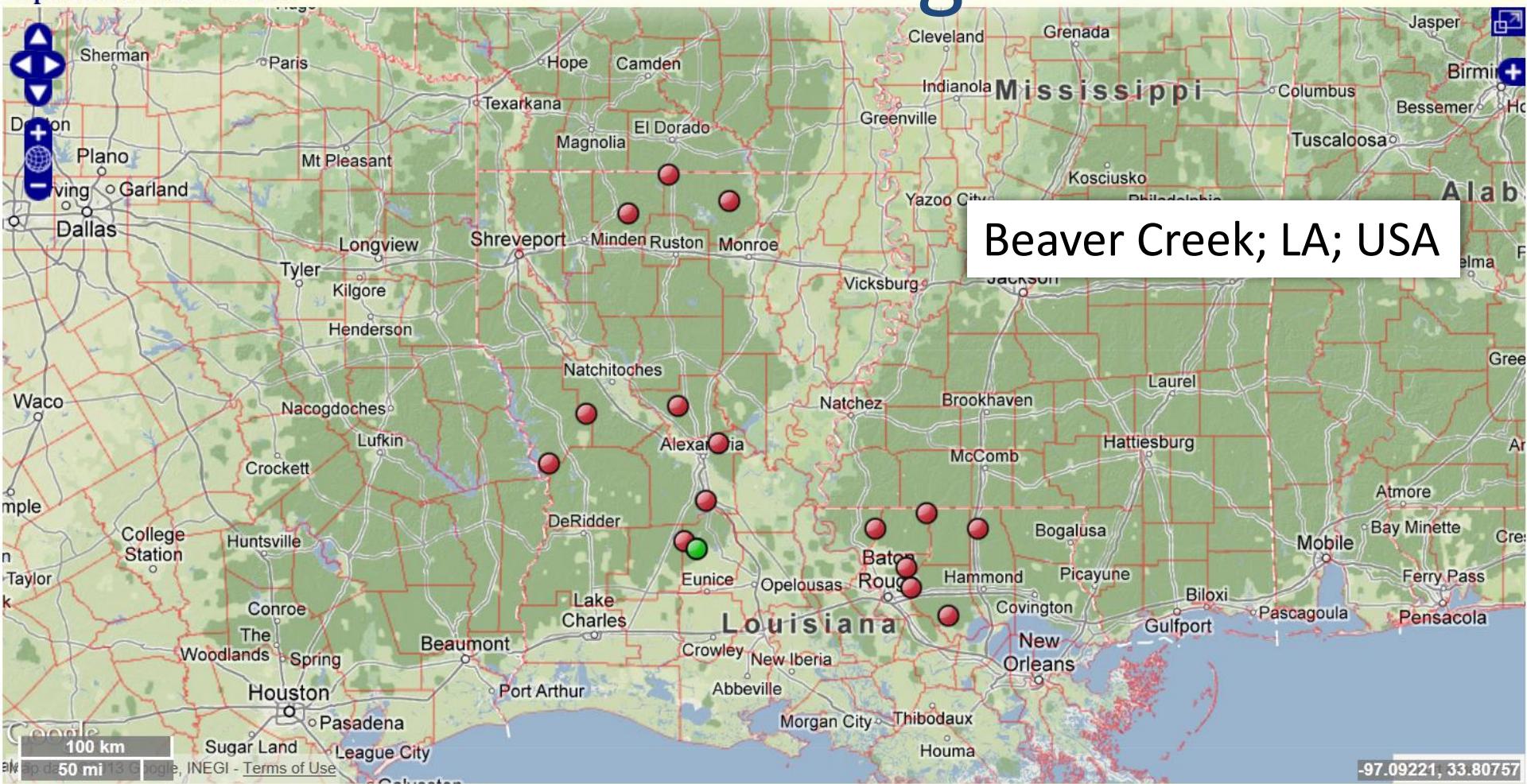
latitude: 30.88792 longitude: -90.190633 uncertainty: 90 m error polygon

30.88792 -90.190633 90 Unavailable





# Evaluating Results



Beaver Creek; LA; USA

Workbench	16 possible locations found
☒	lat: 30.75611, lon: -92.49056, pattern: BEAVER CREEK, error polygon: Unavailable, uncertainty: 210 m, precision: Low(27)
☒	lat: 31.61778, lon: -92.61583, pattern: BEAVER CREEK, error polygon: Unavailable, uncertainty: 210 m, precision: Low(27)
☒	lat: 30.34528, lon: -90.71333, pattern: BEAVER CREEK, error polygon: Unavailable, uncertainty: 210 m, precision: Low(27)
☒	lat: 30.9675, lon: -90.86361, pattern: BEAVER CREEK, error polygon: Unavailable, uncertainty: 210 m, precision: Low(27)
☒	lat: 32.76556, lon: -92.97306, pattern: BEAVER CREEK, error polygon: Unavailable, uncertainty: 210 m, precision: Low(27)
☒	lat: 30.63722, lon: -91.00306, pattern: BEAVER CREEK, error polygon: Unavailable, uncertainty: 210 m, precision: Low(27)

Remove Secondary Points



# Batch Georeferencing

Workbench    2 possible locations found

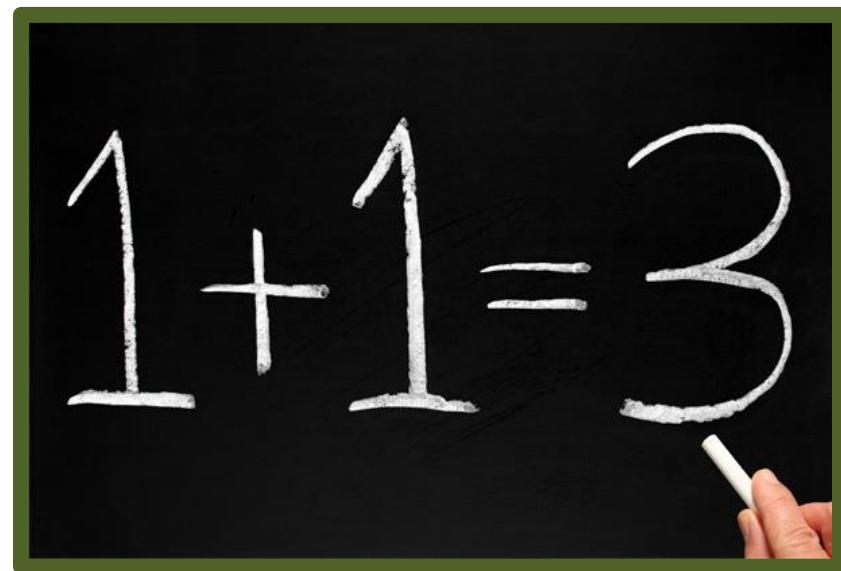
Show 8 records    Page Georeference    Georeference    Options    Correct     Draw polygon     Place marker     Measure

Locality	Country	StateProvince	County	Latitude	Longitude	Corrected	precision
Chambers Spring Road 2.5 km S of Hwy 412, 8.0 km E of Siloam Springs, T17N, R33W,	USA	Arkansas	Benton	36.188027	-94.451005	no	High(89)
Osage Creek, 1.0 mile N on gravel road to bridge crossing; gravel road jcts with	USA	Arkansas	Benton	36.189077	-94.395375	no	High(97)
Yocum Creek, near Oak Grove (Pass 11a), Sec. 30	USA	Arkansas	Carroll	36.454986	-93.322008	no	Low(35)
Village Creek State Park, S of driving range, Sec. 6	USA	Arkansas	Cross	35.161111	-90.70833	no	Low(39)
Sugar Creek, Hwy 163 at Bay Village, Sec. 4	USA	Arkansas	Cross	35.44909	-90.67533	no	High(100)
Buck Creek, 8.0 miles SE Corydon	USA	Indiana	Harrison	38.155118	-86.014724	no	High(88)
E Branch Mill Creek, Hessdale Road, 4.0 km S of Allendorph, Sec. 36	USA	Kansas	Wabaunsee	39.003564	-96.277745	no	High(88)
Blissdale Creek, Hillside National Wildlife Refuge, 500 m SW of Blissdale on Blis	USA	Mississippi	Holmes	33.083754	-90.224633	no	High(84)

Search:    File management    Phoxinus\_erythrogaster\_Locations\_MMN...    Showing 1 to 8 of 44 records

# Collaborative georeferencing

- Increased output by take advantages similarities across collections
- Distribution of workloads to appropriate expertise



# Collaborative Georeferencing: Sharing Data

Homochitto River, 4.9 mi. E Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1960	11
Homochitto River 5 mi. E of Union Church, MS Hwy. 550.	USA	Mississippi	Lincoln	1968	11
Homochitto River at Route 550 bridge, 5.0 mi. E of Union Church.	USA	Mississippi	Lincoln	1970	10

Homochitto River at MS Hwy. 550 bridge 5.0 mi. E of Union Church.	USA	Mississippi	Lincoln	1971	2
Homochitto River at Hwy. 550 bridge 5.0 mi. E of Union Church.	USA	Mississippi	Lincoln	1971	
Homochitto River 5 mi. E of Union Church.	USA	Mississippi	Lincoln	1971	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 4.7 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1970	
Homochitto River 4.7 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 4.7 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 4.7 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1973	



Homochitto River 5 mi. SE of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1978	
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1971	8

Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1971	6
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	8
Homochitto River 5 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	7
Homochitto River 4.7 mi. E of Union Church, Hwy. 550.	USA	Mississippi	Lincoln	1972	6

**Corrected 22 collecting events,  
approx. 200 specimen records**

# Collaborative Georeferencing Performance

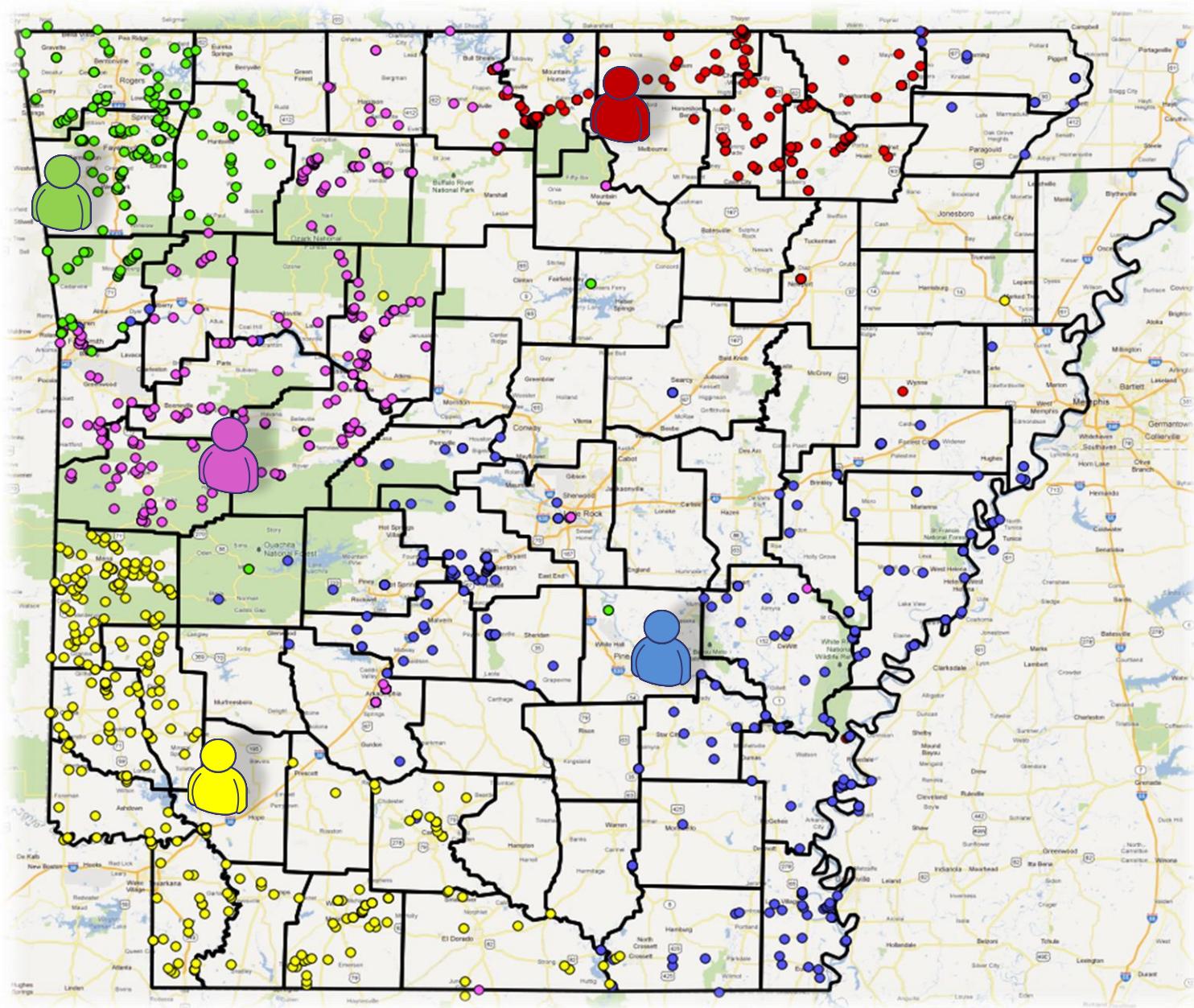


- 2100 randomly selected collecting events from the Tulane University fish collection were imported and georeferenced using the collaborative georeferencing framework
- 33% were duplicates
- 30% more related by similarity index

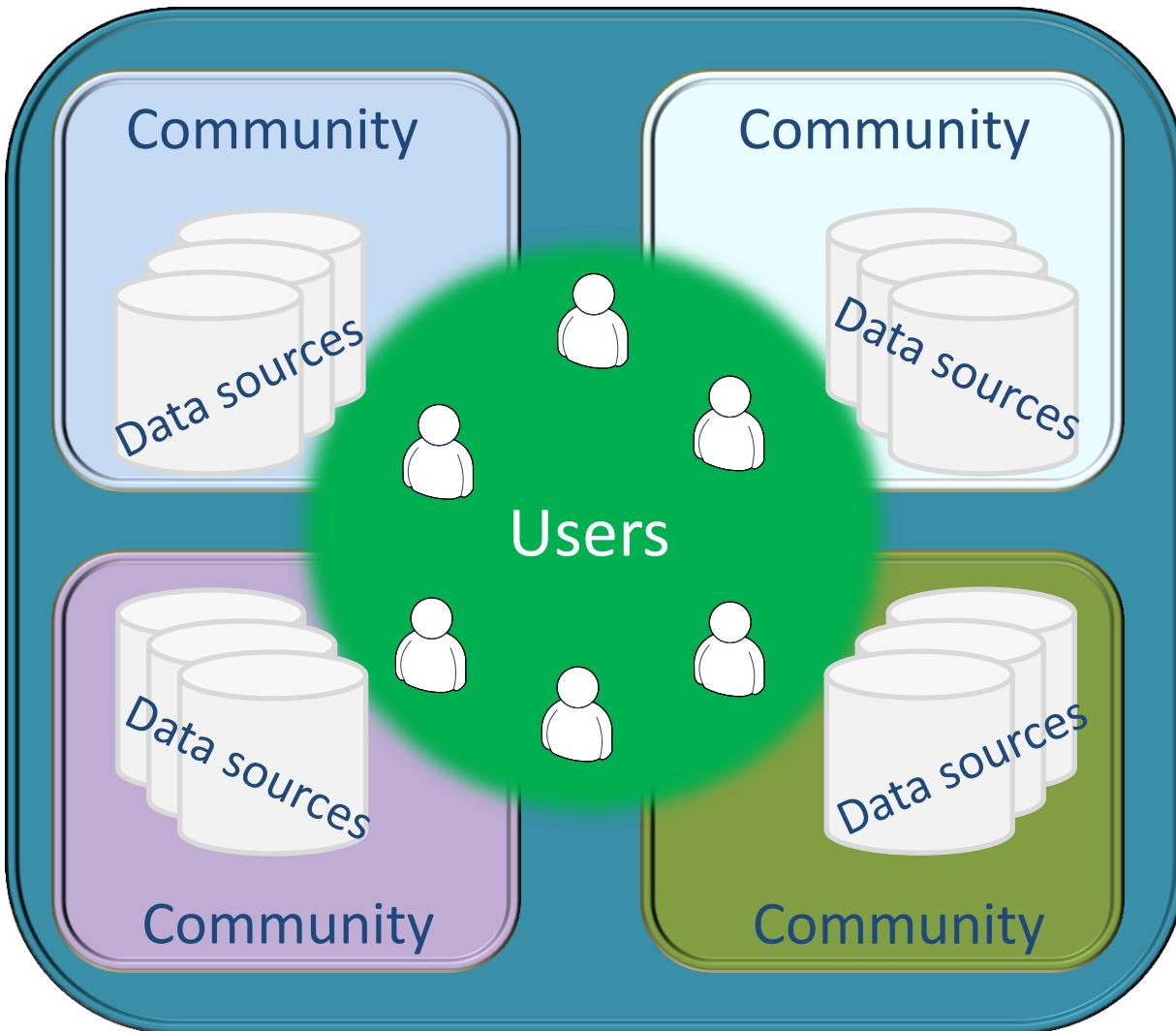
2100 → 782

★ 63% reduction in effort overall

# Distributing Workloads



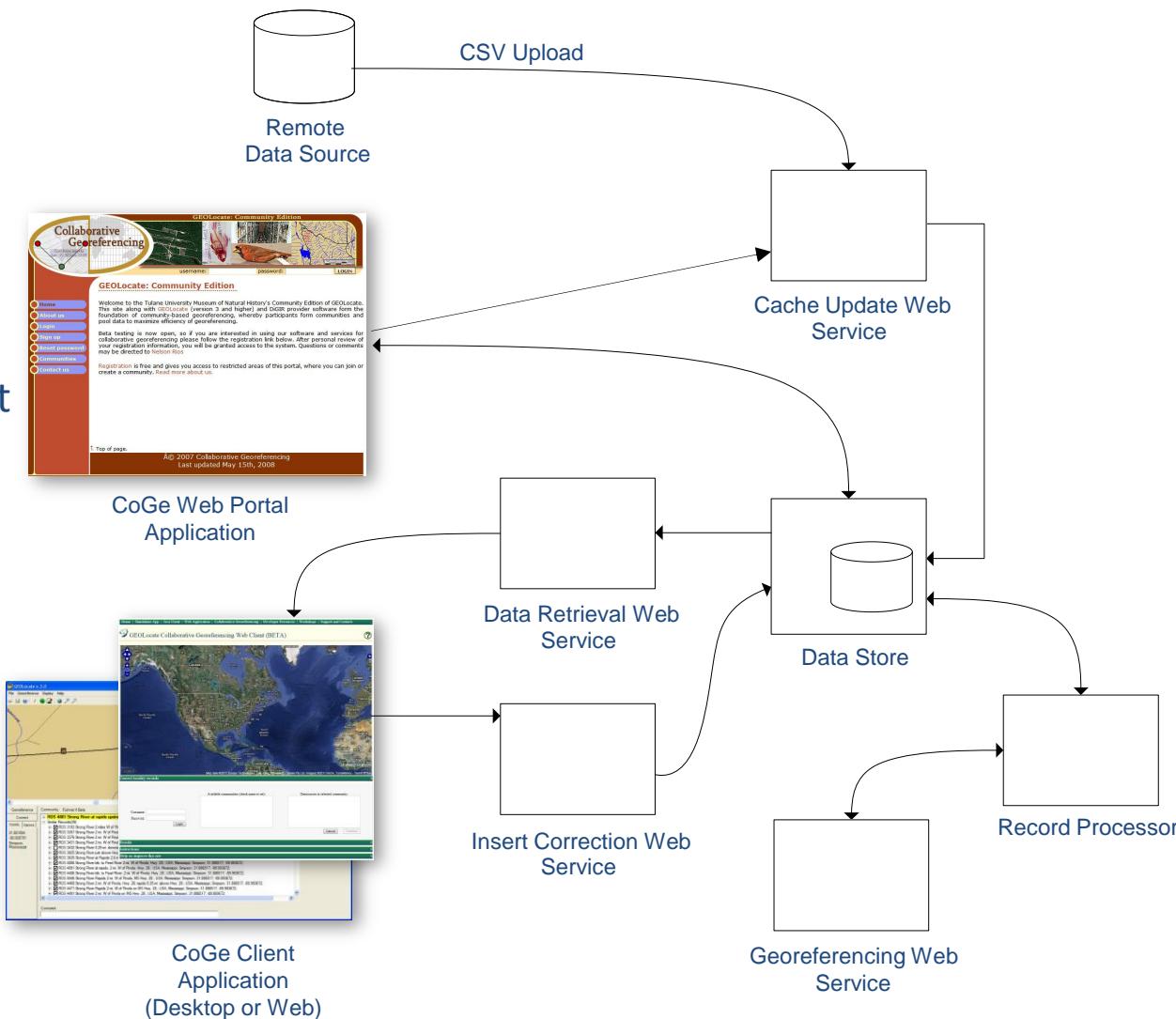
# Organizational Units



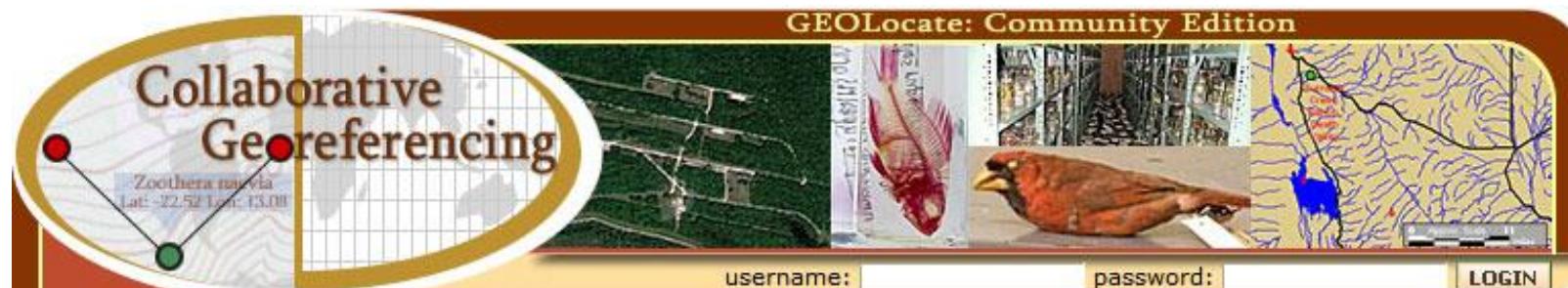
# Collaborative Georeferencing within GEOFIND

Community  
&  
Data Management

Correction  
&  
Verification



# Collaborative Georeferencing Management Portal



## GEOLocate: Community Edition

Welcome to the Tulane University Museum of Natural History's Community Edition of GEOLocate. This site along with [GEOLocate](#) (version 3 and higher) and DiGIR provider software form the foundation of community-based georeferencing, whereby participants form communities and pool data to maximize efficiency of georeferencing.

Beta testing is now open, so if you are interested in using our software and services for collaborative georeferencing please follow the registration link below. After personal review of your registration information, you will be granted access to the system. Questions or comments may be directed to [Nelson Rios](#)

[Registration](#) is free and gives you access to restricted areas of this portal, where you can join or create a community. [Read more about us](#).

- [Home](#)
- [About us](#)
- [Login](#)
- [Sign up](#)
- [Reset password](#)
- [Communities](#)
- [Contact us](#)

[Top of page.](#)

# Georeferencing Communities

Communities List

Create Communities

Join Communities

Account Settings

Fill out the form below to create a new community.

Fields marked \* are required.

Community name:

New Community \*

Description:

Community creation Demo.

Georeferencing options:  Water body matching  Look for hwy/river crossing

Privacy setting:

-  public: any user can join your community.
-  restricted: users send you requests to join your community.
-  private: only users you invite can join your community.

RESET

CREATE COMMUNITY

## Create Communities

## Data Sources

Data Sources

Members

Com Center

Settings

Data source management operations

- Add new community data source via DiGIR
- Add new community data source via CSV files

Use this easy signup link to send a auto-join invite to users:

GENERATE EASY SIGNUP LINK

Enable hyperlinks on data source records:

base link format: "http://domain.com?<key>=" where <key> is a parameter key of your choice.

ADD SPECIMEN HYPERLINK

RESET

SAVE

## Add New Users & Link Out

Data Sources Members Com Center Settings

User management operations:

- Define users working dataset
- Change users community access levels
- Invite users to this community

To define a working dataset, select the search parameters and users below, then click "SUBMIT CHANGES".

Use [CTRL]+click to select multiple.

Community data sources:

- ALL--
- Birds
- BirdsDwC2
- CNFI
- csvTest
- f2sr

States/Provinces:

- ALL--
- '
- Campeche
- Queensland
- "Sara, D. S. C."  
(Georgia)

Community members:

- peter.desmet (Peter Desmet)
- rogburr (Robert P Guralnick)
- rodriguez.zuluaga (Javier A snomelf (Paul Flemons)
- sun123 (Dr.Sunil Wamana)
- swang5 (Shengzhi Wang)
- test1234 (test test)

Selected members queries, consolidated:

'snomelf', 'sun123' and 'swang5' are allowed to search community-wide and only allowed to search by country like 'Kenya' or 'Kenya?'.

Number of locality records matching this query: 169.  
Number of corrections for locality records matching this query: 0.

Sample matching records for this query:

FieldNumber	YearCollected	MonthCollected	DayCollected	JulianDay	TimeOfDay	ContinentOcean	Country	State
0	1895	4	7	0			Kenya	Rift V
	1895	2	2	0			Kenya	
	34	0	6	0			Kenya	Rift V
0	0	0	0	0			Kenya	Coast
0	0	0	0	0			Kenya	Rift V
0	0	0	0	0			Kenya	Coast
0	0	0	0	0			Kenya	East
0	0	0	0	0			Kenya	West

Selected Members Queries: showing 1 to 3 of 3.

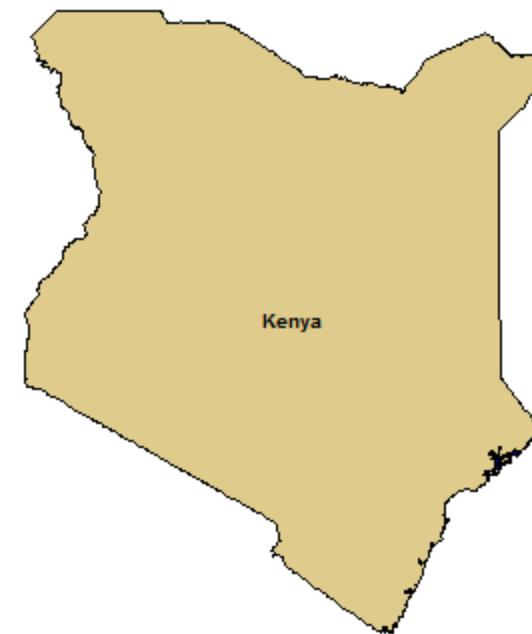
Members	Data sources	Countries	States/Provinces	Counties
snomelf	all	'Kenya' or 'Kenya?'	all	all
sun123	all	'Kenya' or 'Kenya?'	all	all
swang5	all	'Kenya' or 'Kenya?'	all	all

[HIDE FORM](#) [CLEAR FORM](#) [SUBMIT CHANGES](#)

Click on an item's header to expand/collapse its content.

<input checked="" type="checkbox"/> community-wide	member since: Thursday, October 23, 2008
<input checked="" type="checkbox"/> abentley	member since: Wednesday, February 04, 2009
<input checked="" type="checkbox"/> ddraper	member since: Saturday, November 14, 2009
<input checked="" type="checkbox"/> denareg	member since: Thursday, December 11, 2008
<input checked="" type="checkbox"/> ecolife	

# User Management: Task Assignment



Assign all records from Kenya to experts on East African regions

# Monitoring & Managing Progress

✓ community-wide

Community Owner: you

Community description: For testing purposes only. Previously known as Fishnet II Beta.

Number of community data sources: 13

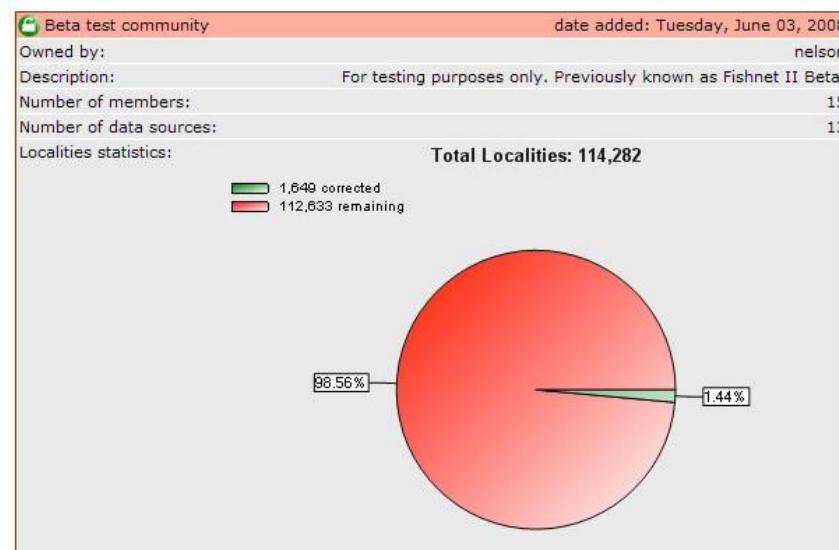
Records statistics:

Total specimen records: 555,897 [VIEW CORRECTIONS](#)

Corrected specimen records: 13,473

Total locality records: 114,282

Corrected locality records: 1,649



✓ TU Fish date added: Tuesday, June 03, 2008

TU Fish

Secondary name:

Path: www.museum.tulane.edu/digir/digir.php

Type: digir

Owner: you

Number of records: 199988

Status: cached

Task:

[UPDATE CACHE](#) [VIEW CACHE](#)

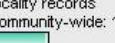
Records statistics:

Total corrected specimen records community-wide: 13,473

12,506 corrected in this data source

Total corrected locality records community-wide: 1,649

1,559 corrected in this data source



# Data Repatriation

TU Fish date added: Tuesday, June 03, 2008

Secondary name: TU Fish  
Path: www.museum.tulane.edu/digir/digir.php  
Type: digir  
Owner: you  
Number of records: 199988  
Status: cached  
Task:

UPDATE CACHE VIEW CACHE

Records statistics: VIEW CORRECTIONS

CoGe: Corrections details for the "TU Fish" data source - Mozilla Firefox

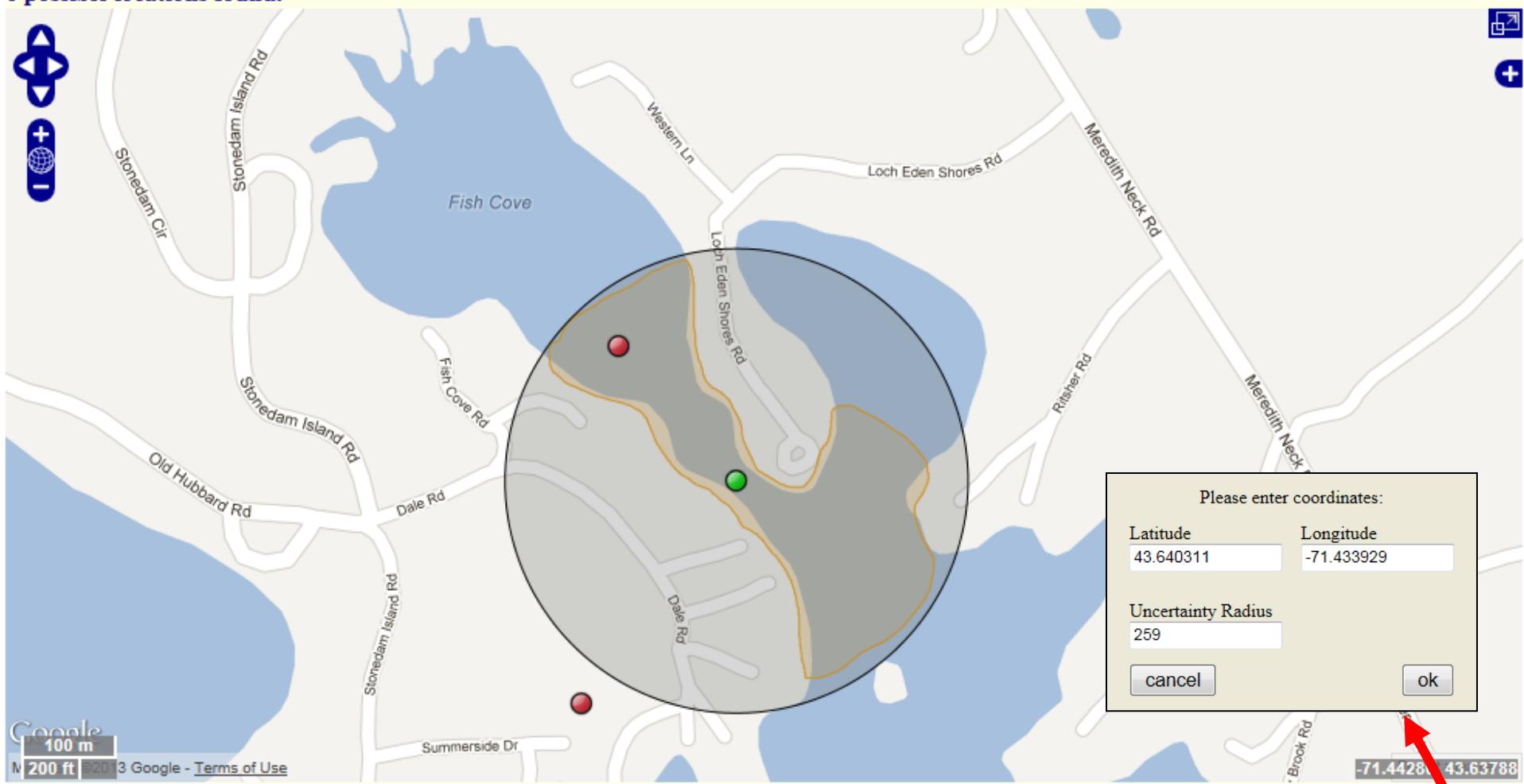
http://www.museum.tulane.edu/coge/protected>ShowDetails.aspx?wid=3909f73d&total=1559&show=135&obj=ds

Showing 1 to 50 of 1559. DOWNLOAD CORRECTIONS

Data source	Continent	Ocean	Country	State/Province	County	Locality
- TU Fish	North America	USA	Utah	Washington		Santa Clara River, 2.75 mi. above Gunlock.
Correction order (most recent first)		Corrected by	Corrected longitude	Corrected latitude	Correction remarks	Date corrected
1		abentley	-113.748037	37.299871		10/27/2008 9:48:20 PM
+ TU Fish	North America	USA	Mississippi	Copiah	Trib. to Homochitto River, 4.6 mi. NE Caseyville.	
+ TU Fish	North America	USA	Mississippi	Lawrence	Pearl River at mouth of Fair River.	
- TU Fish	North America	USA	Florida	Lake	Lake Harris near Leesburg.	
Correction order (most recent first)		Corrected by	Corrected longitude	Corrected latitude	Correction remarks	Date corrected
1		abentley	-81.85438	28.783233		10/27/2008 9:49:33 PM
2		abentley	-81.87806	28.81056		10/27/2008 9:49:00 PM
+ TU Fish	North America	USA	Mississippi	Copiah	Bayou Pierre, 1.7 mi. W of Carpenter or 5.8 mi. E of Carlisle.	
+ TU Fish	North America	USA	Louisiana	Orleans	South shore of Lake Pontchartrain near I-10 bridge.	
+ TU Fish	North America	USA	Mississippi	Simpson	Strong River at rapids upstream from Hwy. 28 bridge, 2 mi. W of Pinola.	
+ TU Fish	North America	USA	North Carolina	Macon	Little Tennessee River, 5 mi. NW Franklin, Hwy. 28.	
+ TU Fish	North America	USA	Louisiana	Orleans	Lake Pontchartrain at south end of causeway on Rt. 11	
+ TU Fish	North America	USA	Louisiana	La Fourche	Ditch near canal, 5.7 mi. south of Golden Meadows on Rt. 78	
+ TU Fish	North America	USA	Mississippi	Marion	Upper Little River tributary of Pearl River, 4.8 mi. SE of Columbia, MS on I	
+ TU Fish	North America	USA	Mississippi	Marion	Trib. of Pearl R. 4.8 N of Sandy Hook on Rt. 35	
+ TU Fish	North America	USA	Alabama	Mobile	Trib. of Escatawpa River 6.8 mi. E of Hurley, MS	
+ TU Fish	North America	USA	Mississippi	Marion	Trib. of Pearl River 6/10 mi. N of LA state line on Rt. 35	
+ TU Fish	North America	USA	Florida	Bay	Trib. of Econfinia River at Youngstown on Rt. 231	
+ TU Fish	North America	USA	Mississippi	Marion	Trib. of Pearl River 1.2 mi. N of MS state line on Rt. 35	
+ TU Fish	North America	USA	Louisiana	St. Tammany	Trib. of Pearl River 12.7 mi. NW of town of Pearl River on Rt. 58.	
+ TU Fish	North America	USA	Mississippi	Marion	Trib. of Pearl River 2.7 mi. N of Sandy Hook on Rt. 35.	
+ TU Fish	North America	USA	Mississippi	Hancock	Long Bay, trib. to Turtleskin Cr. 11.2 mi. E of Picayune or 2 mi. W of turn	
+ TU Fish	North America	USA	Florida	Jackson	Chipola River 1.5 mi. N of Marianna	
+ TU Fish	North America	USA	Florida	Jackson	Chipola River 1.5 mi. N of Marianna	



6 possible locations found.



Please enter coordinates:

Latitude 43.640311	Longitude -71.433929
Uncertainty Radius 259	
cancel	ok



Google  
100 m  
M 200 ft 203 Google - Terms of Use

Workbench    6 possible locations found    History

Community: FishNet 2

Clear Polygon     Draw polygon     Place marker     Measure

Next Record(s)    [+ Lake Winnipesaukee, Fish Cove near mouth of T 108, 3.5 mi ESE of Meredith, Merrimack Watershed, elev. 50](#)

Correct    Similar Records(2)

[Lake Winnipesaukee, Smalls Cove, Merrimack system, 5.5 mi E of Gilford, elev. 504 ft; United States; New Ha](#)

[UMMZ140837 Catostomus commersonii commersoni](#)

[UMMZ140838 Esox niger](#)

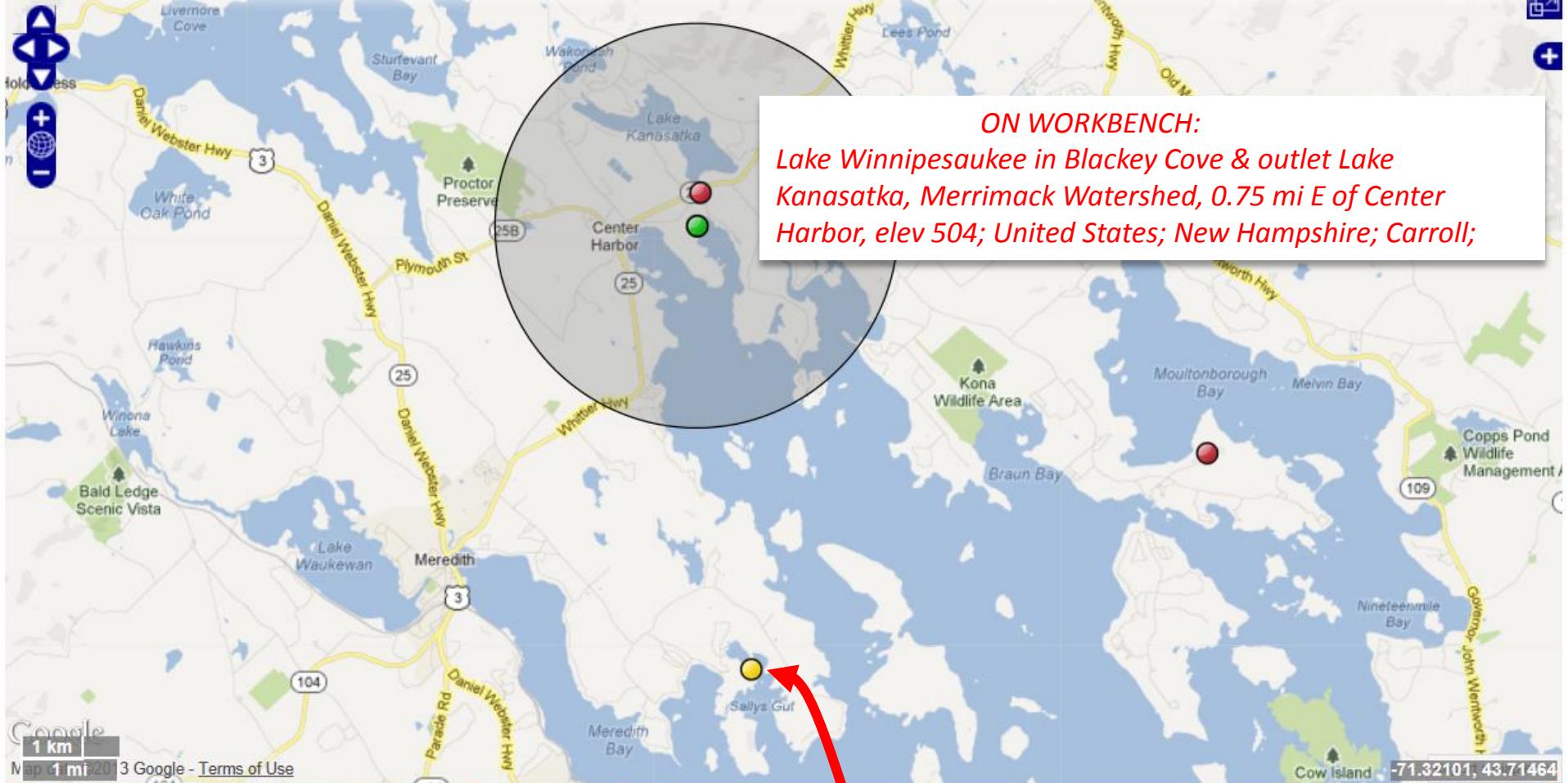
logged in as: nelson

Calculated Coordinates  
Lon: -71.433929  
Lat: 43.640311  
U. Radius: 259 m

Manual Edit

# Utilizing and Reviewing Past Work

2 GEO locate Client - Georeferencing Web Client  
4 possible locations found



Workbench    4 possible locations found    History

show 100 records  
get history  
Options  
 get skipped  
 get corrected

\*corrected on 3/2/2013 10:33:16 am\* Lake Winnipesaukee, Fish Cove near mouth of T 108, 3.5 mi ESE of Meredith, Merrimack  
\*corrected on 3/1/2013 2:02:10 pm\* Calcasieu River, 6.3 miles W of Jct of LA Hwy 113 and US 165.; United States; Louisiana; Rapides  
\*corrected on 3/1/2013 2:02:10 pm\* Calcasieu River, 6.3 mi. W. of Jct. of LA Hwy 113 & US 165; United States; Louisiana; Rapides  
\*corrected on 3/1/2013 1:48:30 pm\* Calcasieu River on La 113; United States; Louisiana; Rapides;  
\*corrected on 3/1/2013 1:48:30 pm\* Calcasieu River on LA 113; United States; Louisiana; Rapides;  
\*corrected on 3/1/2013 1:48:30 pm\* Calcasieu River, on LA 113; United States; Louisiana; Rapides;  
\*corrected on 3/1/2013 1:29:16 pm\* Soucook River, Merrimack system, 3 mi SSE of Concord, elev. 230 ft; United States; New H

move to workbench  
Options  
 include localities with matching determination  
 exclude outdated determinations

HTTP/1.1 200 OK

Content-Type: text/xml; charset=utf-8

Content-Length: length

<?xml version="1.0" encoding="utf-8"?>

<Georef\_Result\_Set xmlns="http://www.museum.tulane.edu/webservices/">

<EngineVersion>string</EngineVersion>

• **Wbservices**

<ExecutionTimems>double</ExecutionTimems>

<ResultSet>

**SOAP**

<WGS84Coordinate>

<Latitude>double</Latitude>

<Longitude>double</Longitude>

</WGS84Coordinate>

**GeoJSON**

<ParsePatterns>long</ParsePatterns>

<Precision>string</Precision>

<Score>int</Score>

<UncertaintyRadiusMeters>string</UncertaintyRadiusMeters>

<UncertaintyPolygon>string</UncertaintyPolygon>

<ReferenceLocation>string</ReferenceLocation>

<DisplacedDistanceMiles>double</DisplacedDistanceMiles>

<DisplacedHeadingDegrees>double</DisplacedHeadingDegrees>

<Debug>string</Debug>

</ResultSet>

<ResultSet>

.

.

.

</ResultSet>

</Georef\_Result\_Set>

# Interoperability

• **Wbservices**

**SOAP**

**JSON**

**GeoJSON**

**Web Client**



*Symbiota*

**Specify 6**



**Google**



**Arctos**



# Specify 6 + GEOLocate



Specify 6.4.08 (EZDB)

File Edit Data System Tabs Help

Welcome Data Trees Reports Interactions Statistics Query Workbench SGR Lifemapper Search

**Actions**

- Import Data
- Import Images
- New Data Set
- Export Data Set
- Export MS Excel Template
- Create Data Set from Record Set

**Reports**

- Basic Label
- Data Set Summary
- Chart
- Top 10

**Data Sets**

- Sample2

Loc LocalityString Geo Country Geo State Geo County Loc Lat Loc Lon Gd uncertainty

Loc	LocalityString	Geo	Country	Geo	State	Geo	County	Loc	Lat	Loc	Lon	Gd	uncertainty
1	Cable Station at Cape York	Australia	Queensland			-10.68850	142.53167						
2	Aberdeen Lake	Canada				64.46667	-99.00000						
3	Pioneer Park near Davis	USA	CA	Yolo									
4	Conroe	USA	TX										
5	Twin Creek at US Hwy 24	USA	CO	Teller									
6	Turkey Creek at Goodwin Road.	USA	AL	Jefferson									
7	Borden Creek at Forest Road 244, Sipsey Wilderness; 13.1 mi SSW M...	USA	AL	Lawrence									
8	Moon Lake	USA	MS	Coahoma									
9	Red River along right bank at River Mile 105; Station 1.	USA	LA	Rapides									
10	Bienville National Forest on US Hwy 20	USA	MS										
11	Zion National Park	USA	UT										
12	Whitetail state wildlife management area	USA	NE										
13	Lincoln Beach	USA	OR	Lincoln									
14	Green River near neatsville	USA	KY	Adair									
15	New Milan Reservoir, 1.75 miles north of milan	USA	MO										
16	Homochitto River, 1.5 mi. S of Bude, Hwy. 98.	USA	MS	Franklin									
17	Homochitto River 5 mi. E of Union Church, MS Hwy. 550.	USA	MS	Lincoln									
18	Mamala Bay	USA	HI										
19	Bay of bengal	India											
20	Henley On Thames	United Kingdom	Oxfordshire										

**GEOLocate Progress**

Process: 19 / 20

Cancel

Highlight Invalid Cells : 0 ▲ ▼ | Highlight New Records ?

Save Form

Trash

Welcome Sample2

Ichthyology DJ's Specify Test Collection djihbril

# Specify 6 + GEOLocate

**GEOLocate Results Chooser - 3 of 20**

**Locality Information**

Description: Pioneer Park near Davis  
 County: Yolo  
 State: CA  
 Country: USA

**Correction (Green) Marker Properties**

Position	Uncertainty Radius	Error Polygon
Latitude: 38.545 Longitude: -121.73944	In meters: 6688	-121.754239949, 38.5754950193, -121.753548949
<input type="button" value="Apply"/> <input type="button" value="Apply"/> <input type="button" value="Clear Polygon"/>		

**GEOLocate Results**

Number	Latitude	Longitude	Pattern	Precision	Error Polygon	Uncertainty
1	38.545	-121.739	Near DAVIS (Adm: YOLO)	Medium (50)	present	6254
2	38.551	-121.686	PIONEER PARK (Adm: YOLO)	Low (27)	unavailable	2289

Get Elevation 16.13m U. Radius: 6688m  Measure Clear Ruler Lat: 38.492294, Lon: -121.571274  
 NED 1/3rd arc-second: Western United States

[GEOLocate Web](#)



```
library(RJSONIO)
library(RCurl)

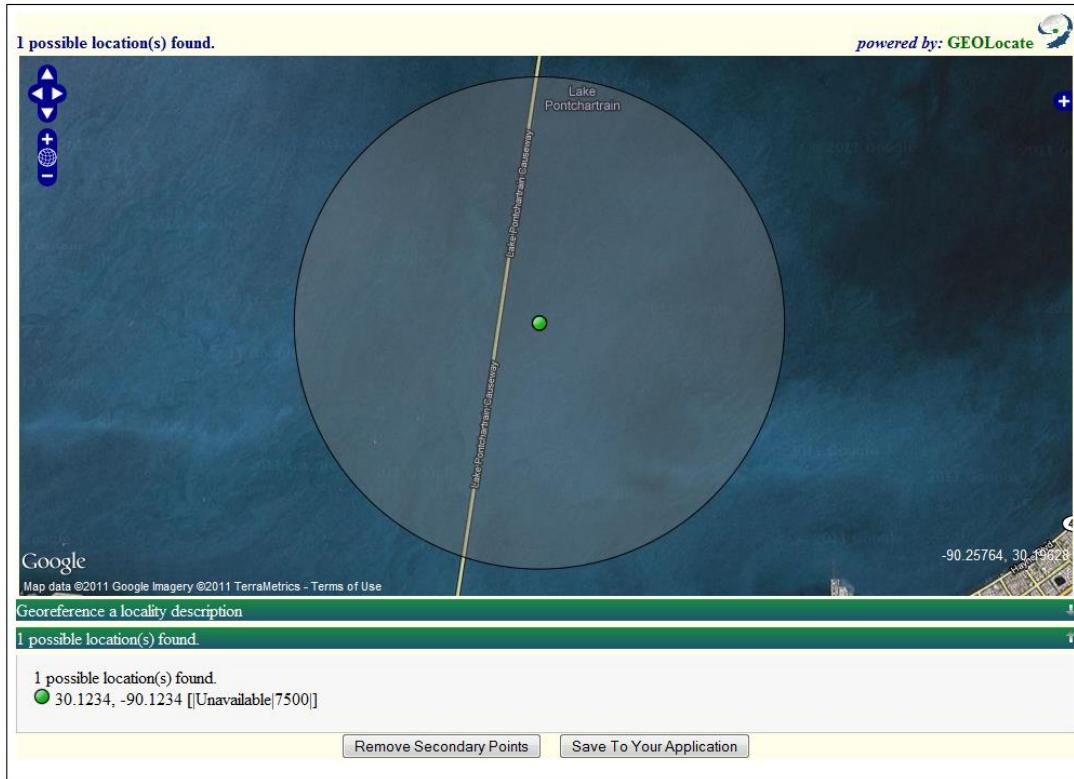
setwd("E:/FishNet2GeoRef")

INPUTFILENAME="t_localities4GLC2.csv"
OUTPUTFILENAME="t_localities4GLC_out.csv"
OUTPUTFILENAMEFIRSTRESULT="t_localities4GLC_out_first_result.csv"

OPTIONS="-&doduncert=true&opolys=false&displacepoly=false"
glcIn= read.csv(INPUTFILENAME)
numGLCRuns = 0
recordCounter = 0
for (k in 1:nrow(glcIn)){
  print(k)
  Sys.sleep(3) #be nice and pause a few seconds between requests
  Country=glcIn[k,]$Country
  Locality=glcIn[k,]$Locality
  StateProvince=glcIn[k,]$StateProvince
  County=glcIn[k,]$County
  q=paste("http://www.museum.tulane.edu/webservices/geolocatesvcv2/glcwrap.aspx?country=",Country)
  q=gsub(' ','%20',q)

  tryCatch({
    JSONresponse = basicTextGatherer()
    curlPerform(url = q, writefunction = JSONresponse$update)
    glcRecNum = k
    glc = fromJSON(JSONresponse$value())
    numresults = glc$numResults
    if (numresults > 0){
      for (i in 1:numresults) {
        glcRank = i
        glcLongitude = glc$resultSet$features[[i]]$geometry$coordinates[1]
        glcLatitude = glc$resultSet$features[[i]]$geometry$coordinates[2]
        glcPrecision = glc$resultSet$features[[i]]$properties$precision
        glcScore = glc$resultSet$features[[i]]$properties$score
        glcParsepattern = glc$resultSet$features[[i]]$properties$parsesPattern
        glcUncert = glc$resultSet$features[[i]]$properties$uncertaintyRadiusMeters
        glcPoly = glc$resultSet$features[[i]]$properties$uncertaintyPolygon
        #if a polygon is present reformat coordinates to geolocate format-a comma delimited array
        if ("coordinates"%in%names(glcPoly)){
          sPoly = ''
```

# Application Services: Web Client APIs



Listening for a message from GEOLocate.

- URL API for user input & lightweight web clients
- Lightweight client, specifically designed for embedding into other web applications.
  - Two way communication between web sites uses JavaScript postMessage()
  - Compatible with all modern browsers:
    - IE 8.0+
    - Firefox 3.0+
    - Safari 4.0+
    - Chrome 1.0+
    - Opera 9.5+



DATA MINING WITH R

East West Records

[ AJAX ] [ SQL ] [ Java ] [ download ]

0 records



- Data Providers
  - Report a bug or request support

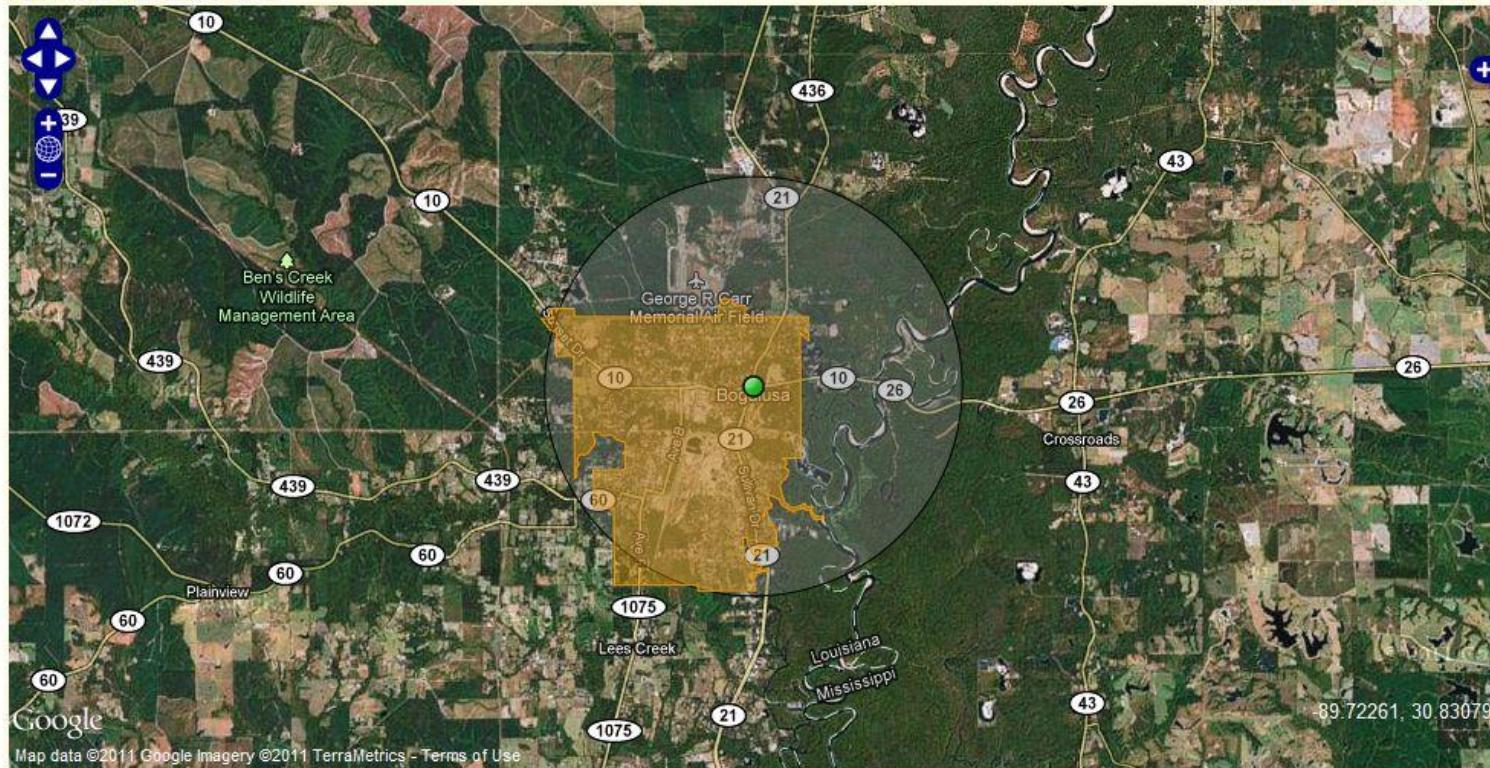


[ help ]

0-06

powered by: GEOLocate

1 possible location(s) found.



Georeference a locality description

1 possible location(s) found.

1 possible location(s) found.

● 30.79083, -89.84861 [BOGALUSA|30.801736012,-89.8943429191...|4490|Low(23)]

Remove Secondary Points

Save To Your Application

# Symbiota + GEOLocate



## Arizona State University Vascular Plant Herbarium

[Home](#) >> [Control Menu](#) >> [Batch Georeferencing Tools](#)

### Query Form

Country: USA State: Arizona County: All Counties  
Locality Term: Tumamoc

Return Count: 39



Geolocate locality

- Pima County, Growing on sanitary landfill, Tumamoc Hill, Tucson [1]
- Pima County, N slope above laboratory ground, Tumamoc Hill [1]
- Pima County, North slope above laboratory grounds, Tumamoc Hill, Tucson [1]
- Pima County, North slope above laboratory grounds, Tumamoc Hill, Tucson [1]
- Pima County, S side of Tumamoc Hill on Desert Laboratory property, TRS: T14S R13E S15 [1]**
- Pima County, South side of Tumamoc Hill along 22nd Street, TRS: T14S R13E S15 SW1/4 [1]
- Pima County, South side of Tumamoc Hills along 22nd Street, TRS: T14S R13E S15 [1]
- Pima County, SW base of Tumamoc Hill on Desert Laboratory property, TRS: T14S R13E S15 SW1/4 SW1/4 [1]
- Pima County, Tucson Mountains, Tumamoc Hill just below (west of) the University of Arizona Geochronology Lab, TRS: T14S R13E S15 NW1/4 [1]
- Pima County, Tucson Mountains, Tumamoc Hill, Tucson [1]
- Pima County, Tucson Mountains, Tumamoc Hill just below (W of) the University of Arizona Geochronology Lab, TRS: T14S R13E S15 [1]
- Pima County, Tucson Mountains, Tumamoc Hill, AZ [1]
- Pima: Tucson, south slope of Tumamoc Hill, TRS: T14S R13E sec 6 G-AZ; TRS: T14S R13E sec 15 G-AZ [3]
- Pima: Tucson, south slope of Tumamoc Hill, TRS: T14S R13E sec 6 SW1/4 SW1/4 G-AZ; TRS: T12S R13E sec 36 NE1/4 NE1/4 G-AZ; TRS: T14S R13E sec 6 G-AZ; TRS: T14S R13E sec 15 SE1/4 -

### Statistics

Records to be Georeferenced  
Arizona: 6317  
Total Number: 39723  
Total Percentage: 21.6%

Deg.	Min.	Sec.	Decimal
Latitude:			N <input type="button" value="°"/> = <input type="text"/>
Longitude:			W <input type="button" value="°"/> = <input type="text"/>
Error (in meters):	meters		Datum: <input type="text"/>
Sources:	egbot 2012-04-01		
Remarks:	<input type="text"/>		
Verification Status:	reviewed - high confidence		
Elevation:	<input type="text"/>	to	<input type="text"/> meters

GEOLocate Tool - Mozilla Firefox

localhost:89/seinet/collections/georef/georef/georeference.php?country=USA&state=Arizona&county=&locality=

Avg Secure Search

County: All Counties Generate List

13E sec 6 G-AZ; TRS: T14S R13E sec 15 SE1/4! Statistics

Records to be Georeferenced

Arizona: 6317 Total Number: 39723 Total Percentage: 21.6%

Lon: -111.0031  
Lat: 32.2138  
Uncertainty: 969 meters  
Edit uncertainty  
Parse pattern: undefined

Georeference a locality description

2 possible location(s) found.

2 possible location(s) found.

32.2138, -111.0031 [TRS|Unavailable|969|High(85)]

32.21278, -111.00556 [TUMAMOC HILL|Unavailable|1807|Low(27)]

Remove Secondary Points Save To Your Application



# Excel + GEOLocate



	A	B	C	D	E	F
1	Locality	Country	State	County	Link to GEOLocate Web App	<a href="#">Referencing</a>   <a href="#">Developer Resources</a>   <a href="#">Workshops</a>   <a href="#">Support and Contacts</a>
2	Bogalusa	USA	LA	Washington	<a href="#">Georeference Me!</a>	<a href="#">?</a>
3						
4						
5						

The map displays a zoomed-in view of Bogalusa, Louisiana. A green dot marks the georeferenced location. A grey circle highlights the city boundaries, and an orange polygon shows the error or displacement polygon. The map includes labels for Ben's Creek Wildlife Management Area, George R Carr Memorial Air Field, Superior Dr, Superior Ave, Ave B, Ave F, Old Camp Rd, and Crossroads. Roads are labeled with route numbers like 10, 21, 26, 43, 439, 1072, 1075, and 1076. A scale bar indicates 2 km.

Georeference a locality description

Locality String: Bogalusa  
Country: UNITED STATES OF AMERICA  
State: LA County: Washington

Match Water Body | Language: English

Detect Hwy/River Crossing  Restrict to Lowest Adm. Unit  
 Do Uncertainty  Do Error Polygon  Displace Polygon

Latitude: 30.79083 Longitude: -89.84861  
Uncertainty: 4490 m

+BG (may slow things down)  Draw polygon  Clear Polygon  Measure

Click here for batch georeferencing.  
30.801736012,-  
89.8943429191,30.803885012,-  
89.8962909191,30.803941012,-  
89.8960619191,30.803941012,-  
89.8937979191,30.803960012,-  
89.8933499191,30.805185012,-

1 possible location(s) found.

<http://www.museum.tulane.edu/geolocate/web/WebGeoref.aspx?v=1&Country=USA&State=LA&County=Washington&Locality=Bogalusa&georef=run>

# Georeferencing Wet Collections:

The FishNet 2 Project



Global network of fish collections

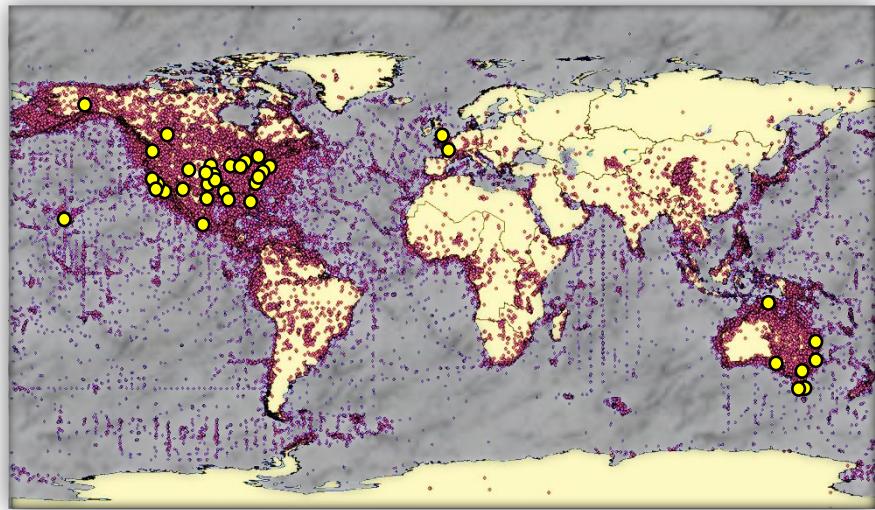
53 data providers

3.3 million lots

30+ million specimens

57% georeferenced

4+ million lots  
100% georeferenced



**FishNet 2**

Search News About Join FishNet Contact Us Help

**Search FishNet:**  
[+] Click to minimize Text Search Fields

Taxon:   
Location:   
Institution Code and/or Catalog Number:  >>

Date Range (yyyy-yyyy):   
Other:   
[Beta] Search Polygon (in Well-Known Text format):  
You may use the map below to draw a polygon.  
Doing so will populate this field.

[+] Click to expand Map for drawing

Execute Query Clear Fields

Looking for the older search pages? Click here.

Join us on [facebook](#)

Development funding provided by:  
National Science Foundation | National Biological Information Infrastructure  
© 2010 FishNet 2 - All Rights Reserved  
Updated Aug. 13, 2010

# Distributed Georeferencing



CALIFORNIA  
ACADEMY OF  
SCIENCES

NATURAL  
HISTORY  
MUSEUM  
LOS ANGELES COUNTY



TEXAS NATURAL SCIENCE CENTER  
THE UNIVERSITY OF TEXAS AT AUSTIN

KU BIODIVERSITY  
INSTITUTE  
The University of Kansas

The Field  
Museum

ILLINOIS NATURAL  
HISTORY SURVEY  
PRAIRIE RESEARCH INSTITUTE



Cornell University  
Museum of Vertebrates

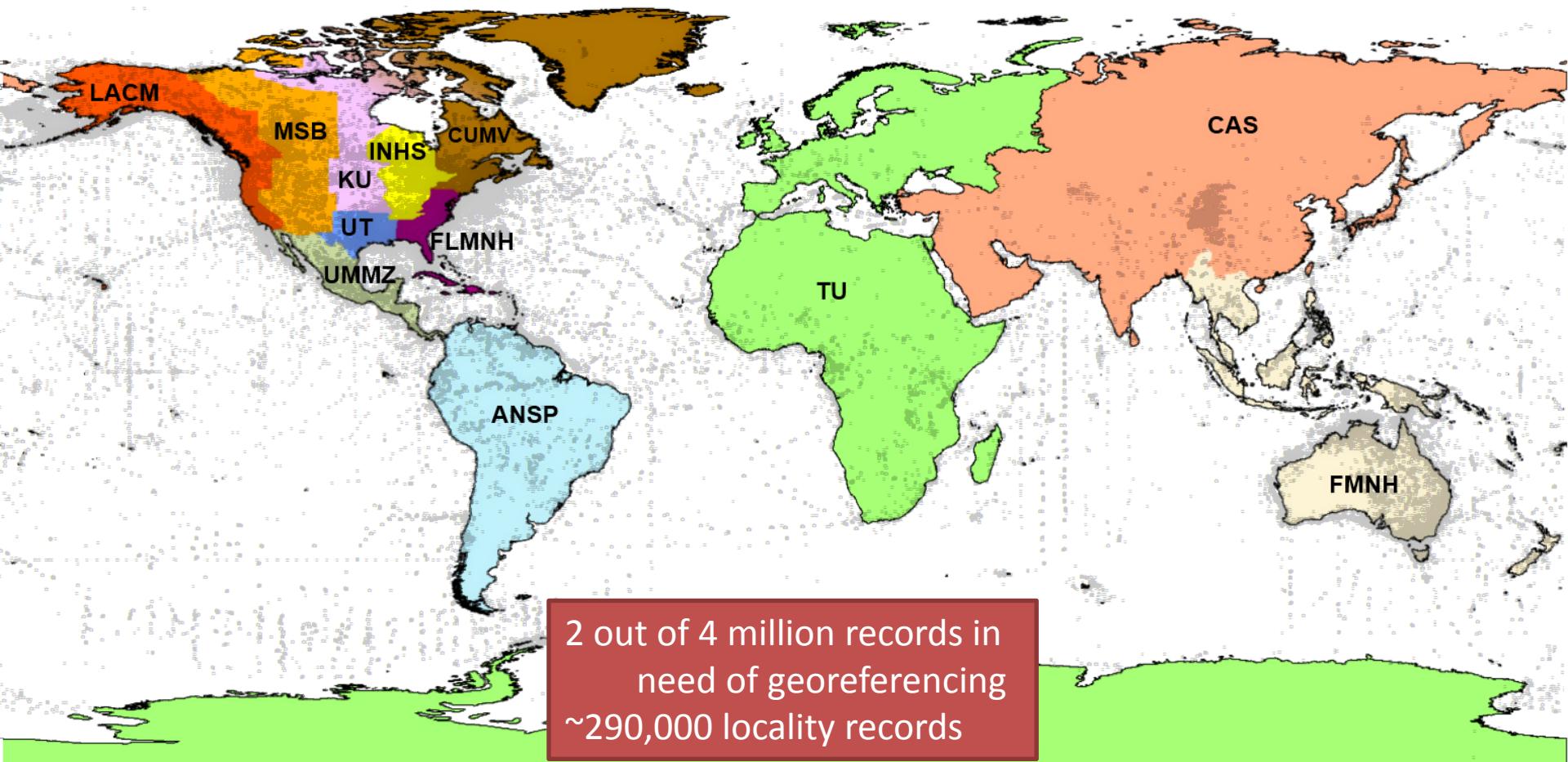
THE ACADEMY OF NATURAL SCIENCES  
—CONNECTING PEOPLE TO NATURE SINCE 1812—



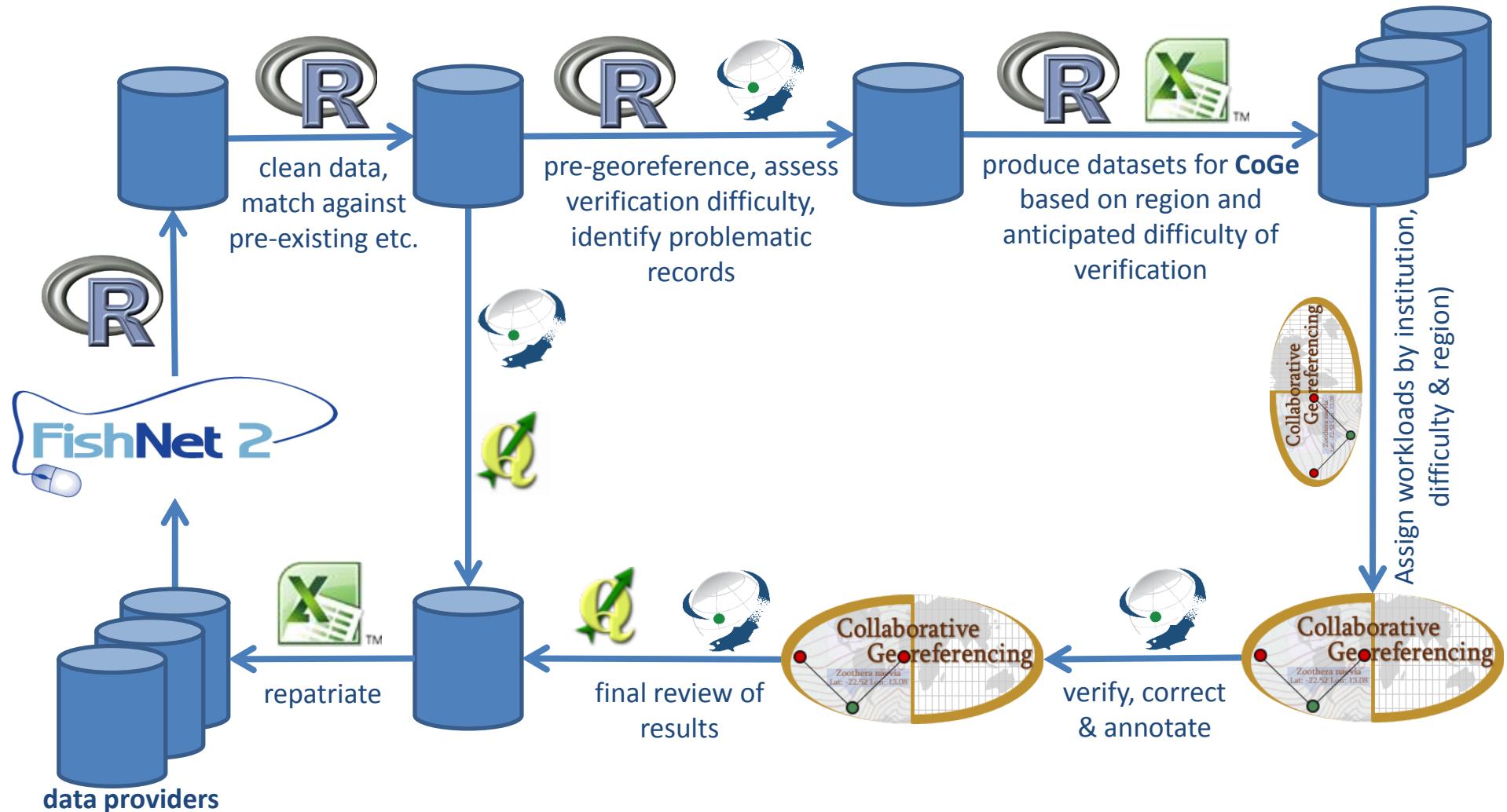
FLORIDA  
MUSEUM  
OF NATURAL HISTORY



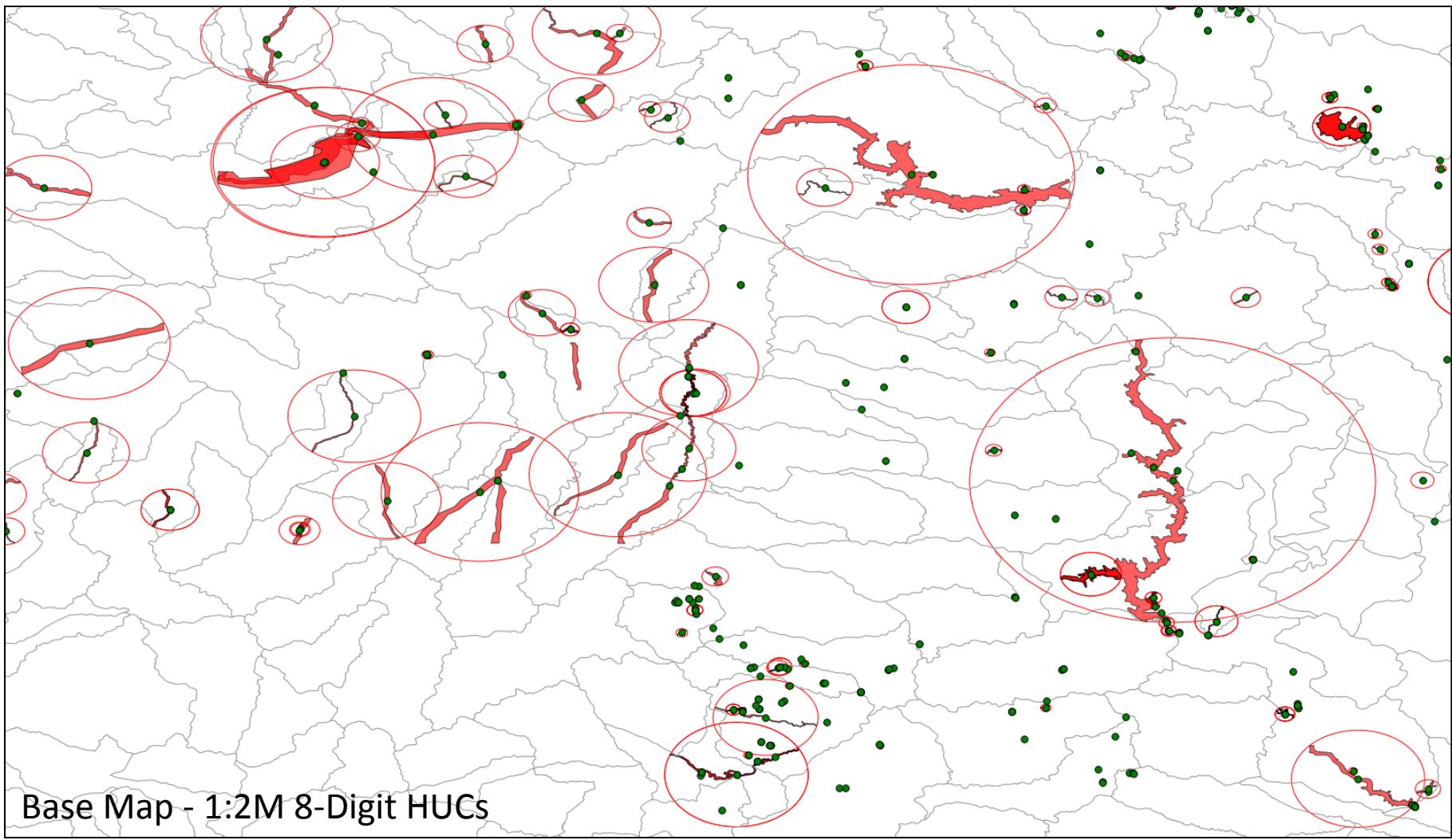
# “Preliminary” Assignments



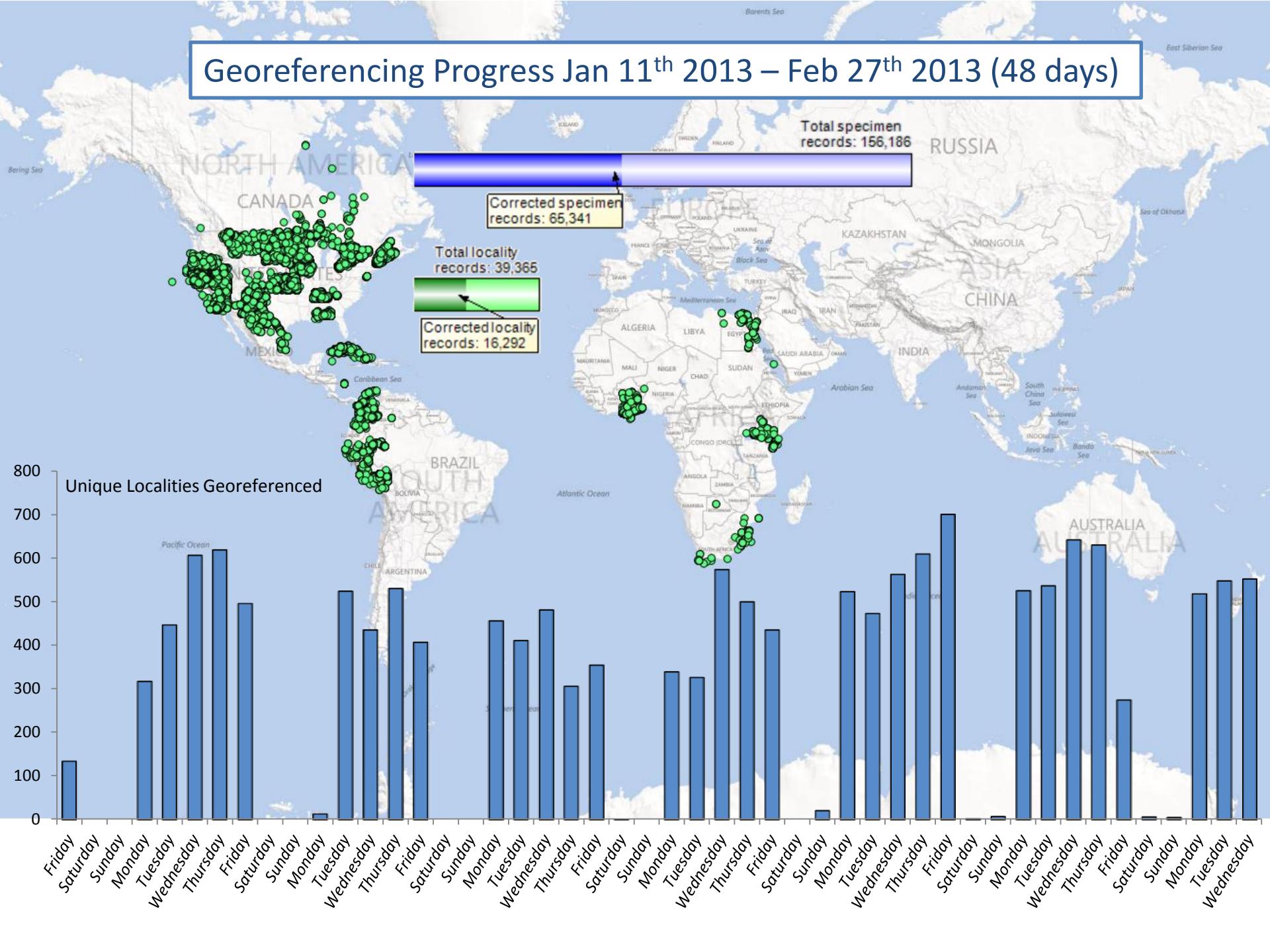
# Workflow: Integrating API's



# Representing Uncertainty



# Georeferencing Progress Jan 11<sup>th</sup> 2013 – Feb 27<sup>th</sup> 2013 (48 days)



# Acknowledgements

Djihbrihou Abibou	Benito Lorenzo	Alexandra Snyder
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Paul DeSalles	Luiz Rocha	Ed Wiley
Michael Doosey	Megan Roberson	
Rick Feeney	Rob Robins	
Bill Fink	Mark Sabaj	
John Friel	Leo Smith	
Ed Gilbert	Norine Spears	
Justin Grubich	Rod Spears	
Dean Hendrickson		
Mariangeles Arce Hernandez		

