Exploring the Surprising Beetle Diversity of the I-35 corridor via iNatualist

Mike Quinn, M.Sc.

Outline

A Few Early Texas Coleopterists

Beetle Collections Important to Texas

Karl Stephan of Latimer Co., Okla

Explosion of Observational Data

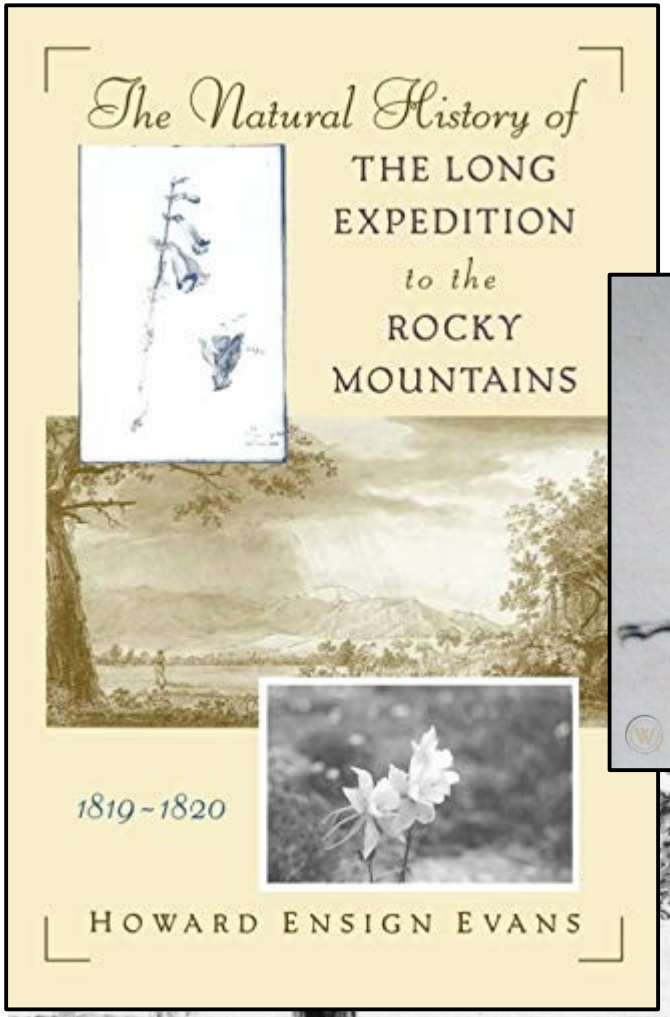
Discussion of BugGuide and iNat

Distribution of Beetles & Peoples

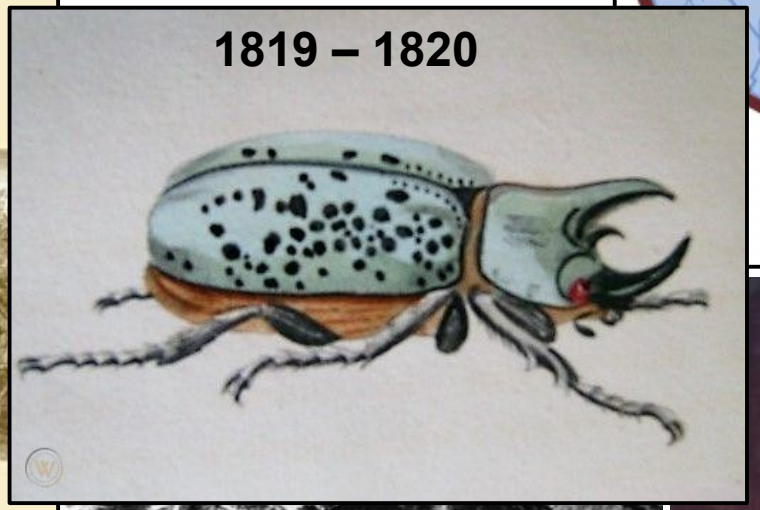
iNat vs E. G. Riley Beetle Diversity

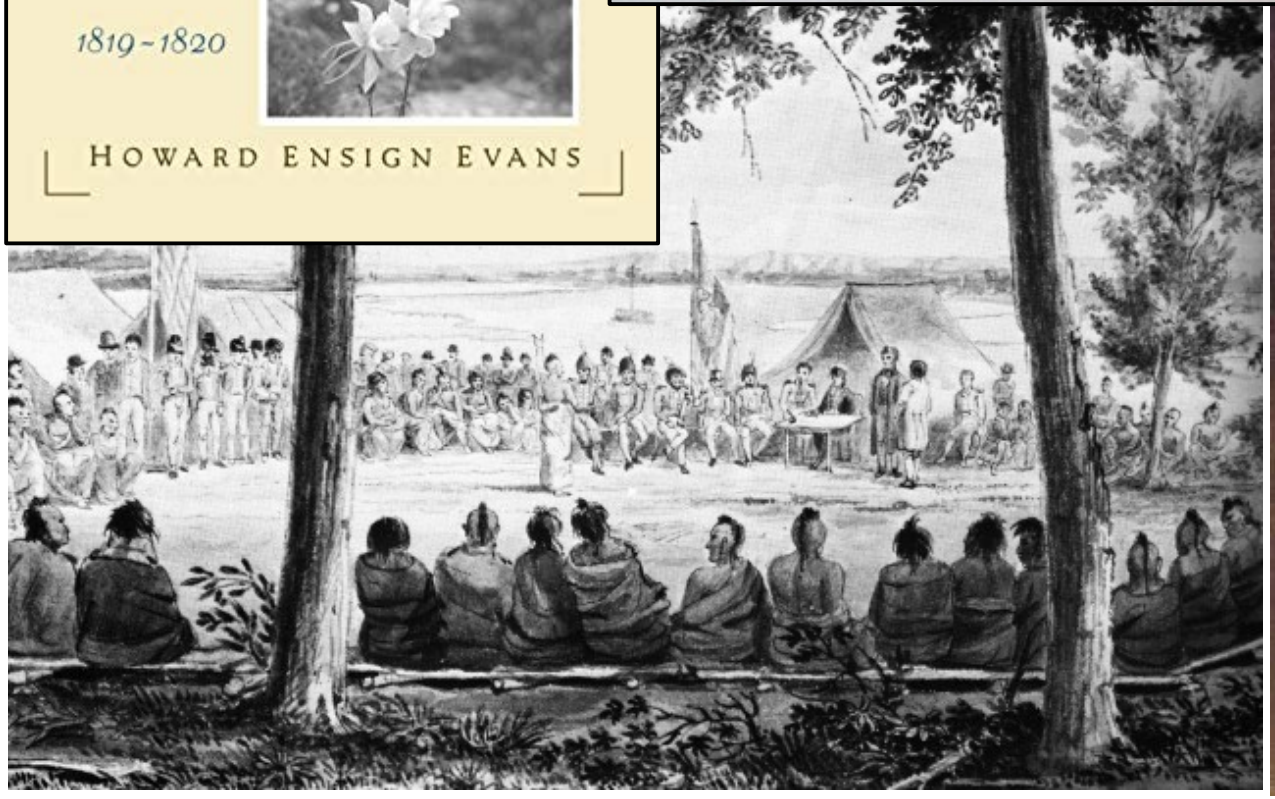
How to Go Small

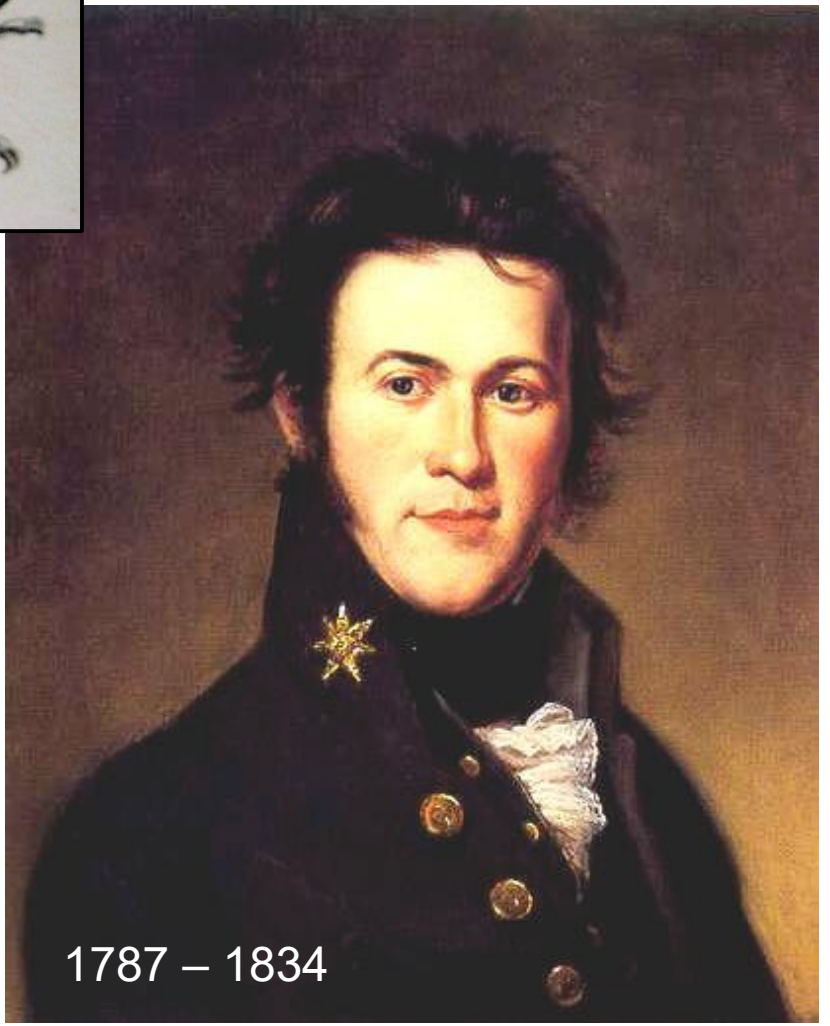
The Long Expedition



1819 – 1820





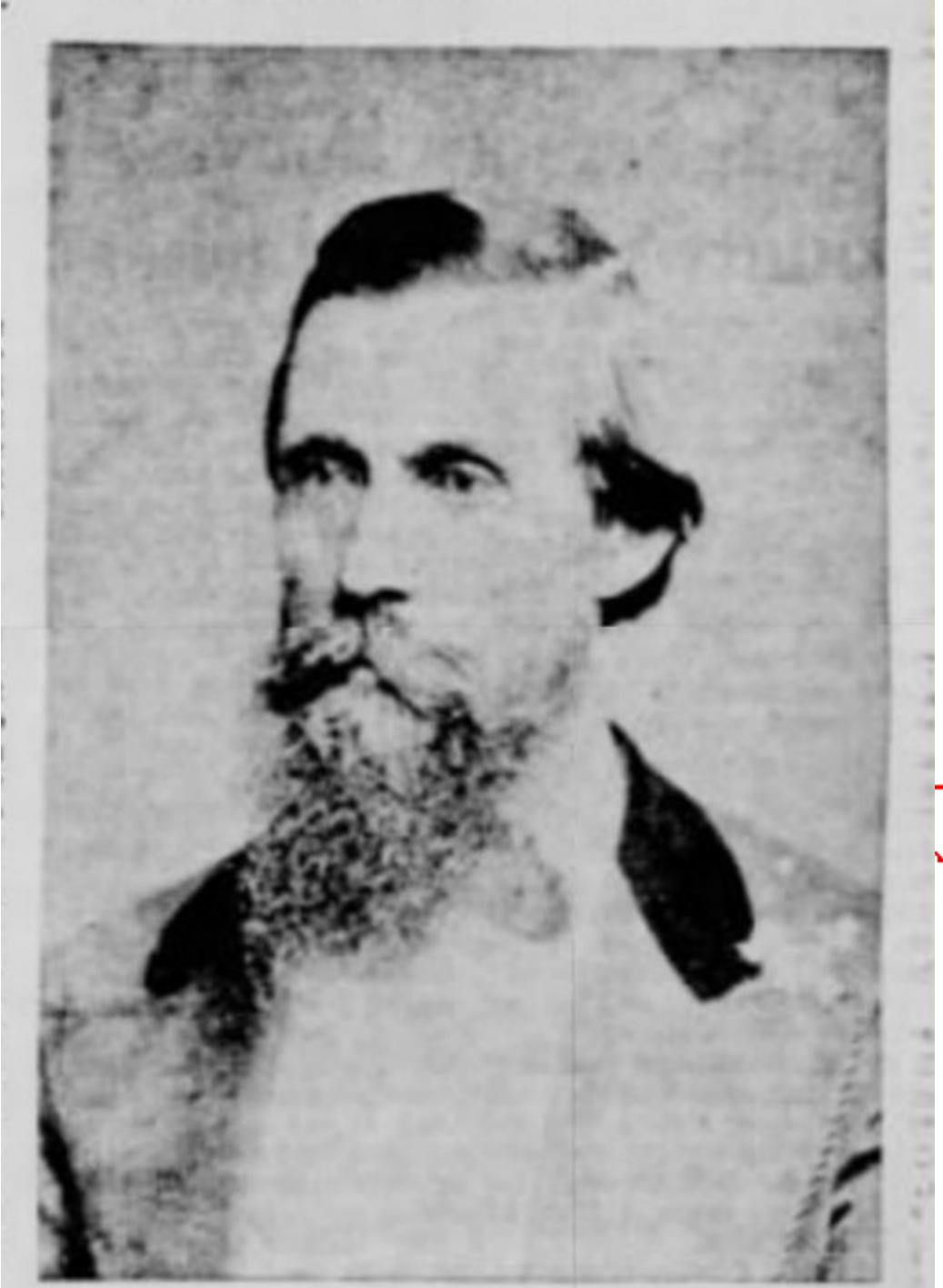


1787 – 1834

The Mexican-United States Boundary Commission - 1849-1855
Texas portion of the Rio Grande was surveyed **1851-1855**

The Mexican-US Boundary Survey was the source of many new beetles species that LeConte described.

Grave marker in the
Santa Ana NWR Cemetery of
Thomas. W. Jones (c. 1827-1853),
assistant surveyor of the
US Mexico boundary survey party,
who drowned in the Rio Grande near
Santa Ana.

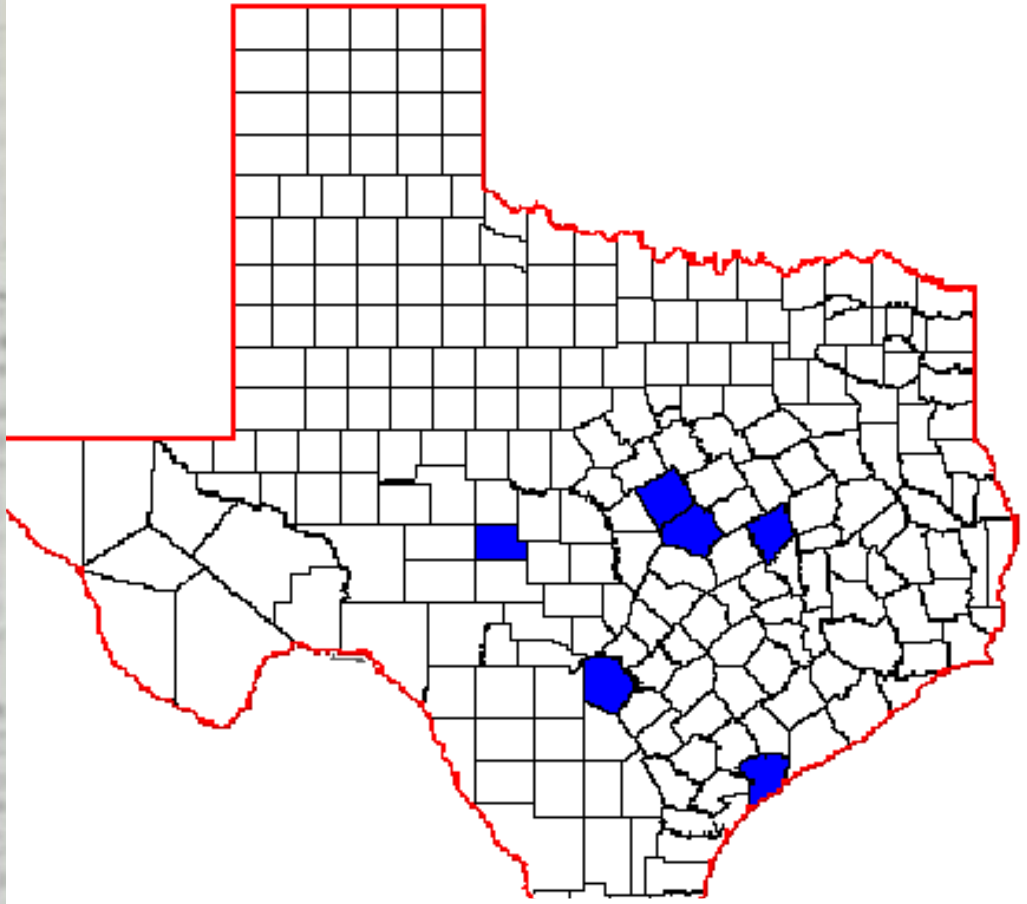


MAJOR HORACE HALDEMAN OF OLD TROY

A Yankee Soldier Who Stayed With the South

Horace Haldeman (1820-1883)

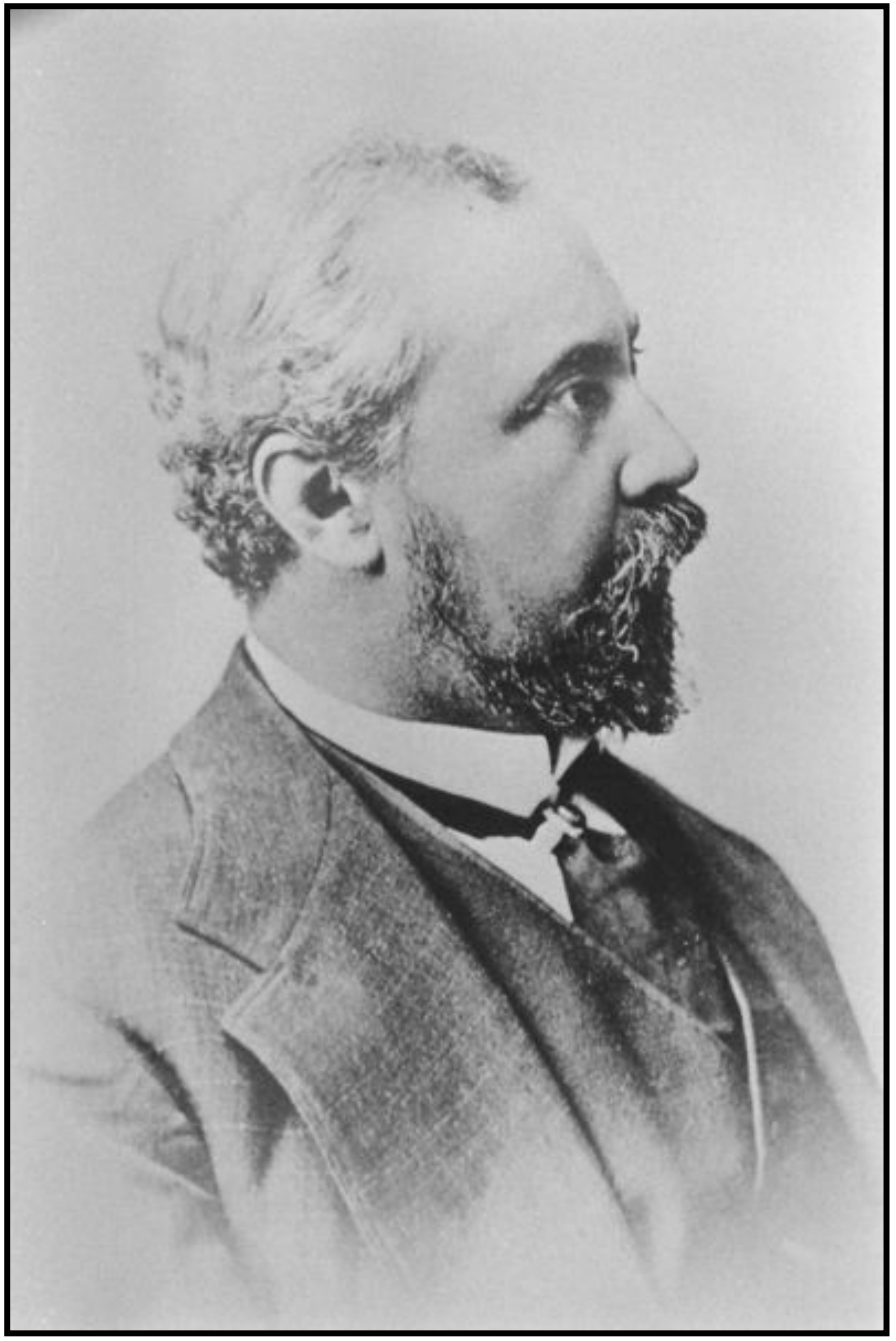
Horace Haldeman was one of the first persons to concentrate on collecting insects in Texas.



Horace sent his specimens, mostly beetles, to Samuel S. Haldeman and to John LeConte for description.

***Leptinotarsa haldemani* (Rogers, 1856)**

***Zopherus nodulosus haldemani* Horn**
Orig. Comb:
***Zopherus haldemani* Horn, 1870**



Wikimedia Commons

John Lawrence LeConte (1825 - 1883)

Father of American beetle study

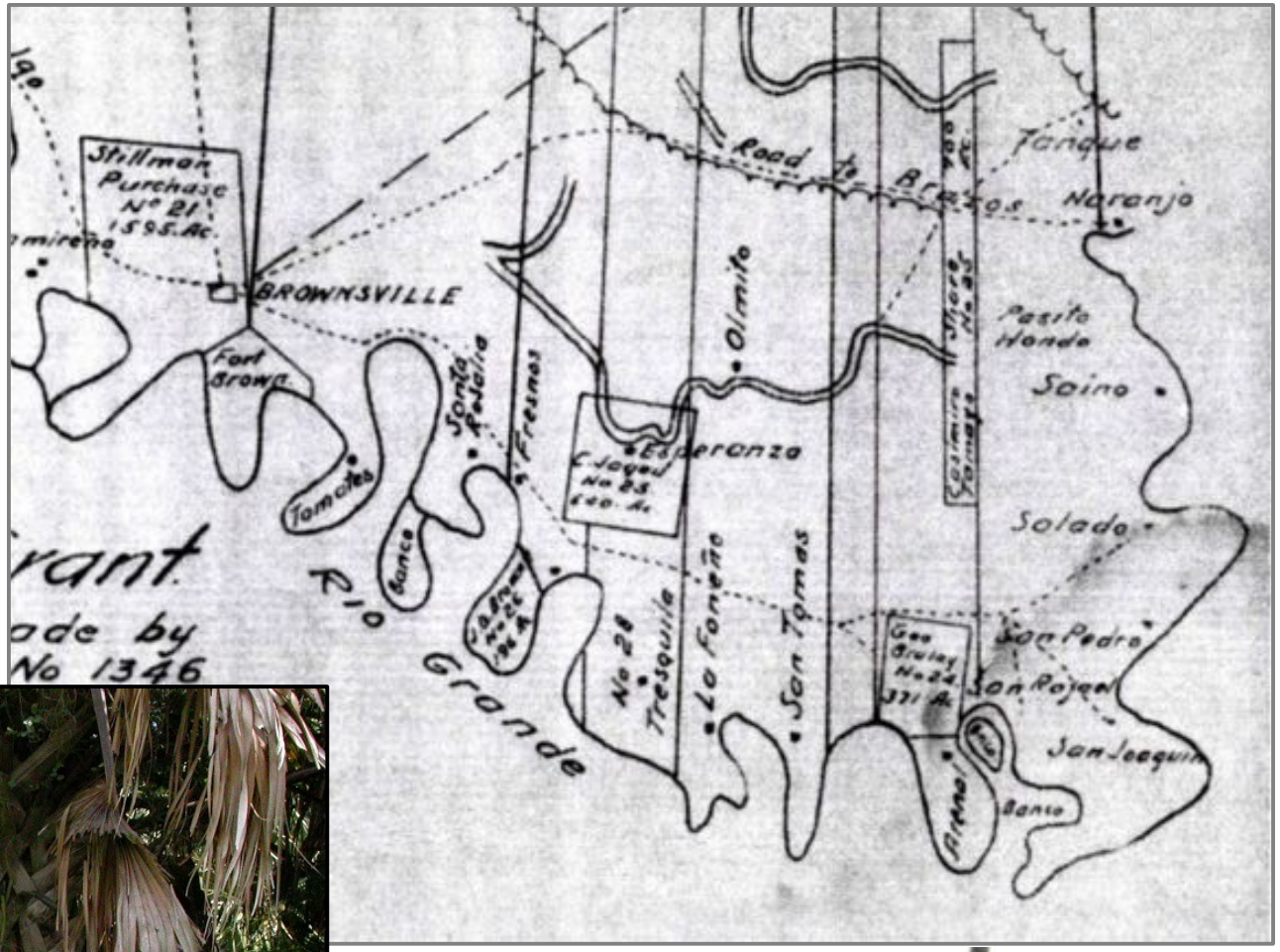
…was the most important American entomologist of the 19th century, responsible for naming and describing approximately half of the insect taxa known in the United States during his lifetime, including almost 5,000 species of beetles.

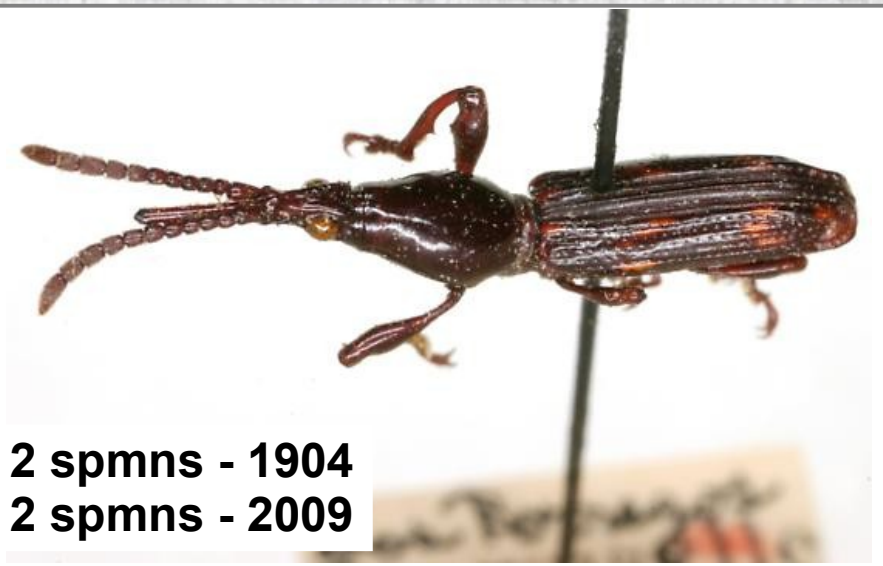
He moved to Philadelphia in 1852, residing there for the rest of his life.

LeConte's Thrasher
LeConte's Sparrow
Ammodramus leconteii (Audubon, 1844)

Charles Schaeffer's
former coll'g Grounds

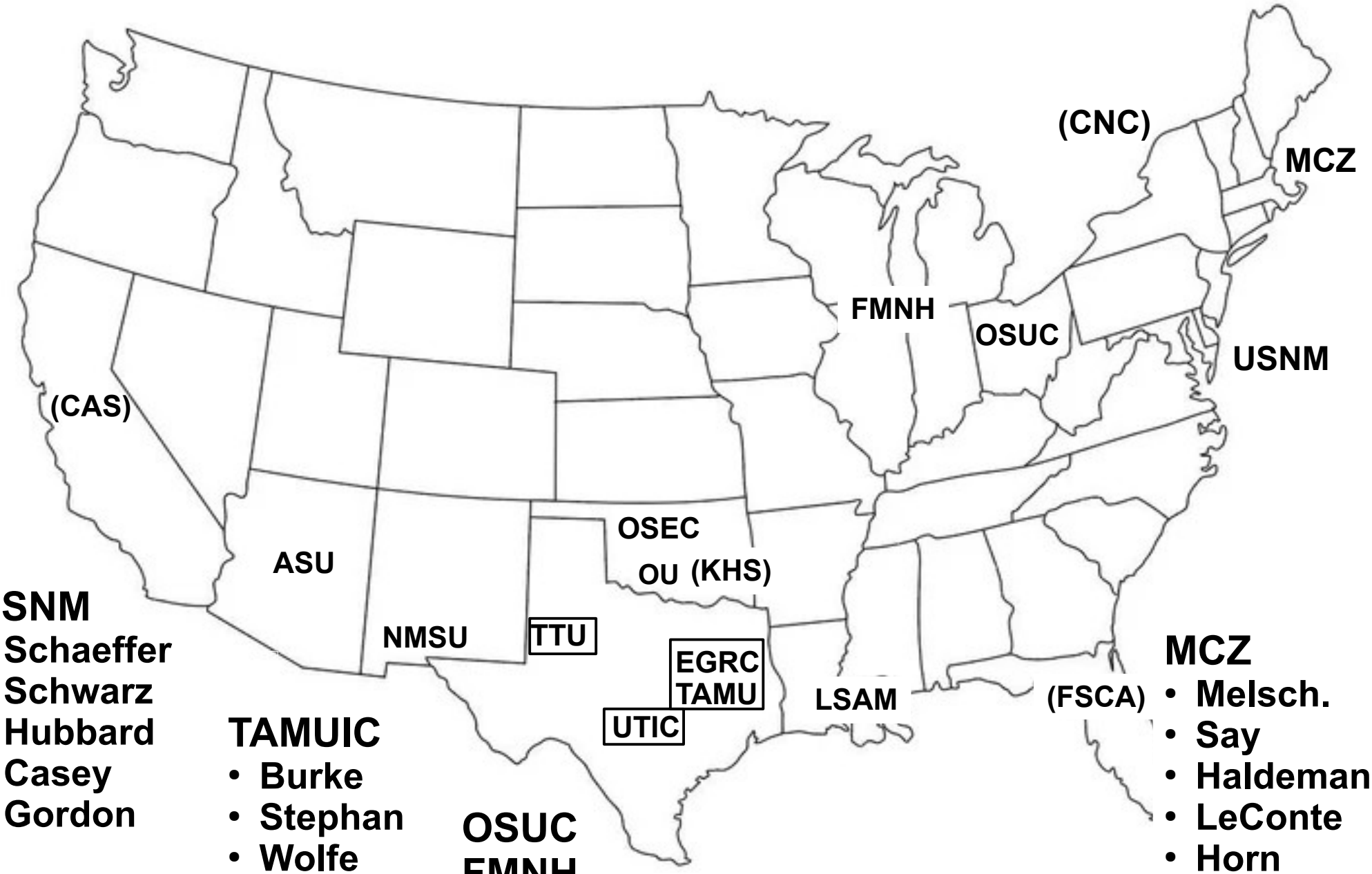
Schaeffer described:
109 species in
91 genera in
26 families
that occur in Cameron County, Texas.





2 spmns - 1904
2 spmns - 2009

Beetle Collections Important to Texas



USNM
- Schaeffer
- Schwarz
- Hubbard
- Casey
- Gordon

TTU
- O'Brien

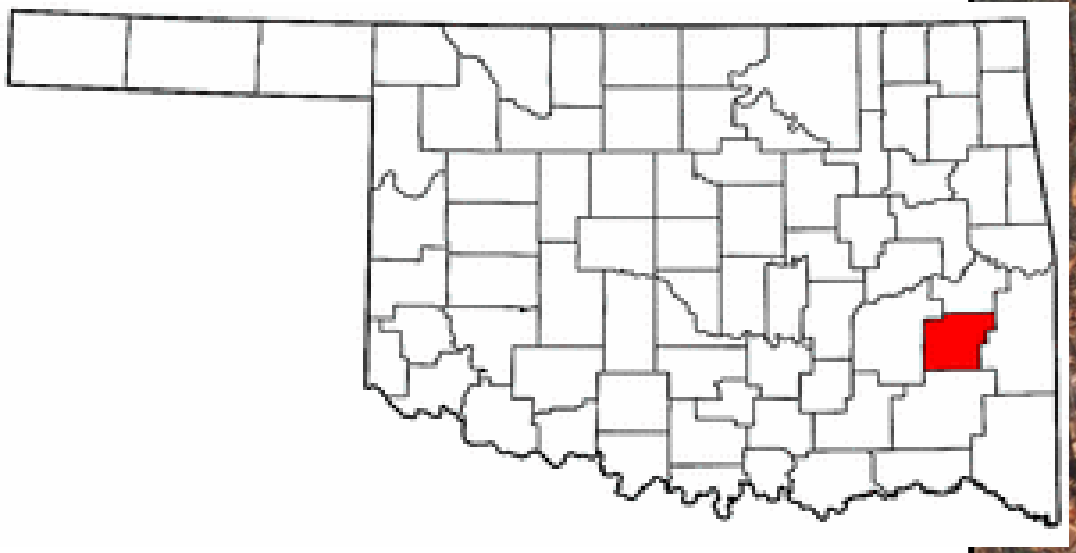
TAMUIC
- Burke
- Stephan
- Wolfe
- Heffern
- (Riley)

OSUC
FMNH
- J&D Knull (pre HWY)
- Triplehorn

MCZ
- Melsch.
- Say
- Haldeman
- LeConte
- Horn
- Fall
- Crotch

Karl Heinz Stephan
(1931-2005)

”He was quite possibly the most skilled beetle collector of modern times.”



“This is one of the most thoroughly documented pieces of real estate in the U.S. for beetle diversity.”

Carlton et al., 2005. Obituary: Karl Heinz Stephan 1931-2005.

H. W. Robison, 1990

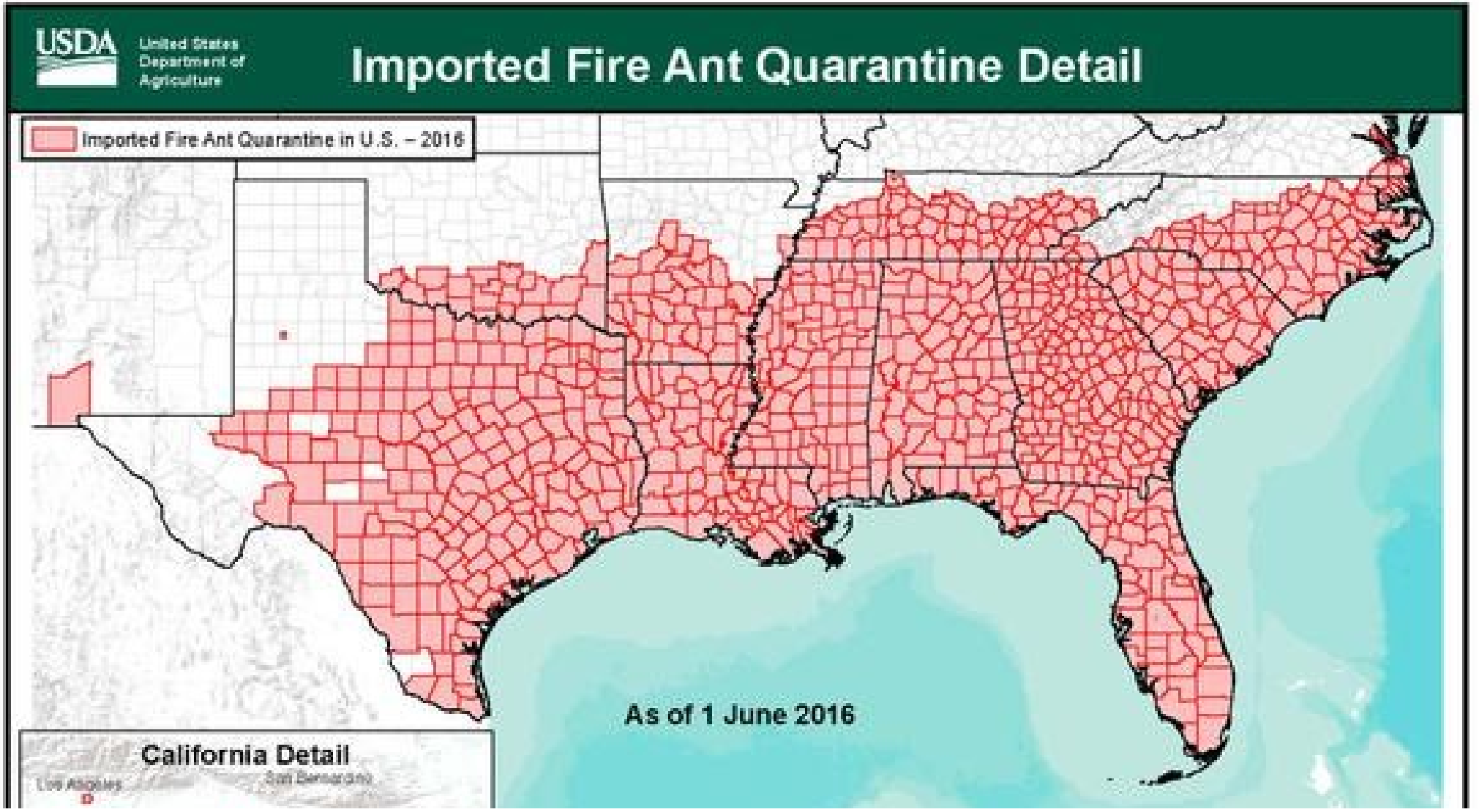
Karl Stephan collected **3,516 beetle species** in one Oklahoma county

That's more than the **3,296 bird species** in all of South America!

(But just 120 beetle species from Latimer County, OK have been posted to iNaturalist.)

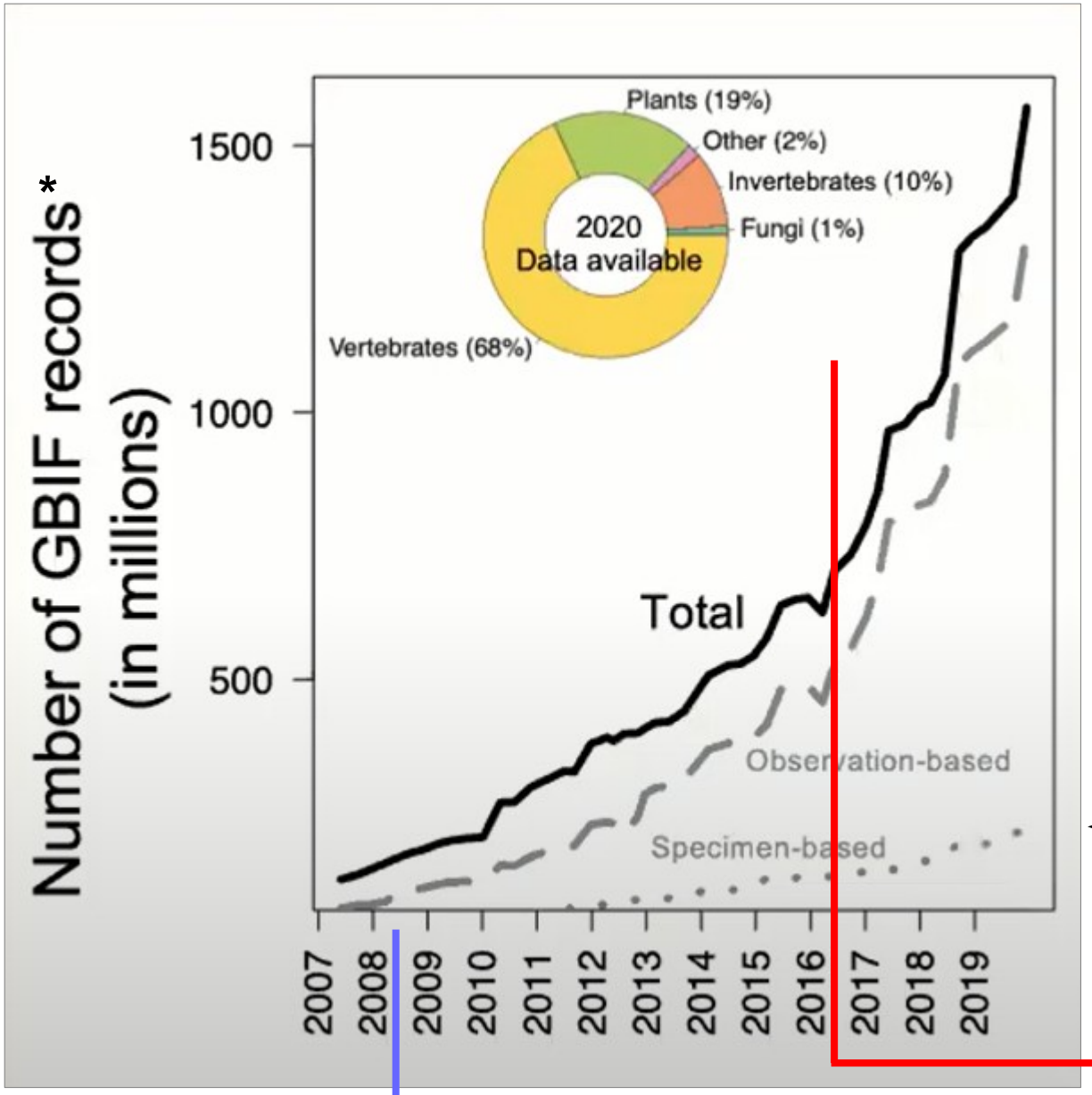
Dec. 2022

Fire Ant Quarantine as of 2016



USDA

GBIF Records (Observed and Spmn) 2007-2020



% GBIF Taxa

68% - Verts (Birds)

19% - Plants

10% - Inverts

*NOTE: these are the # of ***Obs*** and ***Spmns***, not ***Spp.***

← Specimen-based data ~175M records

Inflection Point

eBird 2002 – 1B(!)

BG 2003 – 1.2M (500K RG)

iNat founded 2008 – 54M RG

Heberling et al., (in revision)

What is GBIF?

Global Biodiversity Information Facility

GBIF in an umbrella dataset that combines data from >2K databases from around the world
Most datasets with <2M records

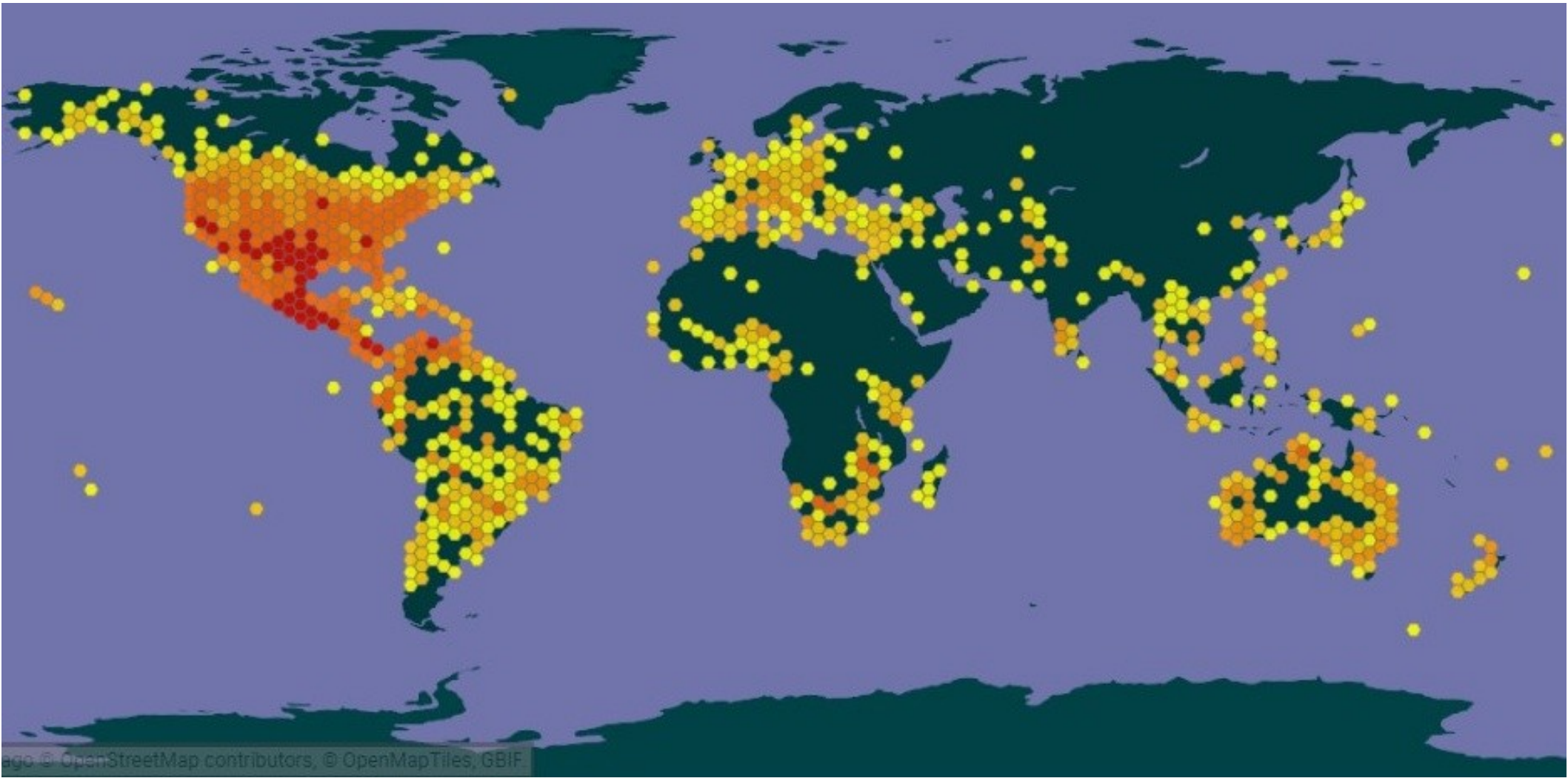
Scarlet Macaw (*Ara macao*) by Yeanina Cruz. Photo licensed under CC BY-NC 4.0.

www.gbif.org

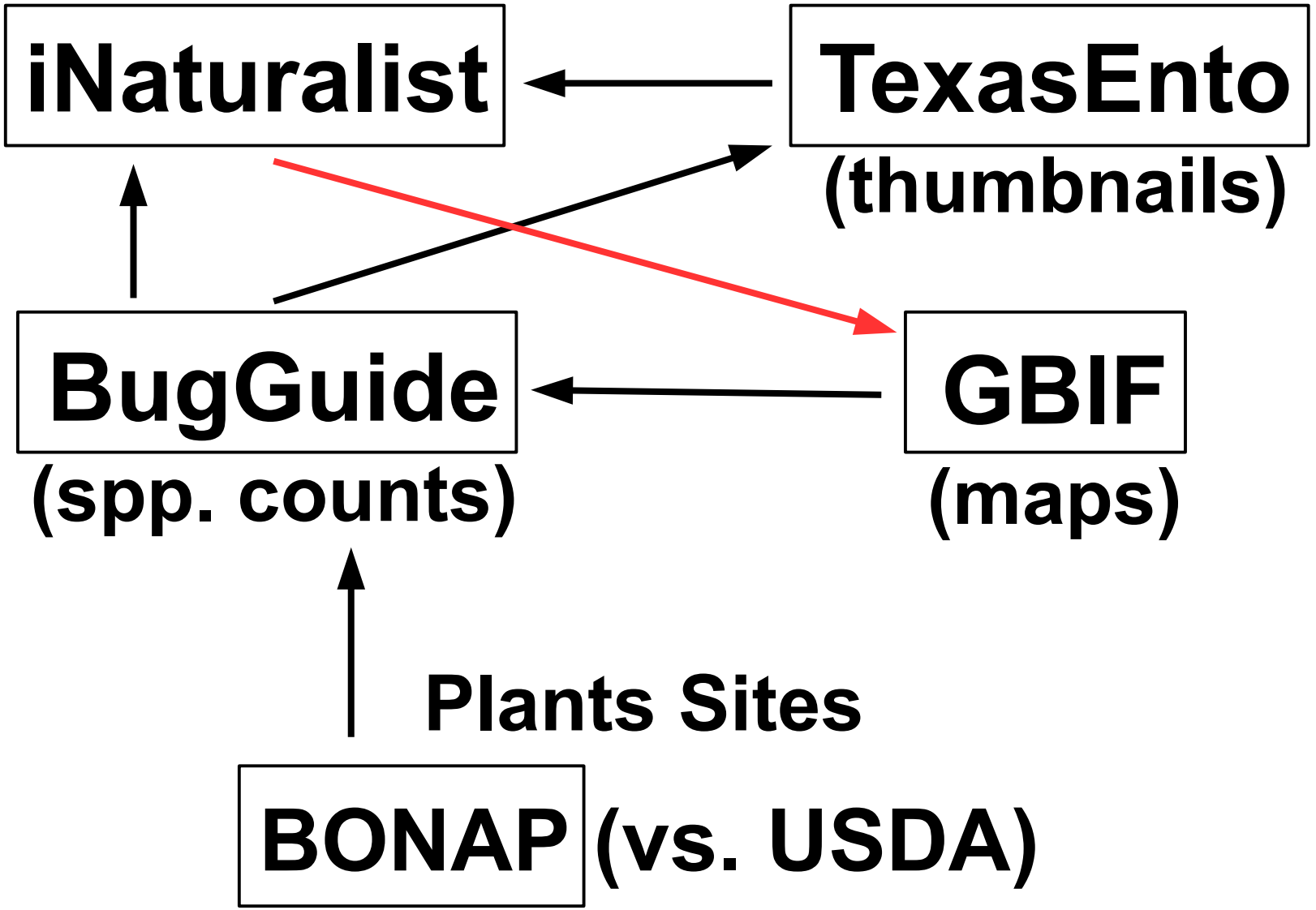
Texas A&M University Insect Collection

The TAMUIC has grown steadily through the years, especially in the last three decades, to become a major research collection with 2.6+ million curated specimens and holdings of more than 45,000 species.

One million TAMUIC Records Entered into GBIF



Quinn's Primary Websites



	BugGuide	iNaturalist
Identification Tips	XX	
Similar Spp. & H/T/D	X	
# of Spp. in N. Amer.	XX	
Taxonomy (higher + author)	X	(X)
Length	X	
Life History, Host(s), Habitat	XX	
Remarks	X	
Print References	X	
Links (e.g. Featured Creatures)	X	
Select for Larval Lep Pix	X	
Cut-and-paste thumbpix	XXX	
Statistics		XX
Comparisons		XXX
Range Maps		XXX
Volume of Observations		XXX
Apps (iNat & Seek)		XXX
CVS - AI Algorithm		XXX(*)
In State Spp.		XX
Phenology (Seasonality)		XX
Darwin Core		XX

(Behind the Scenes) BugGuide Brain Trust

BugGuide was begun in 2003 by **Troy Bartlett** (left)

John VanDyk (right) has maintained BugGuide at Iowa State since 2006

Mike Boone (in back) contributed the data mapping function to BugGuide

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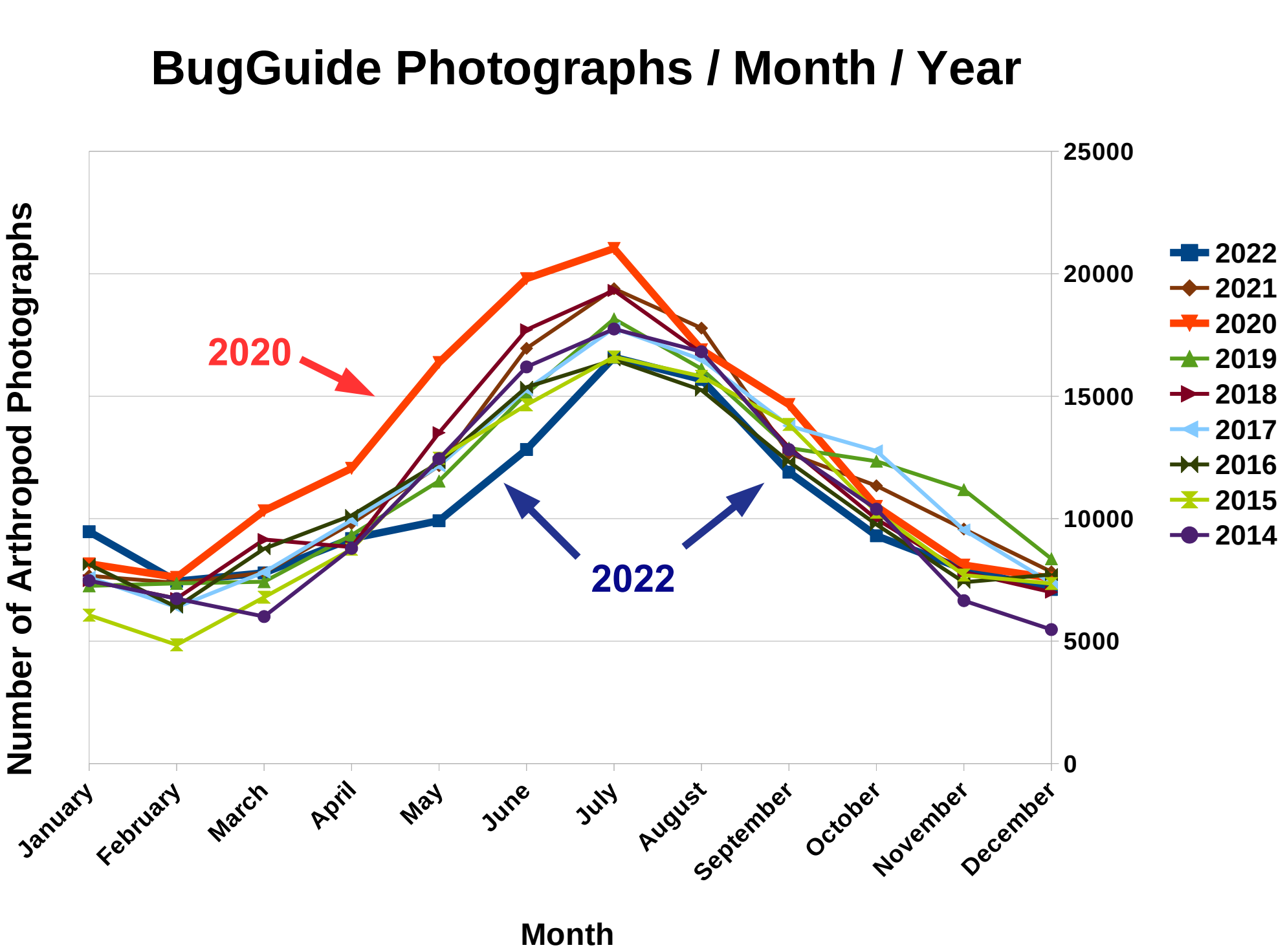
Iowa State Insect Collection
Iowa State University
Ames, Iowa - July 30, 2011


BugGuide Photographs / Month / Year
Number of Arthropod Photographs
25000
20000
15000
10000
5000
0
2020
2022
January
February
March
April
May
June
July
August
September
October
November
December
Month
2022
2021
2020
2019
2018
2017
2016
2015
2014

Arboreal Beetle Abundance Through Time in Western Travis Co.

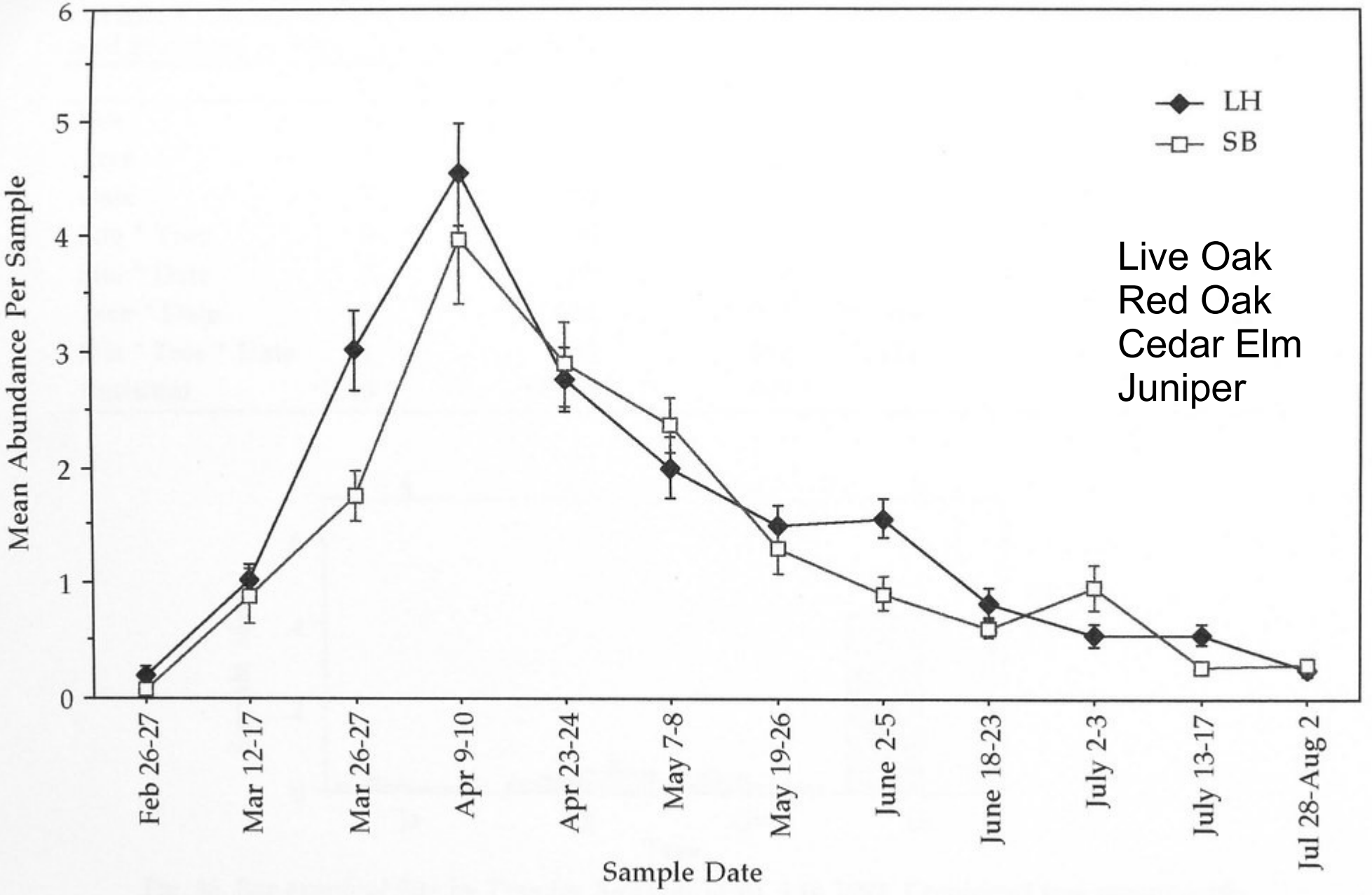
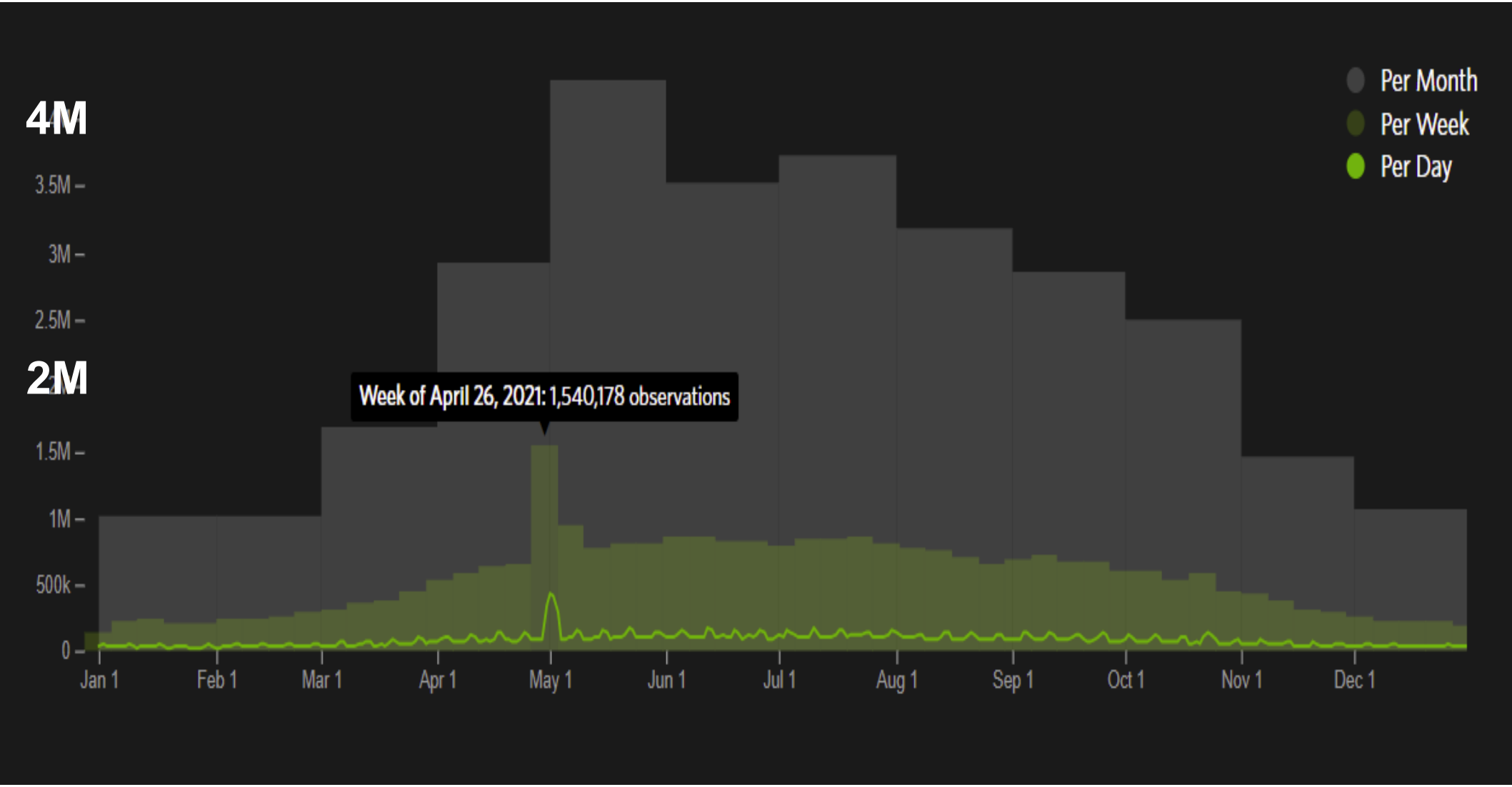


Fig. 35. Seasonal patterns of Coleoptera at Long Hollow and Shellberg in 1994. Vertical bars represent 1 SEM.

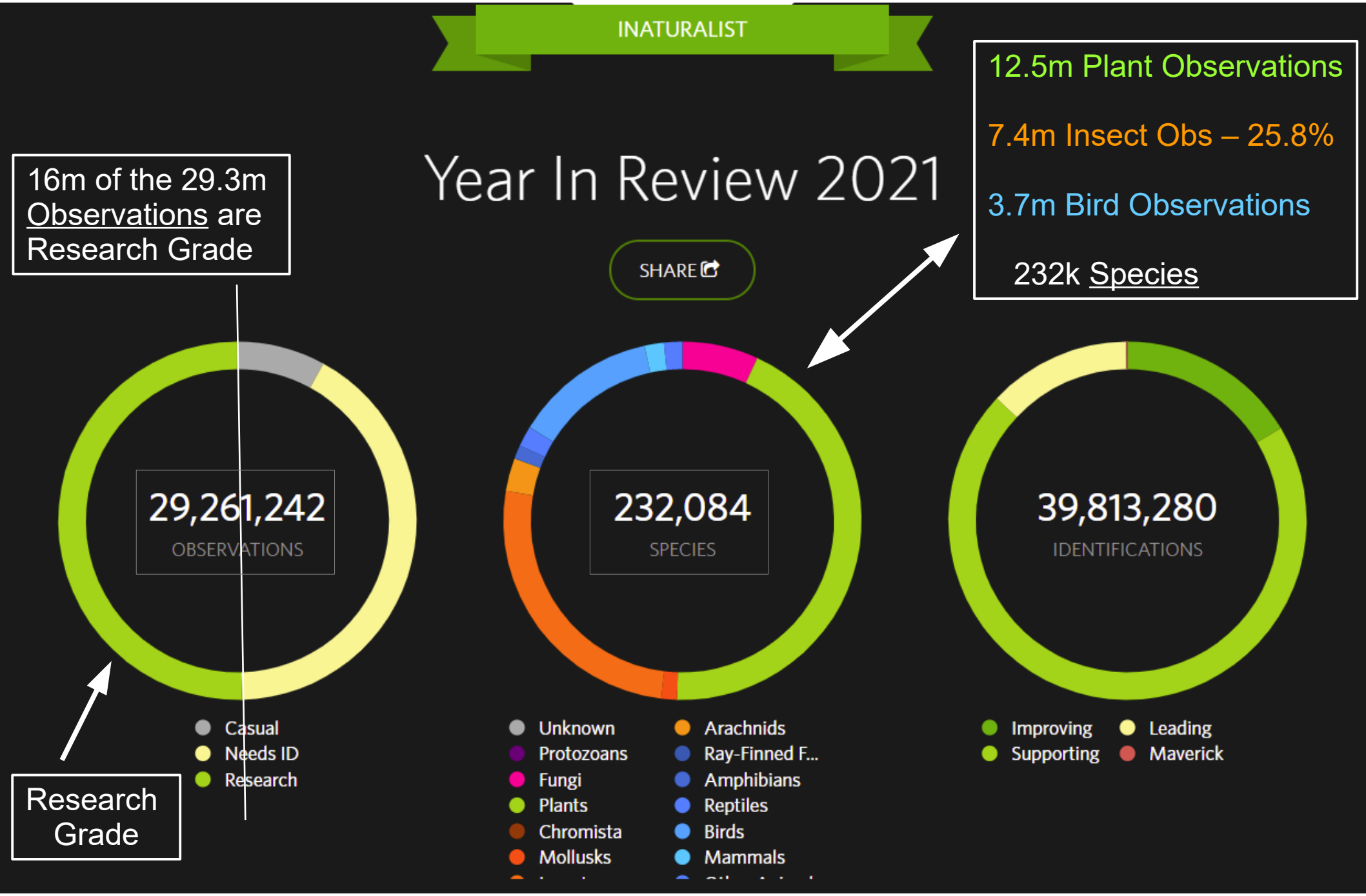
Quinn, 2000

2021 iNaturalist Year In Review



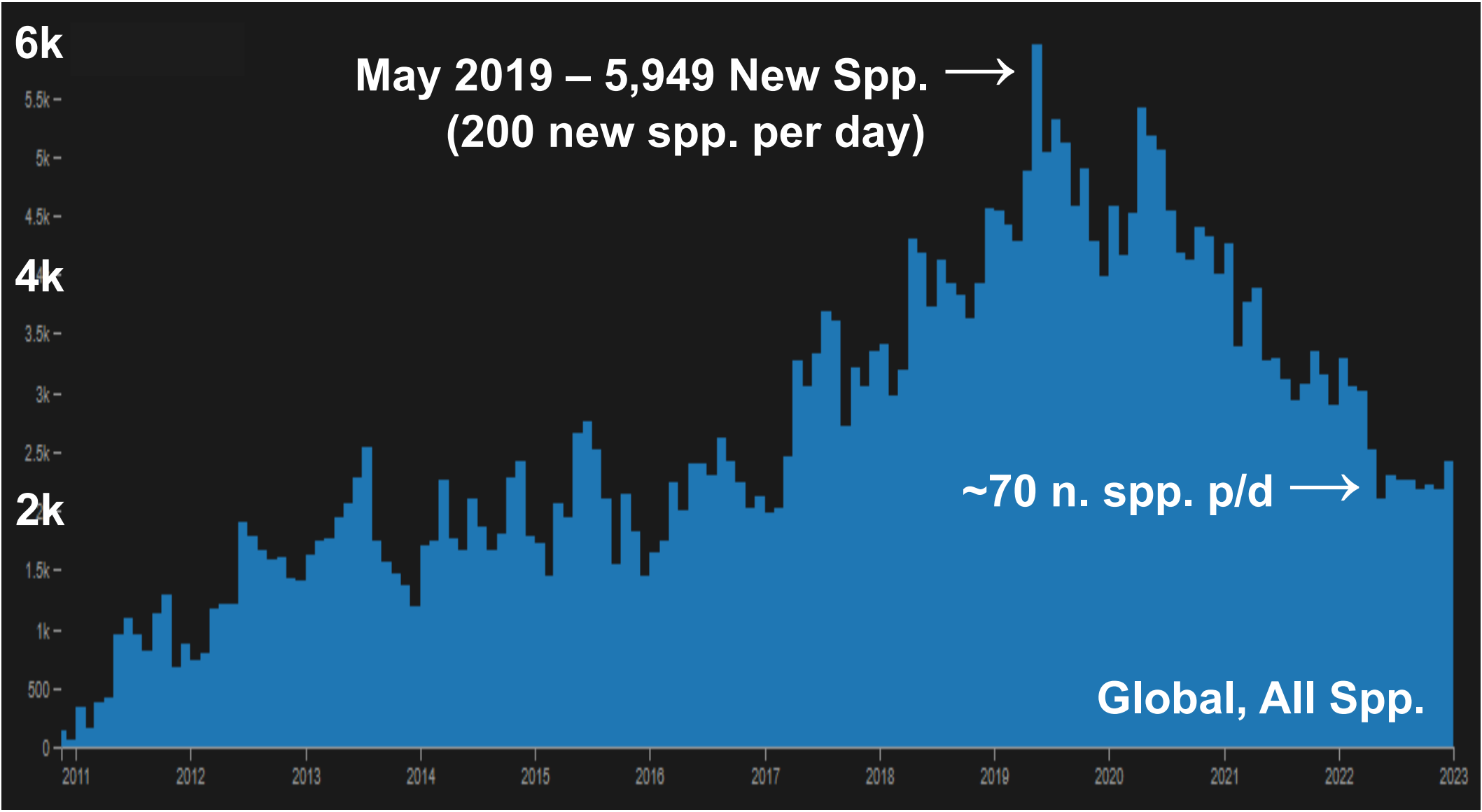
Week of April 26, 2021: 1.5m global all taxa observations

2021 Global All Taxa iNaturalist Stats



Jan. 2022

Newly Added iNat Species Per Month



2011 2014 2017 2020 2023

Just 1% of the more than 1.7 million people with registered iNaturalist accounts uploaded more than 60% of the platform's observations.

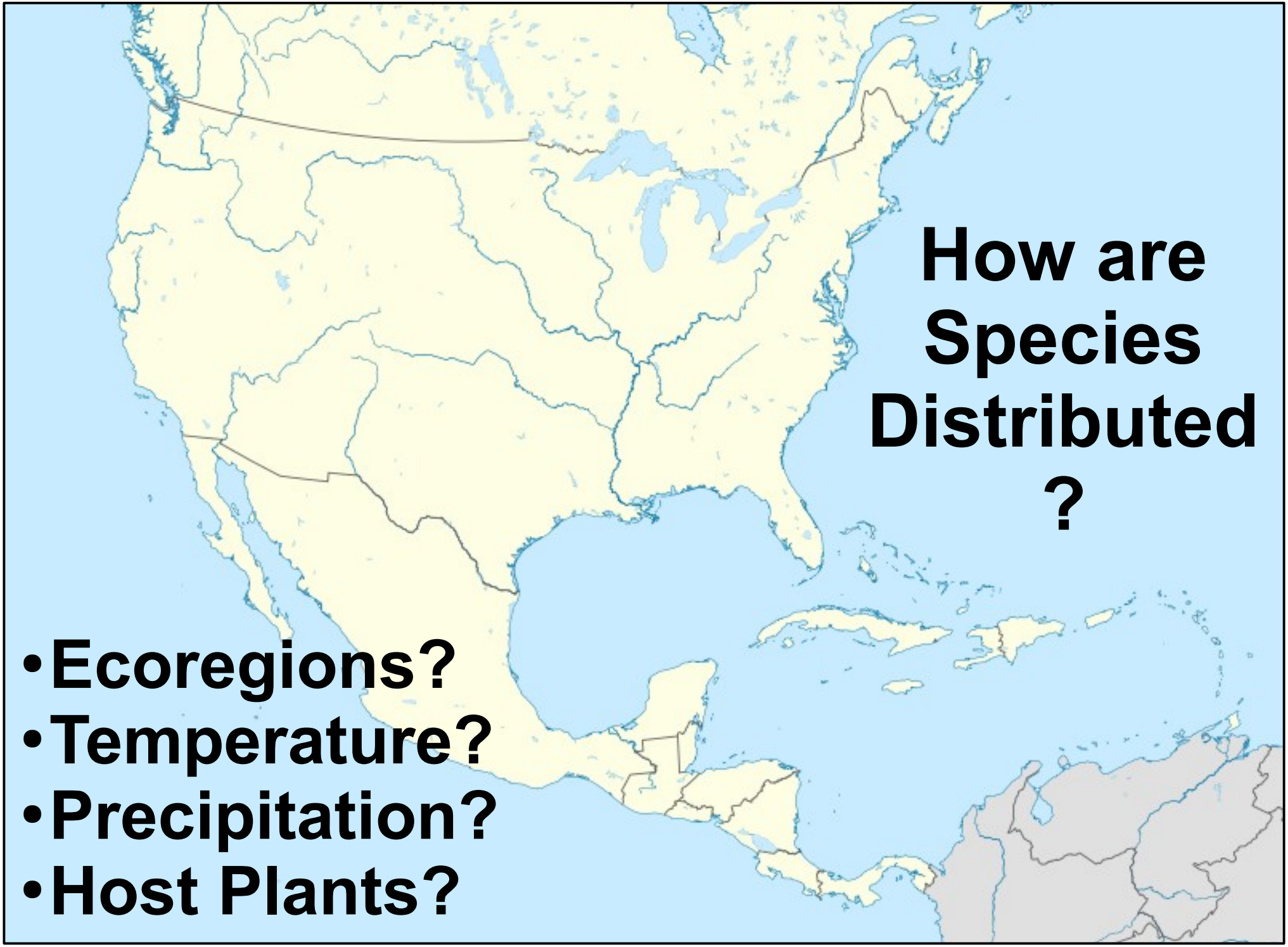
Jerald Pinson. 2021. ...large-scale study of iNaturalist users.

27,700 iNat beetle observers in TX

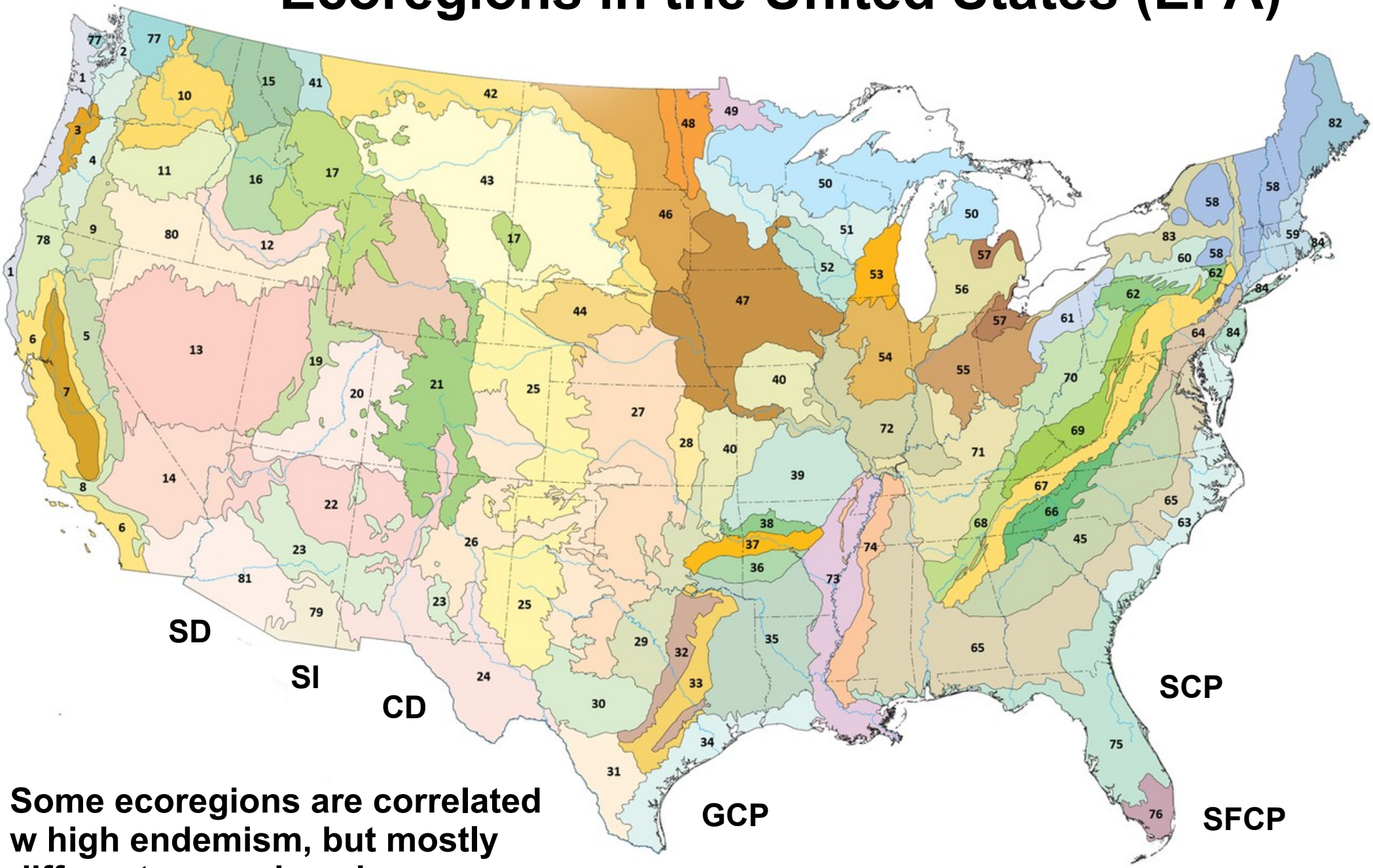
Top 1% would be 277 beetle observers

The 277th observer observed 37 beetle spp.!

Nov. 2022

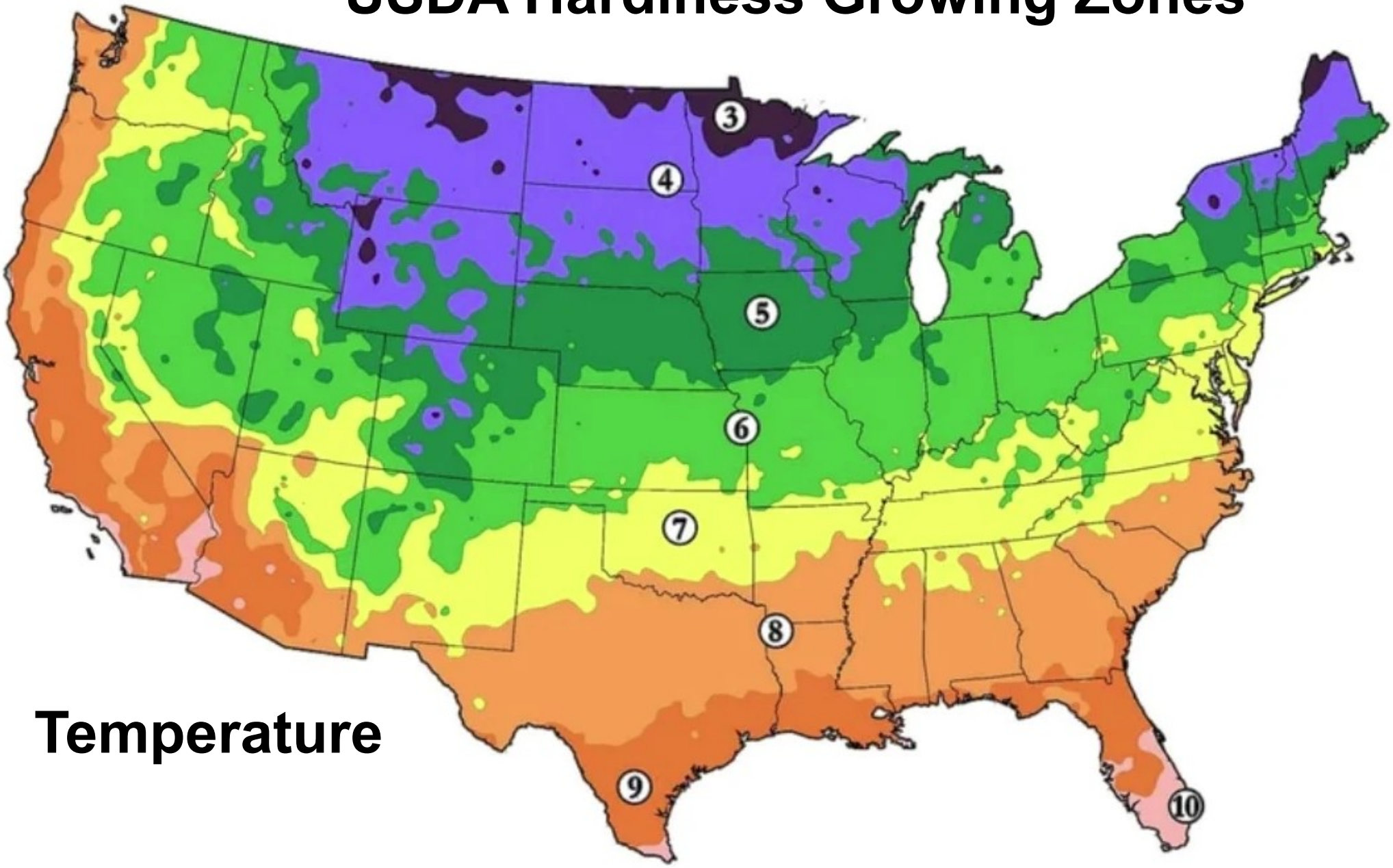

How are Species Distributed ?
•Ecoregions?
•Temperature?
•Precipitation?
•Host Plants?

Ecoregions in the United States (EPA)



Some ecoregions are correlated w high endemism, but mostly different ecoregions have different species abundances

USDA Hardiness Growing Zones



Temperature

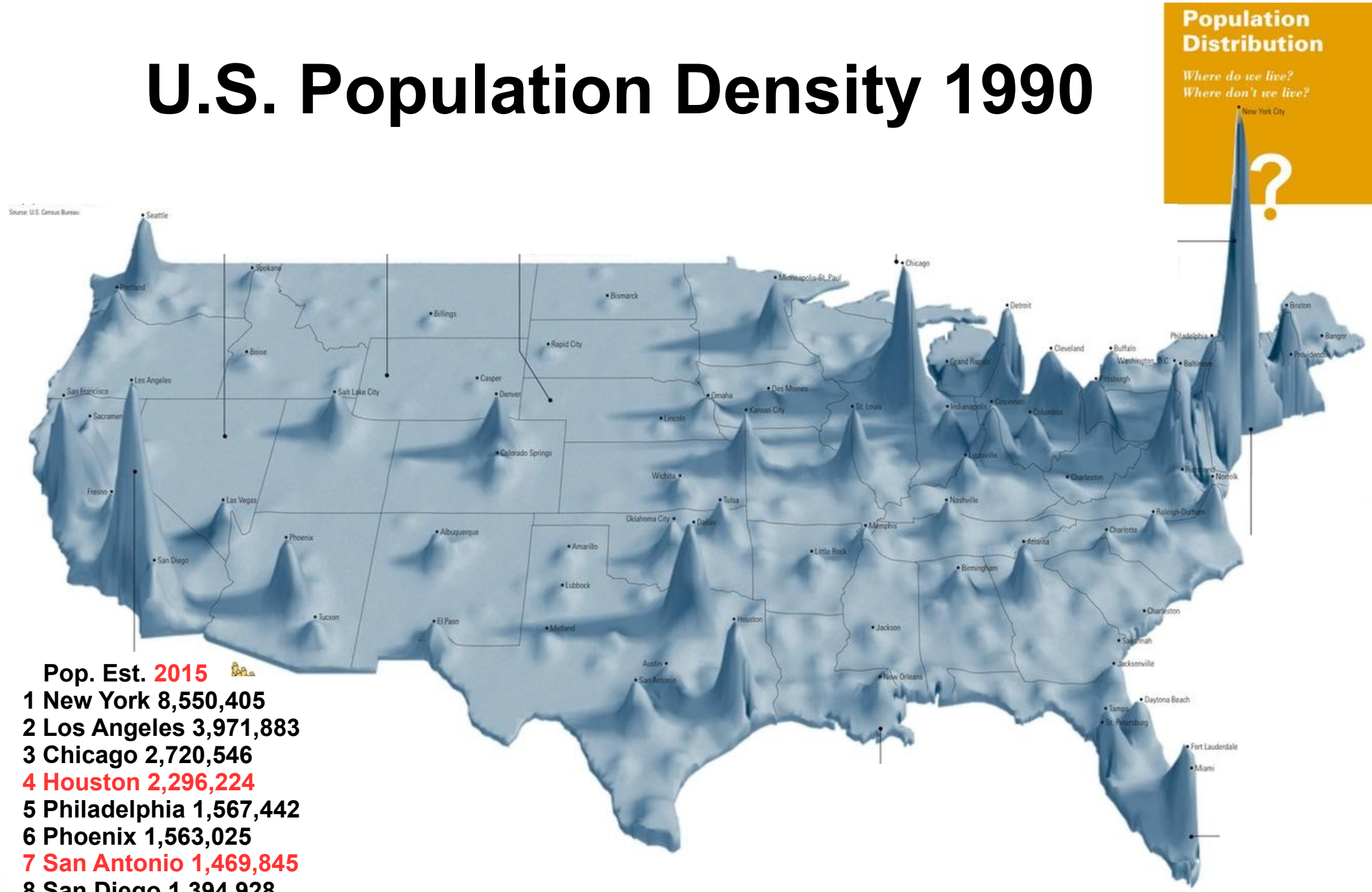
Average Precipitation

Precipitation varies widely across the United States, from a low of 2.3 inches per year in California's Death Valley to a high of 460 inches on Hawaii's Mount Waialeale. Nevada ranks as the driest state, with an average annual precipitation of 9.5 inches, and Hawaii is the wettest, at 70.3 inches.

Average Annual Precipitation (in inches)
1961-1990

180.1-200	35.1-40
140.1-180	30.1-35
120.1-140	25.1-30
100.1-120	20.1-25
80.1-100	15.1-20
70.1-80	10.1-15
60.1-70	5.1-10
50.1-60	5 and less
40.1-50	

U.S. Population Density 1990



Pop. Est. 2015

1 New York 8,550,405
2 Los Angeles 3,971,883
3 Chicago 2,720,546
4 Houston 2,296,224
5 Philadelphia 1,567,442
6 Phoenix 1,563,025
7 San Antonio 1,469,845
8 San Diego 1,394,928
9 Dallas 1,300,092
10 San Jose 1,026,908
11 Austin 931,830

U.S. Sensus Bureau

As lifelong environmentalist and more recently as an entomologist, I've heard a lot of ‘slogans’ such as:

‘You can’t protect what you don’t know’

or E. O. Wilson’s:

‘The little things that run the world’

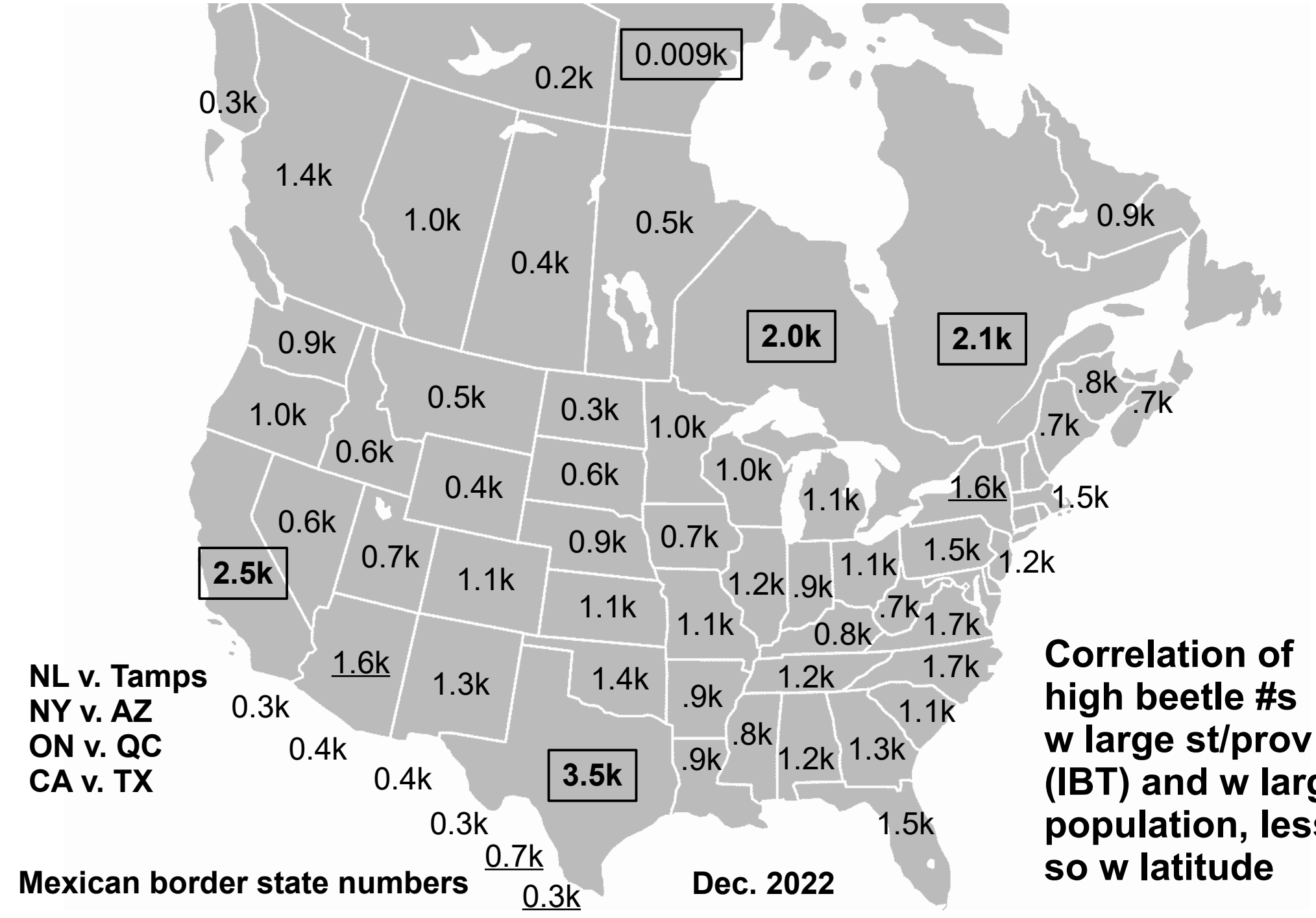
but Dr. Carrie Seltzer, a member of the iNat team, has the following ‘slogan’ on her iNat profile page:

People need biodiversity
and
Biodiversity needs people

through most of my career, I would have winced at that almost paradigm shifting perspective, but I now think there is a ton of truth to her statement, at least in terms of revealing that diversity.

Dr. Carrie Seltzer

Number of iNat Beetle Species per State or Provence



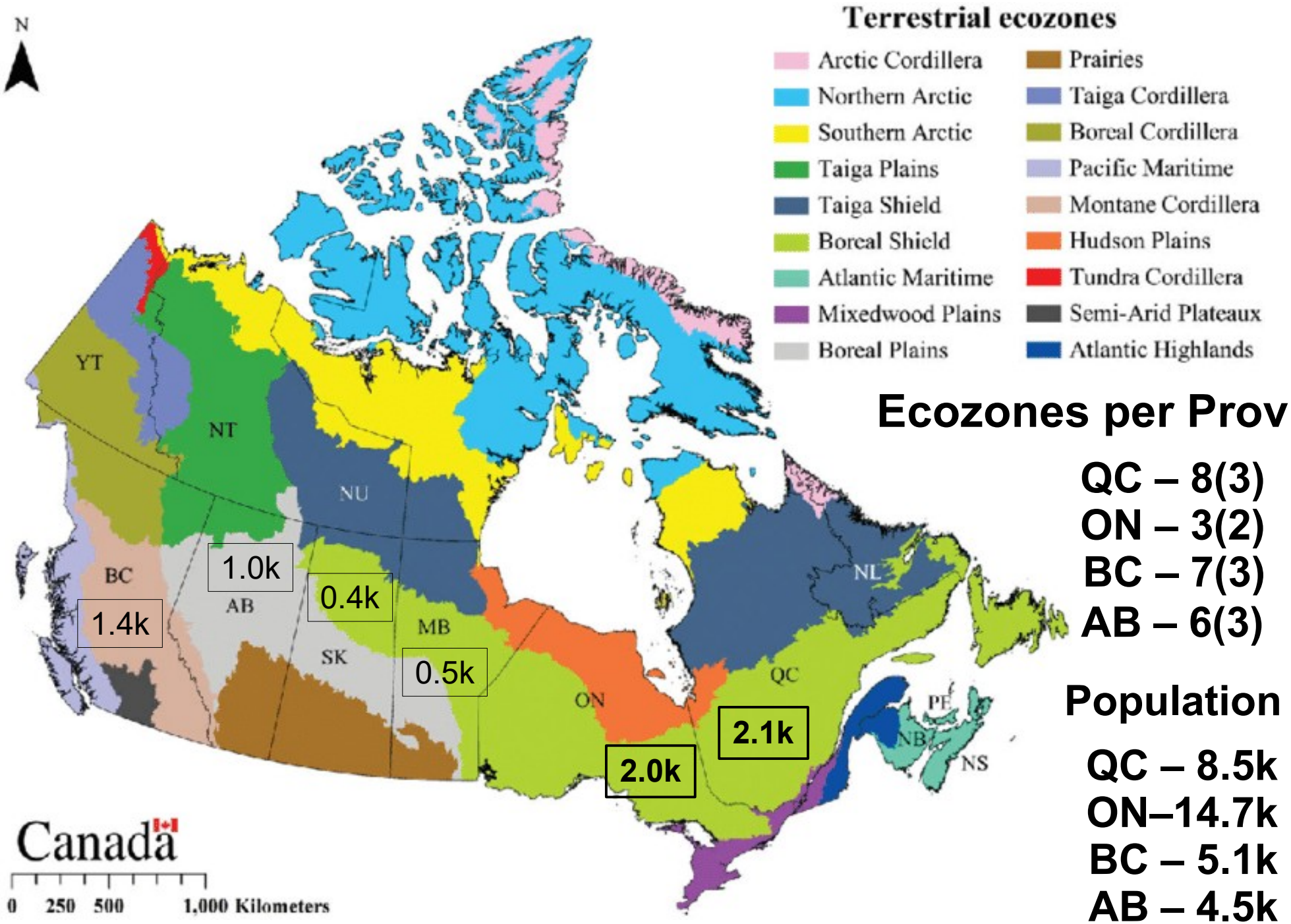
NL v. Tamps
NY v. AZ
ON v. QC
CA v. TX

Mexican border state numbers

Dec. 2022

Correlation of high beetle #s w large st/prov (IBT) and w large population, less so w latitude

Map of Terrestrial Ecozones in Canada



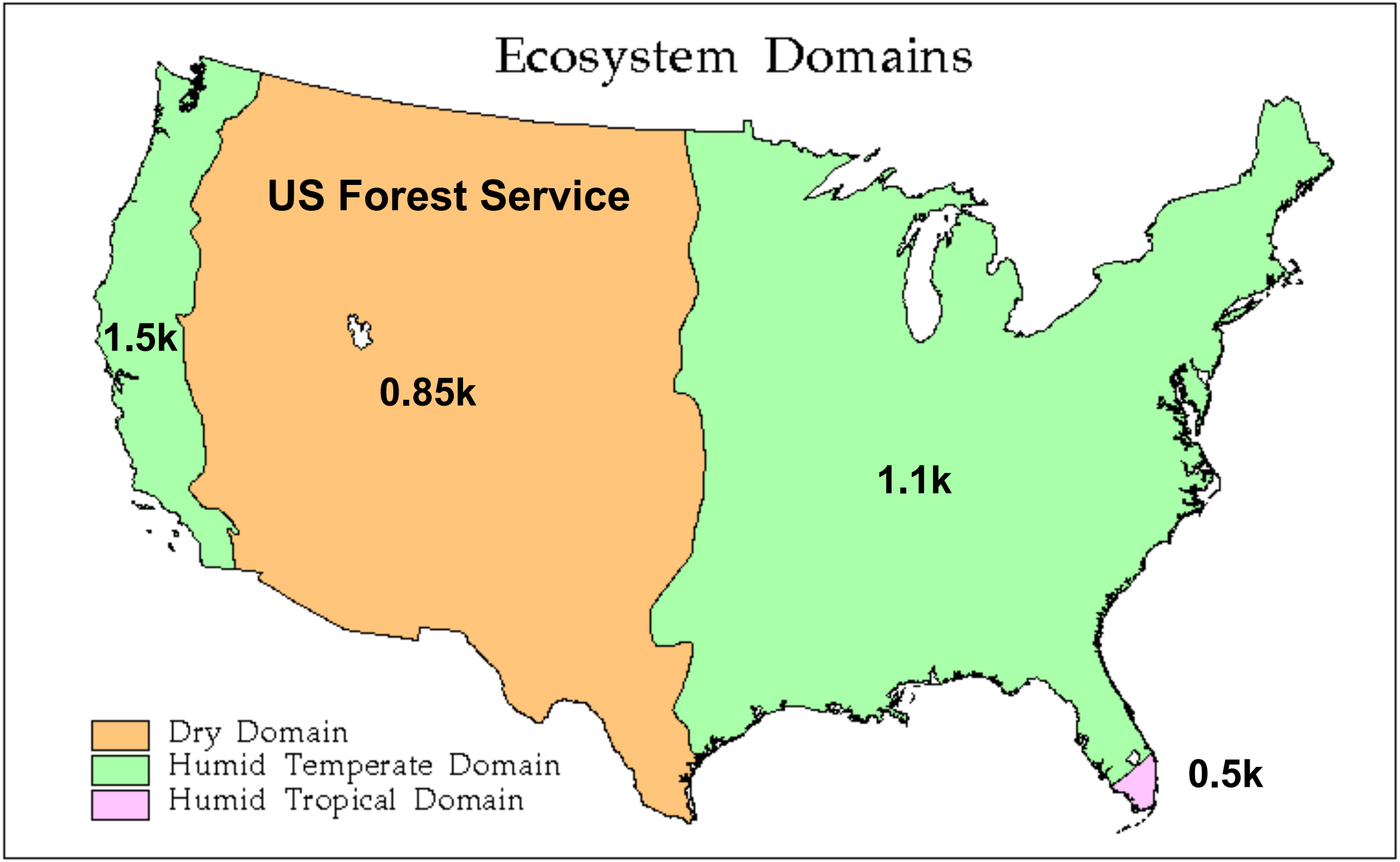
Ecozones per Prov

QC – 8(3)
ON – 3(2)
BC – 7(3)
AB – 6(3)

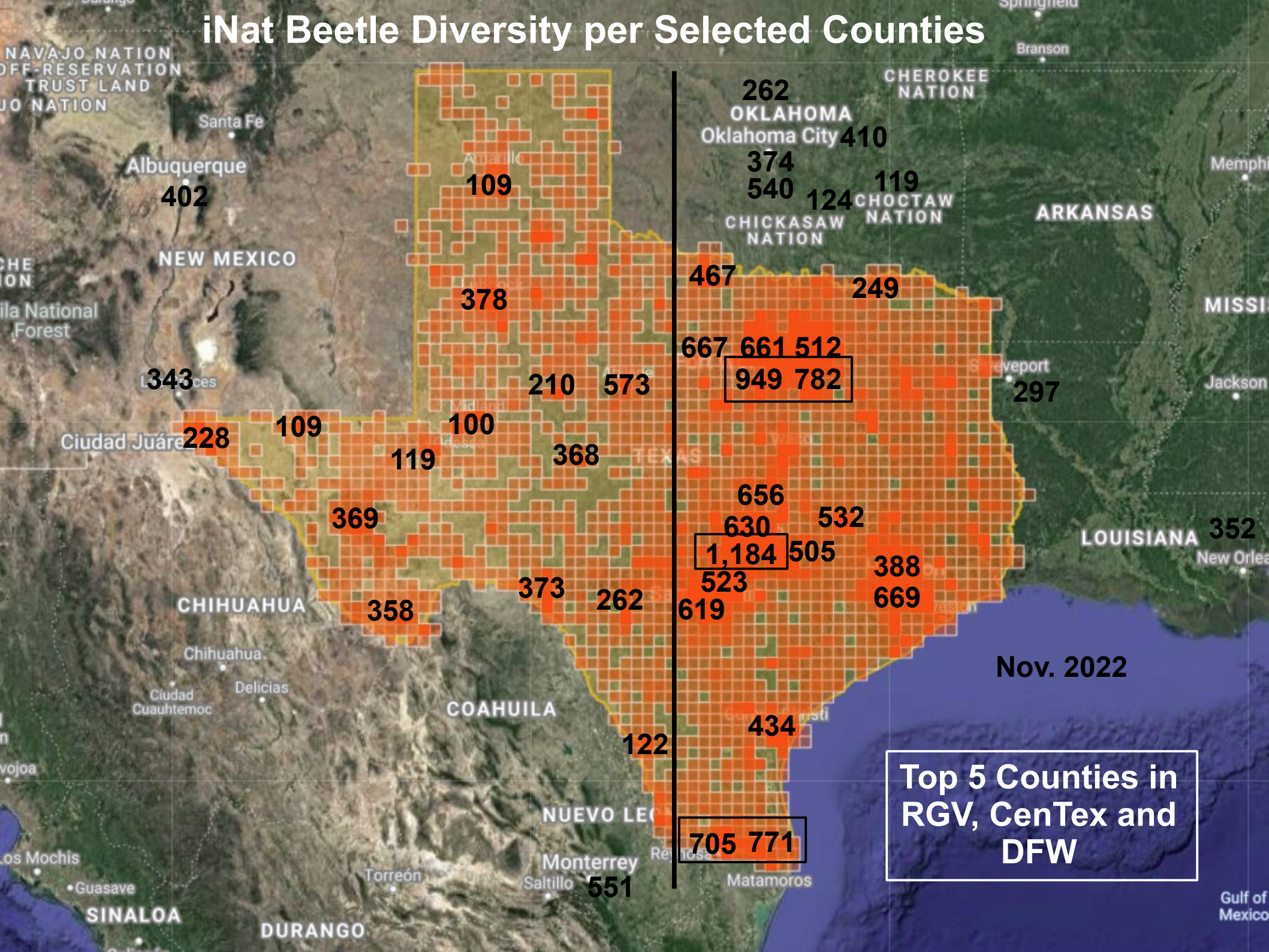
Population

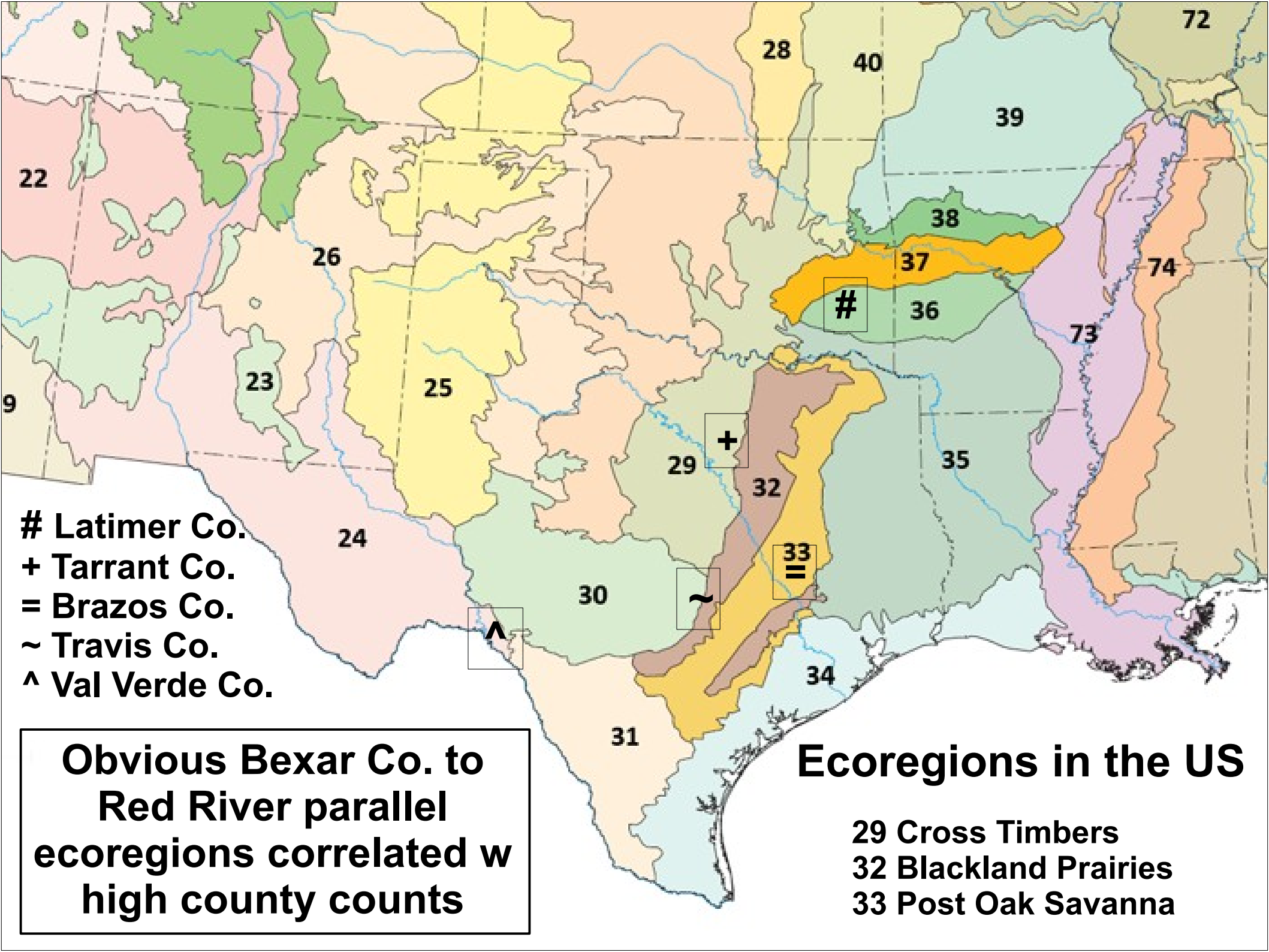
QC – 8.5k
ON–14.7k
BC – 5.1k
AB – 4.5k

Average Number of iNat Beetle Species per State* per Domain



*Sans central Great Plains and most small New England states


iNat Beetle Diversity per Selected Counties
NAVAJO NATION
OFF-RESERVATION
TRUST LAND
JO NATION
Santa Fe
Albuquerque
402
NEW MEXICO
ila National
Forest
343
Ciudad Juárez
228
109
109
100
119
368
210
573
378
262
OKLAHOMA
Oklahoma City
410
374
540
124
119
CHOCTAW
NATION
CHICKASAW
NATION
CHEROKEE
NATION
ARKANSAS
Branson
Memphi
MISSI
Jackson
297
467
249
667
661
512
949
782
656
630
532
1,184
505
388
523
669
619
373
262
358
369
352
LOUISIANA
New Orlea
CHIHUAHUA
Chihuahua
Ciudad
Cuauhtemoc
Delicias
COAHUILA
434
122
NUEVO LE
705
771
Monterrey
Saltillo
551
Torreón
Matamoros
Los Mochis
Guasave
SINALOA
DURANGO
Gulf of
Mexico
Nov. 2022
Top 5 Counties in
RGV, CenTex and
DFW


72
28
40
39
22
38
26
37
74
#
36
73
23
25
9
+
29
35
32
24
33
=
30
~
^
34
31
Latimer Co.
+ Tarrant Co.
= Brazos Co.
~ Travis Co.
^ Val Verde Co.
Obvious Bexar Co. to Red River parallel ecoregions correlated w high county counts
Ecoregions in the US
29 Cross Timbers
32 Blackland Prairies
33 Post Oak Savanna

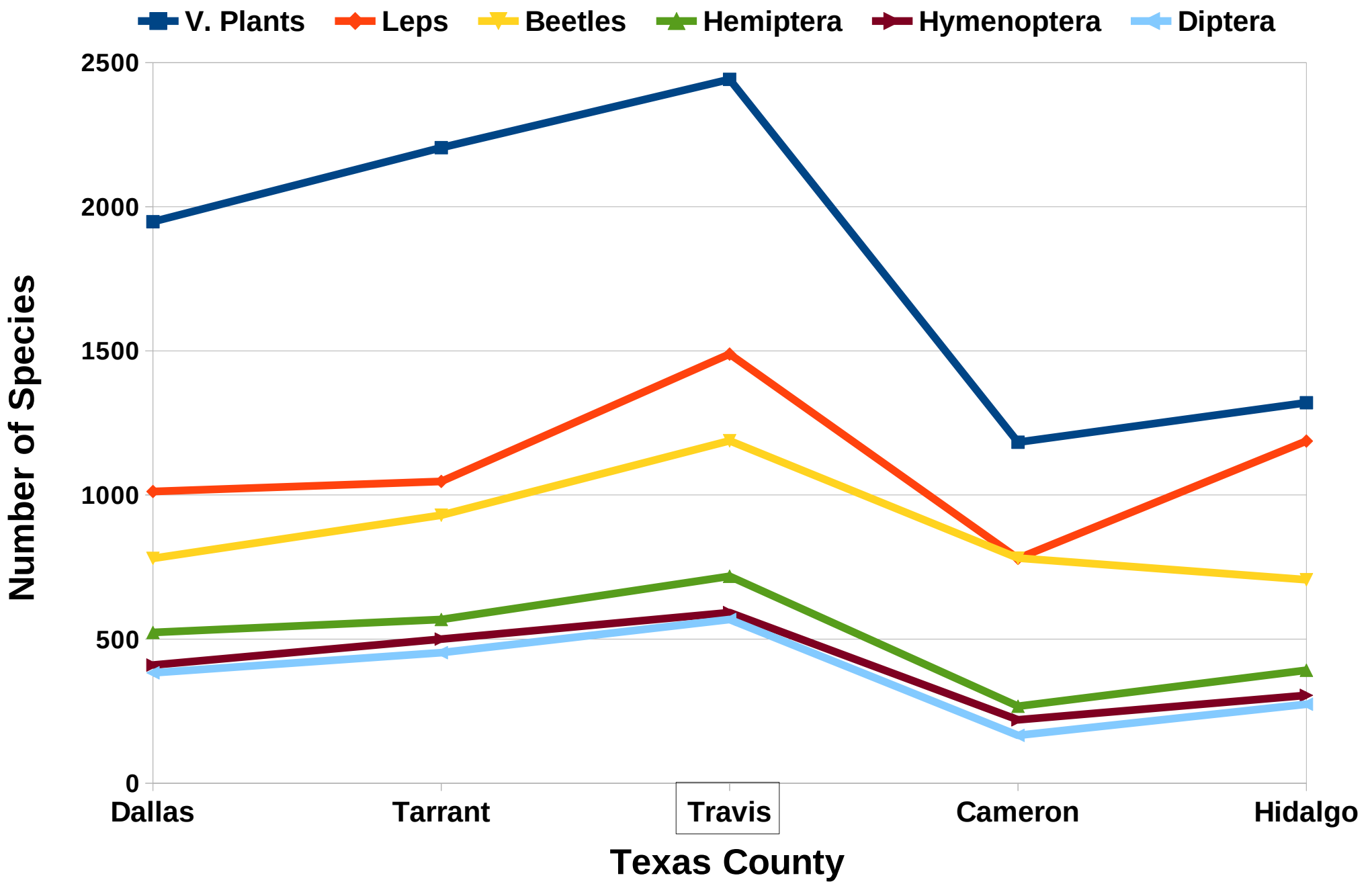
245,407 OBSERVATIONS	3,523 SPECIES	5,766 IDENTIFIERS	27,603 OBSERVERS

General Locations of 11 Top Texas Beetle Species Observers *

Rank	User				Observations	Species
1	entomike		Cen-Tex		2,723	1,870
2	sambiology	NCT			6,626	888
3	catenatus	NCT			8,916	819
4	annikaml	NCT			4,893	620
5	pfau_tarleton	NCT			2,807	577
6	dusty_in_vilas-tx	NCT			5,189	503
7	franpfer		Cen-Tex		2,002	388
8	hydaticus		Cen-Tex		830	383
9	mako252			Corpus	3,036	368
10	gcwarbler		Cen-Tex		1,537	355
11	kimberlietx	NCT			1,739	339

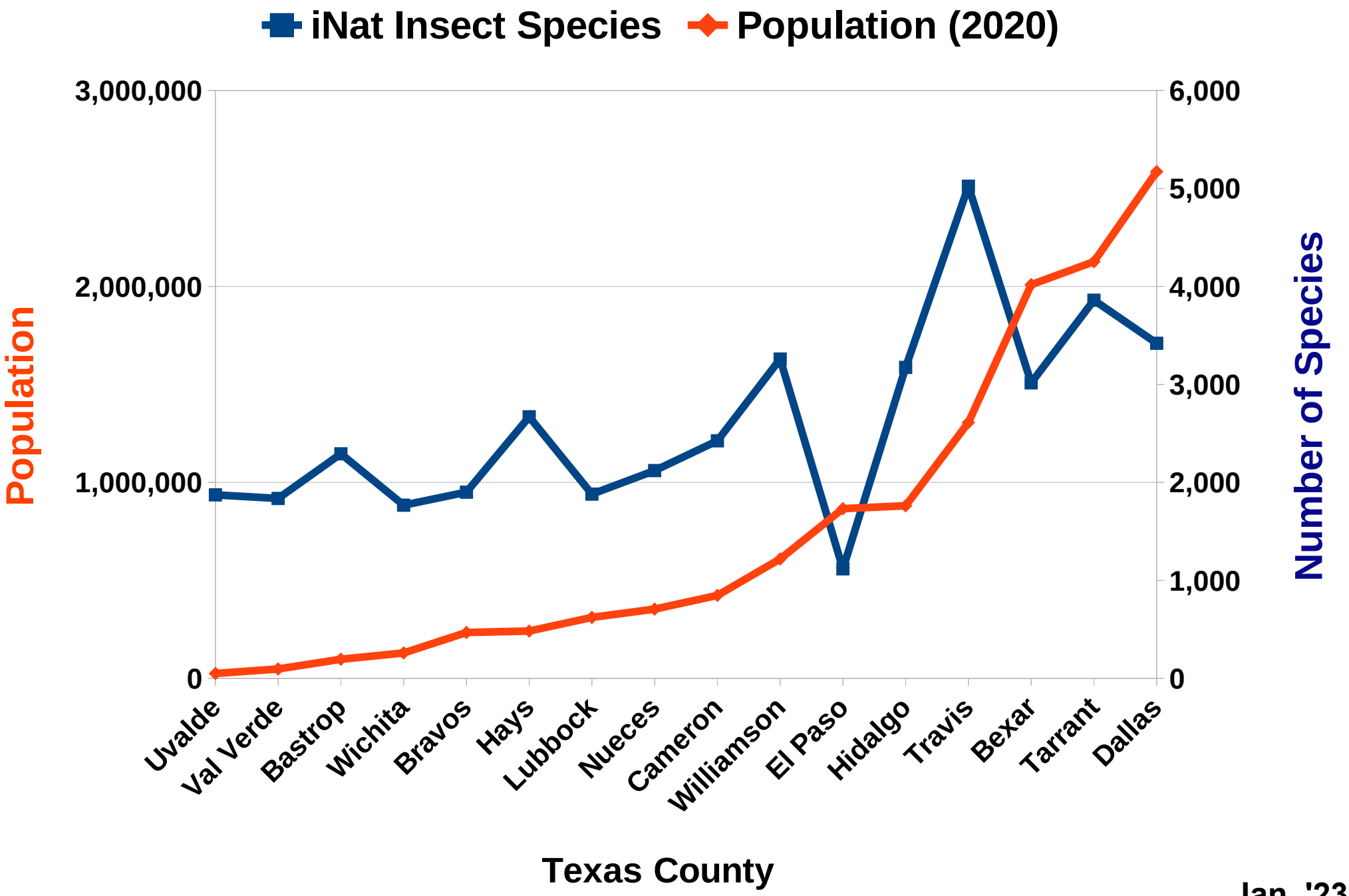
Nov. '22

iNaturalist Taxonomic Comparisons Per County

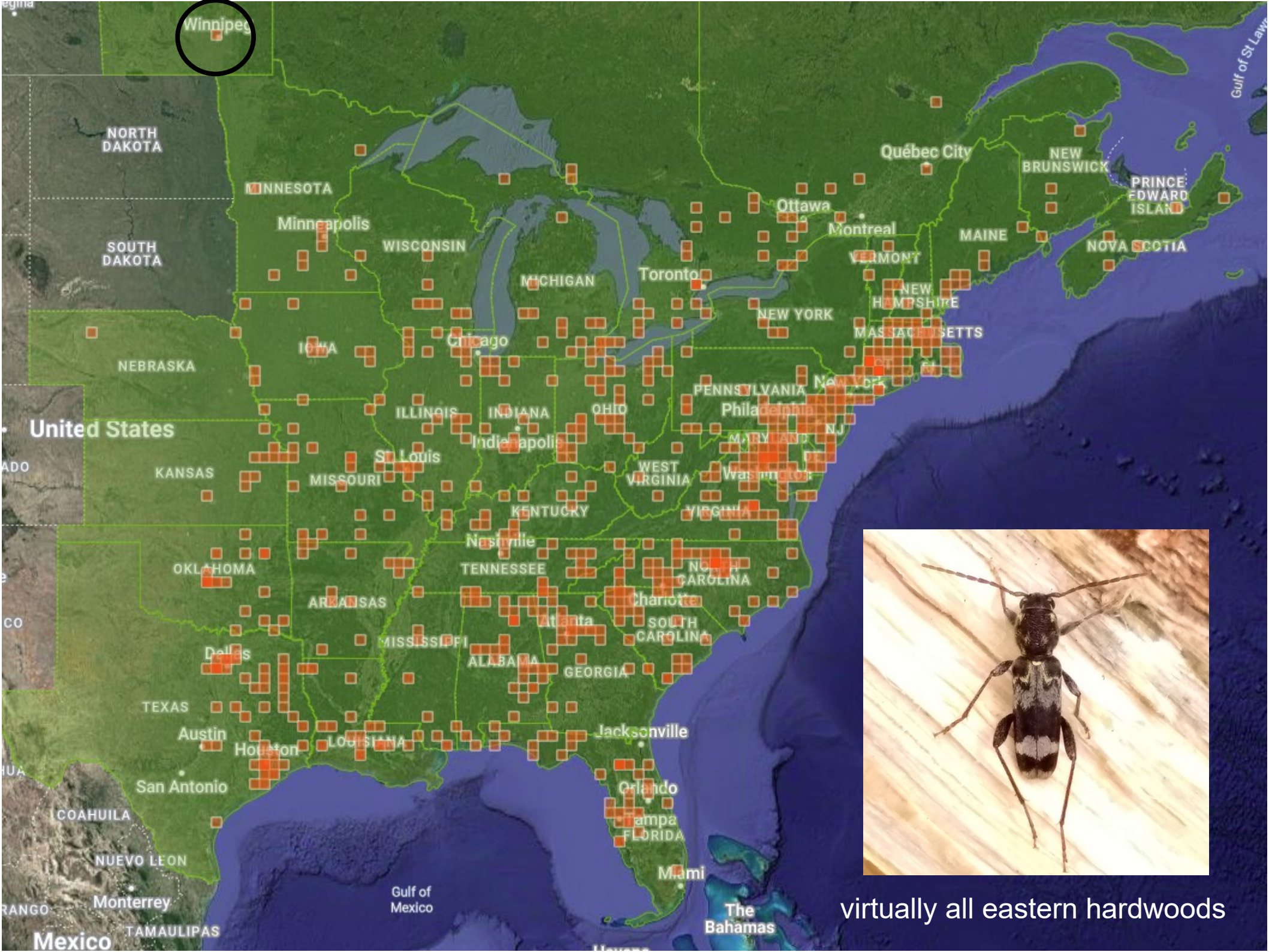


Jan. '23

Insect Species and Population by County

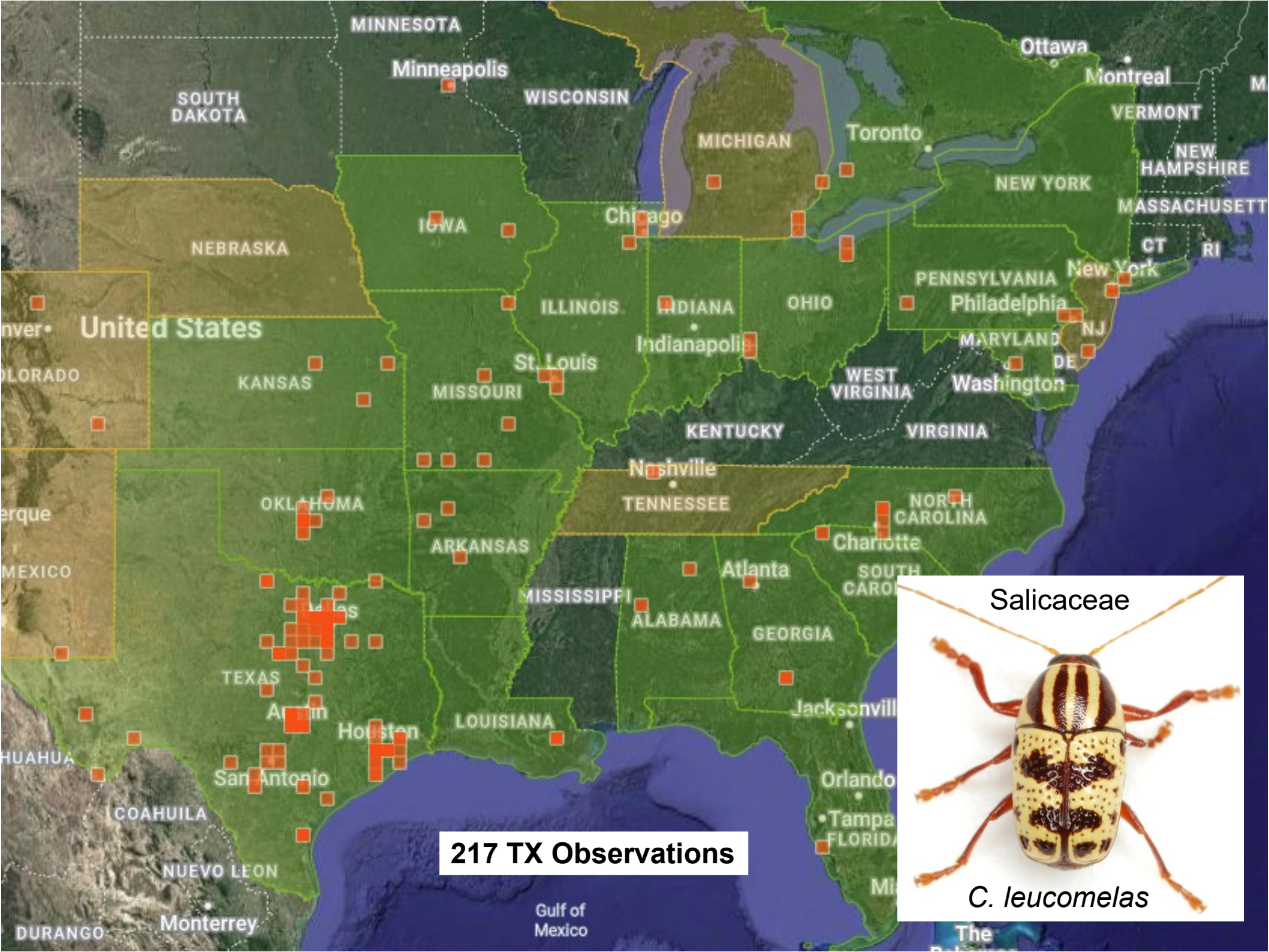


Jan. '23

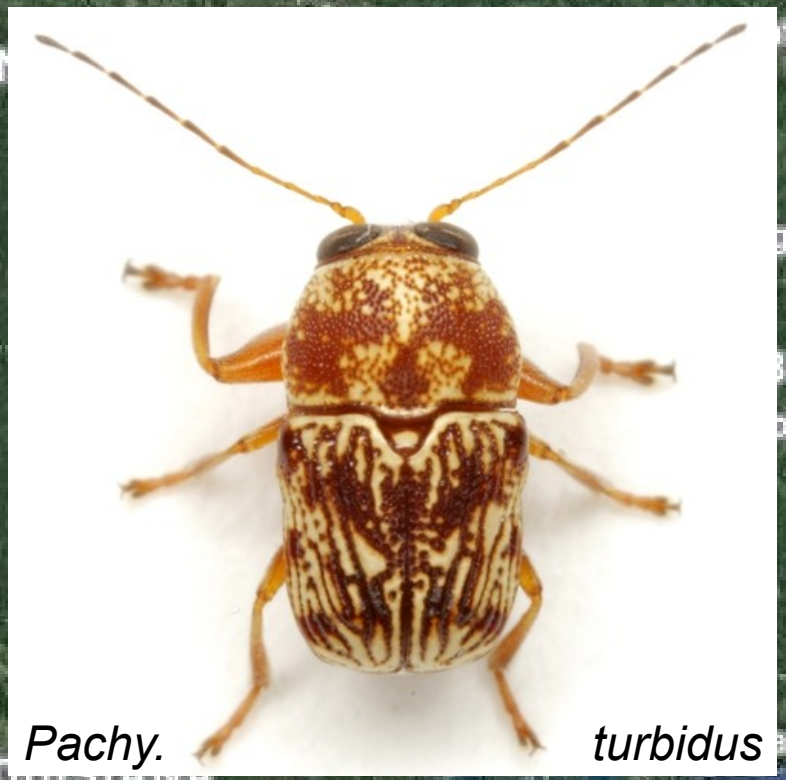


virtually all eastern hardwoods

645 TX Observations

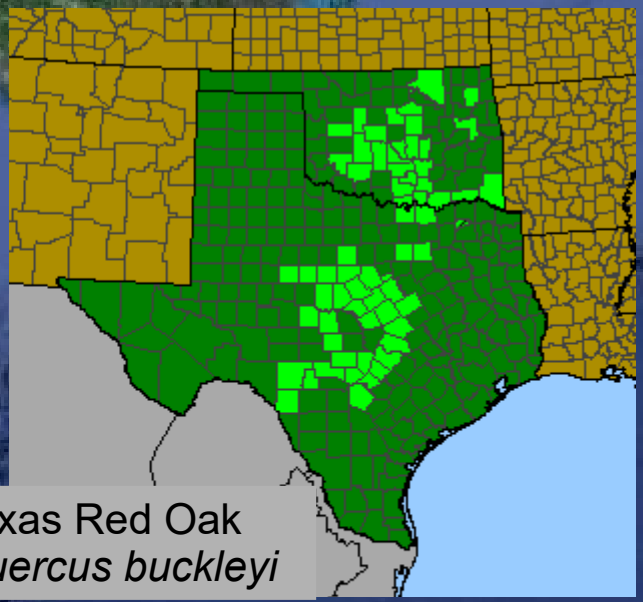

MINNESOTA
Minneapolis
SOUTH DAKOTA
WISCONSIN
MICHIGAN
Ottawa
Montreal
VERMONT
Toronto
NEW HAMPSHIRE
NEW YORK
MASSACHUSETT
CT
RI
NEBRASKA
IOWA
Chicago
PENNSYLVANIA
New York
Philadelphia
NJ
United States
ILLINOIS
INDIANA
OHIO
Indianapolis
MARYLAND
DE
St. Louis
KANSAS
MISSOURI
WEST VIRGINIA
Washington
KENTUCKY
VIRGINIA
Nashville
TENNESSEE
OKLAHOMA
NORTH CAROLINA
Charlotte
ARKANSAS
Atlanta
MISSISSIPPI
ALABAMA
GEORGIA
TEXAS
LOUISIANA
Houston
Jacksonville
San Antonio
Orlando
Tampa
COAHUILA
NUEVO LEON
Monterrey
DURANGO
Gulf of Mexico
217 TX Observations
Salicaceae
C. leucomelas


WYOMING
NEBRASKA
IOWA
Chicag
ILLINOIS
Denver
United States
COLORADO
KANSAS
St. Louis
MISSOURI
Nash
TENNESSEE
OKLAHOMA
Albuquerque
ARKANSAS
NEW MEXICO
Charlotte
NORTH CAROLINA
Atlanta
SOUTH CAROLINA
MISSISSIPPI
ALABAMA
GEORGIA
Dallas
TEXAS
Austin
LOUISIANA
Jacksonville
CHIHUAHUA
Orlando
COAHUILA
Tampa
FLORIDA
NUEVO LEON
Miami
Monterrey
Gulf of Mexico
SINALOA
DURANGO
223 TX Observations

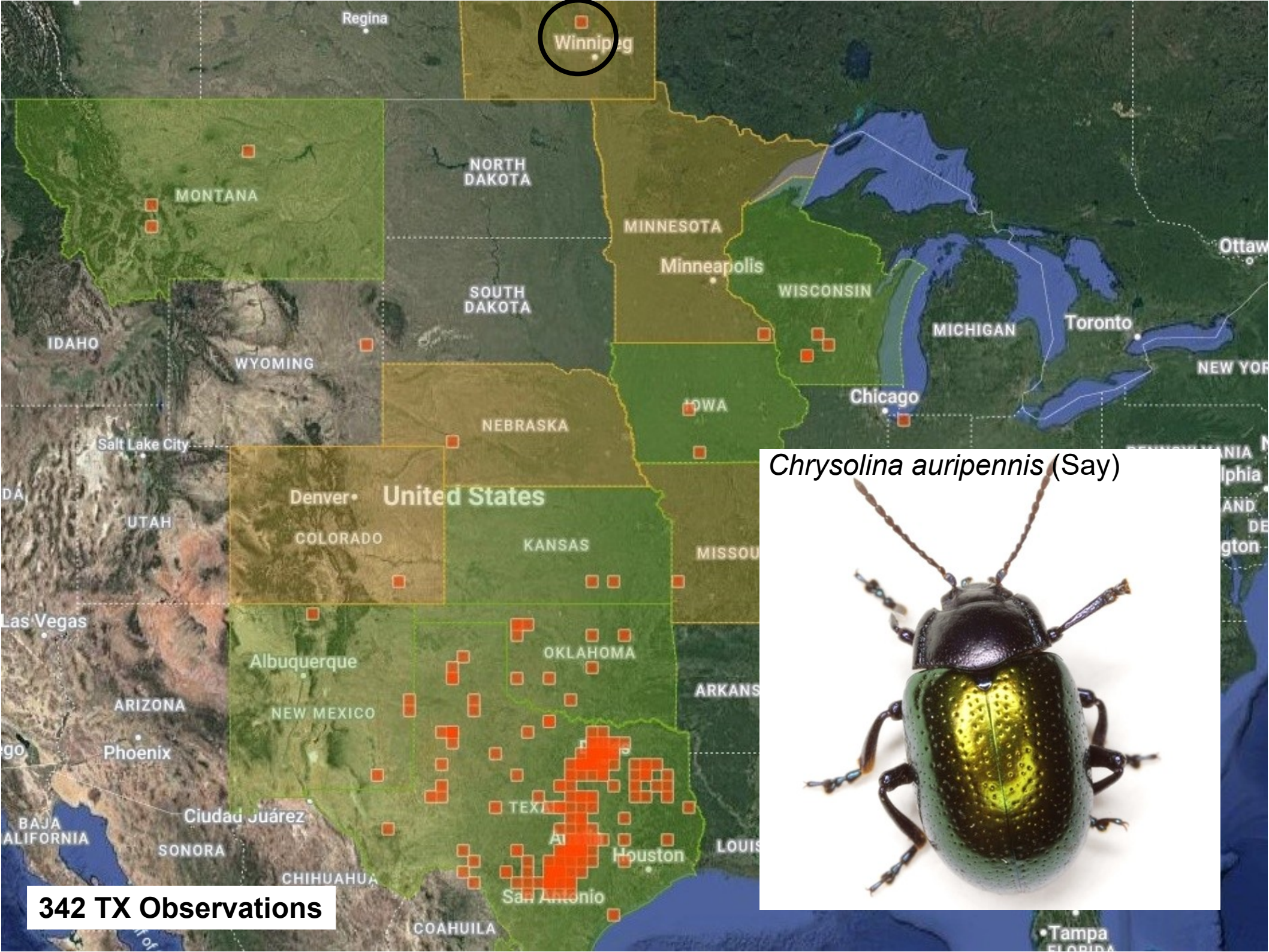


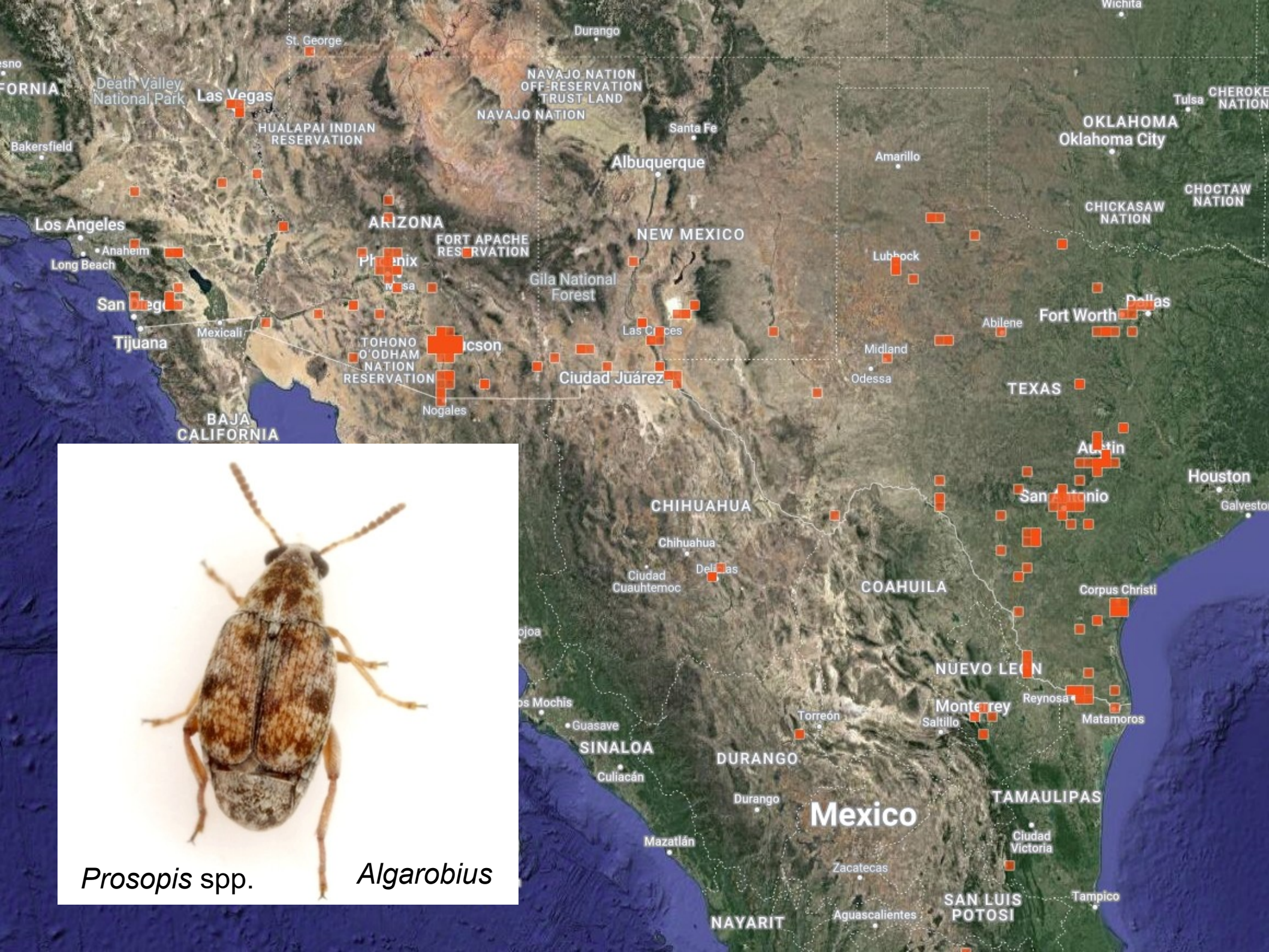
Pachy. *turbidus*

Pachybrachis turbidus	
Qt	1
U	1
Qv	1
M	1



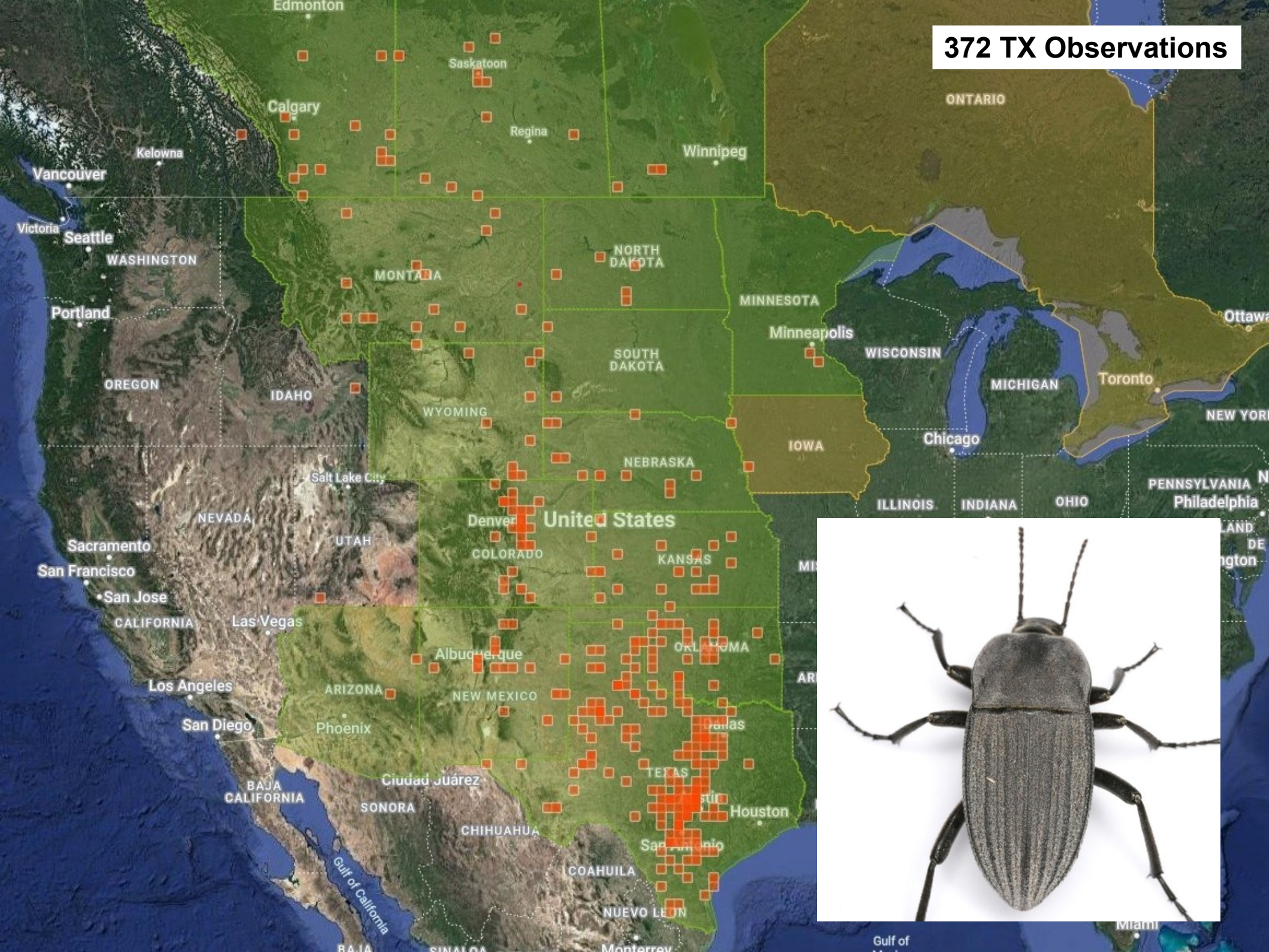
Texas Red Oak
Quercus buckleyi


Regina
Winnipeg
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
MINNESOTA
Minneapolis
WISCONSIN
MICHIGAN
Toronto
Ottaw
NEW YOR
IDAHO
WYOMING
NEBRASKA
IOWA
Chicago
Salt Lake City
Denver
United States
COLORADO
KANSAS
UTAH
Las Vegas
Albuquerque
OKLAHOMA
ARKANS
ARIZONA
NEW MEXICO
Phoenix
Ciudad Juárez
BAJA CALIFORNIA
SONORA
CHIHUAHUA
Houston
San Antonio
COAHUILA
Tampa
342 TX Observations
Chrysolina auripennis (Say)



Prosopis spp.

Algarobius


372 TX Observations
Edmonton
Saskatoon
Calgary
Regina
Winnipeg
ONTARIO
Kelowna
Vancouver
Victoria
Seattle
WASHINGTON
MONTANA
NORTH DAKOTA
MINNESOTA
Portland
Minneapolis
SOUTH DAKOTA
WISCONSIN
OREGON
IDAHO
MICHIGAN
Toronto
WYOMING
Chicago
IOWA
NEBRASKA
Salt Lake City
NEVADA
Denver
United States
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
Philadelphia
Sacramento
UTAH
COLORADO
KANSAS
San Francisco
San Jose
CALIFORNIA
Las Vegas
Albuquerque
Los Angeles
ARIZONA
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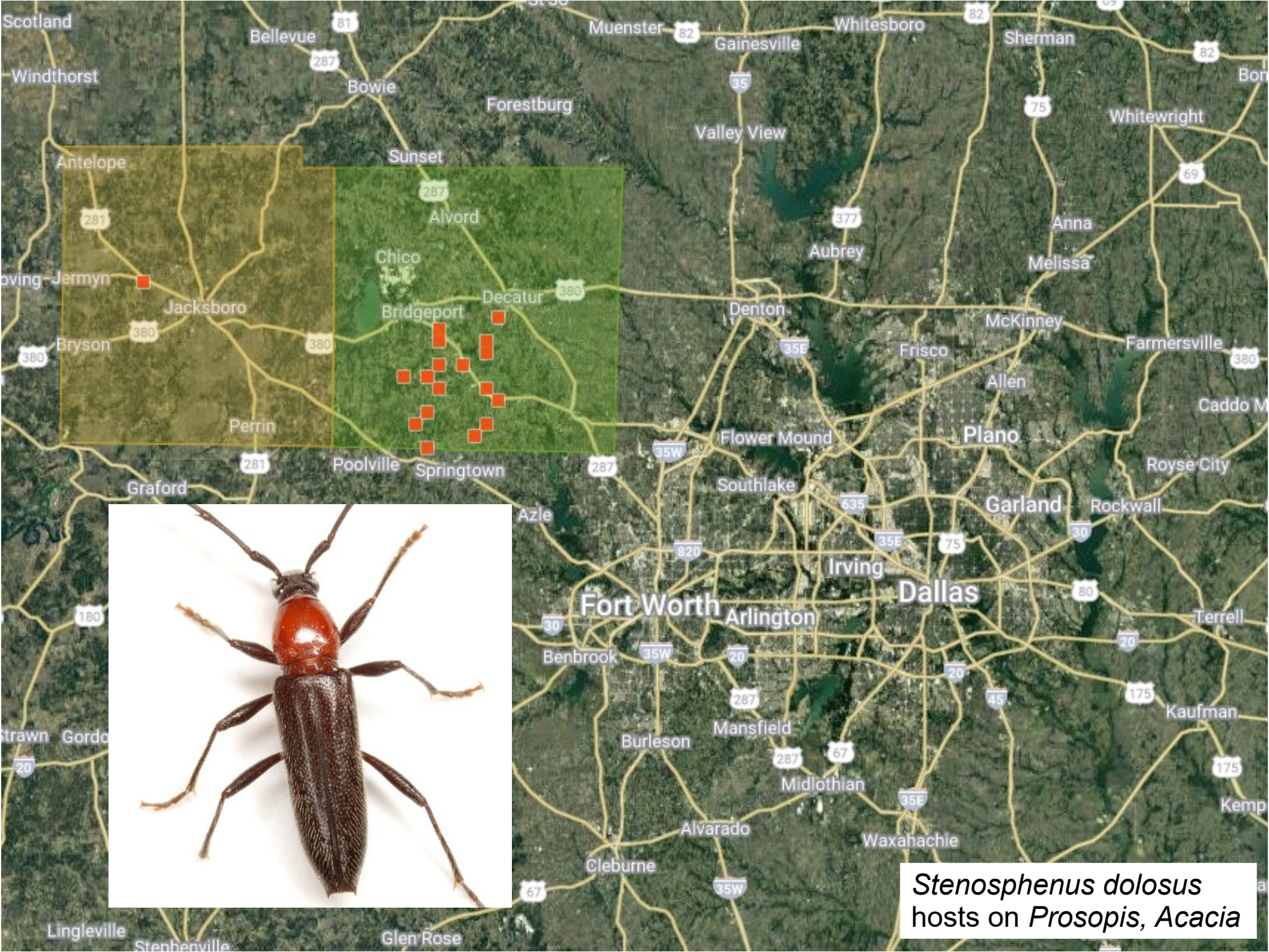
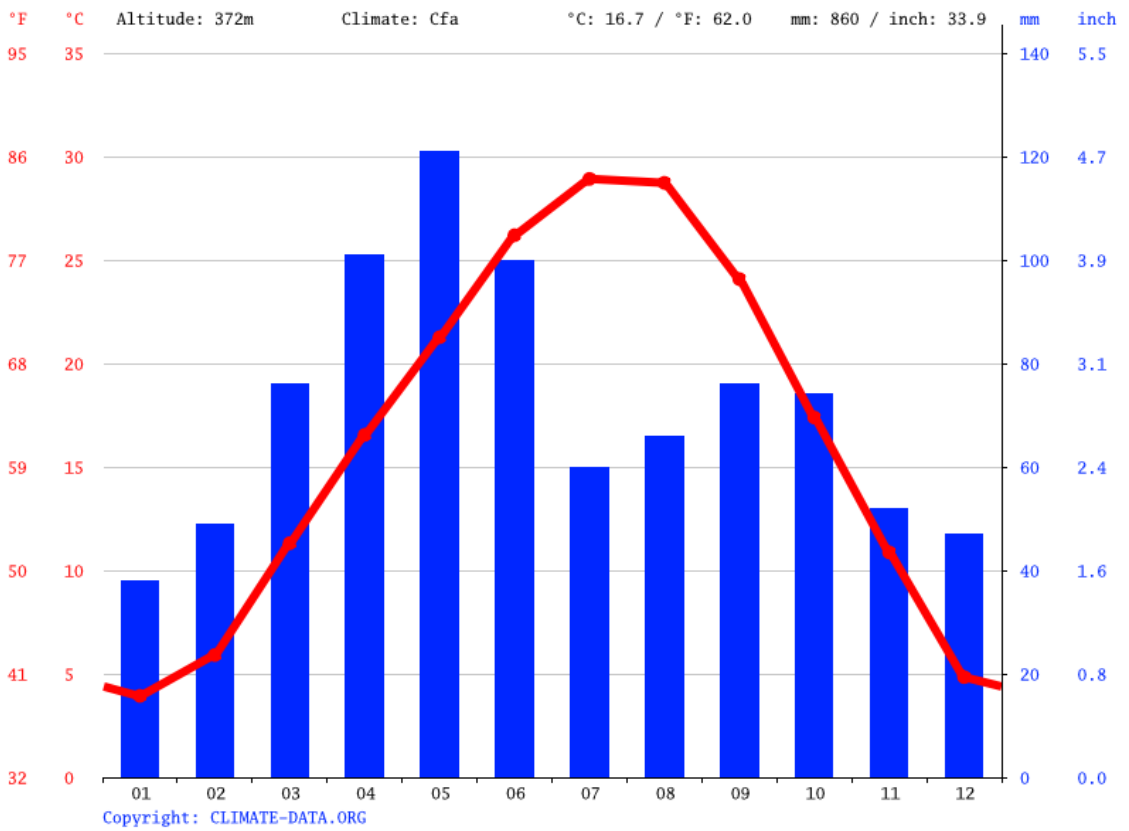
BAJA CALIFORNIA
Ciudad Juárez
SONORA
CHIHUAHUA
COAHUILA
Gulf of California
NUEVO LEON
Monterrey
Gulf of



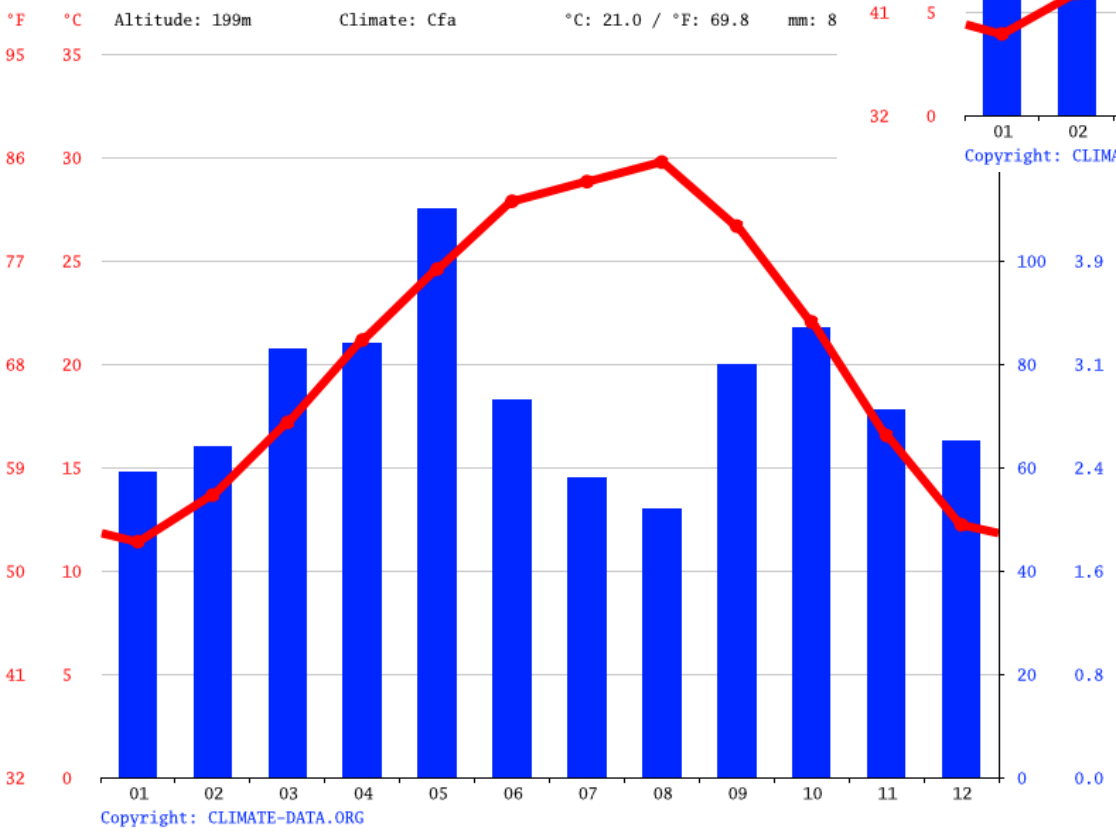
Stenosphenus dolosus
hosts on *Prosopis, Acacia*

Climate Graphs

Oklahoma City



San Antonio



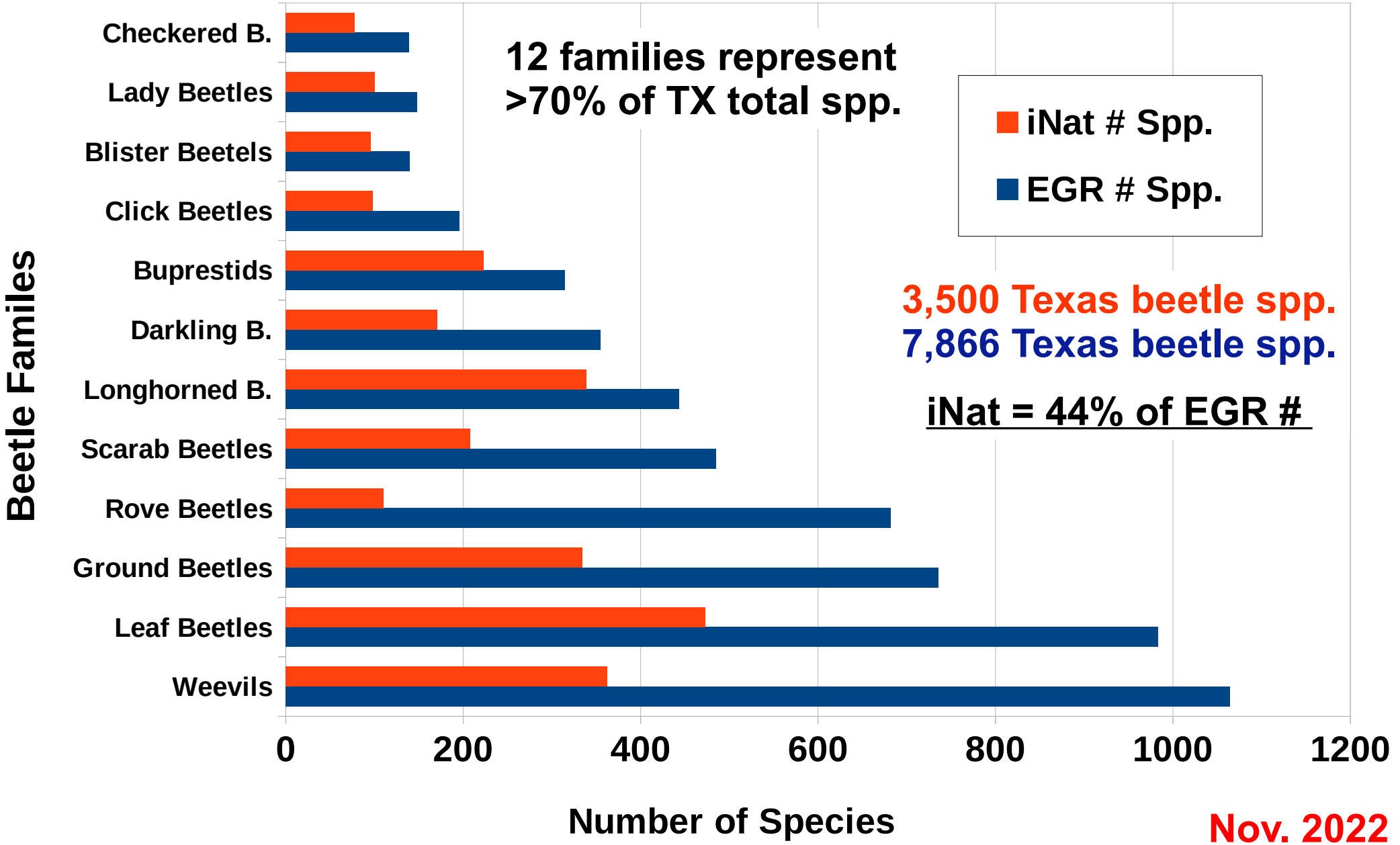
Temperature

Precipitation

Climate-Data.org

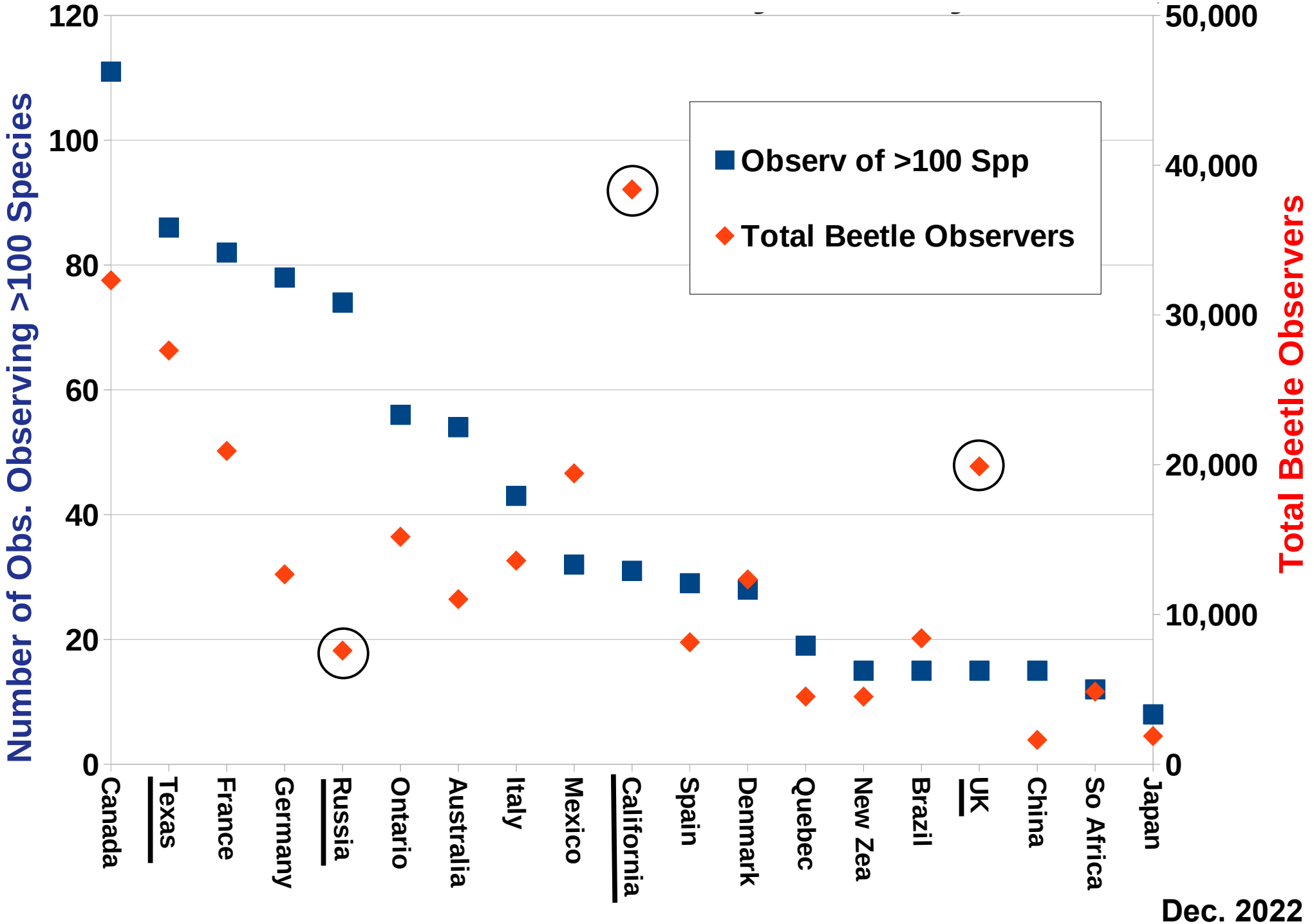
Number of Texas Beetle Spp. per Family

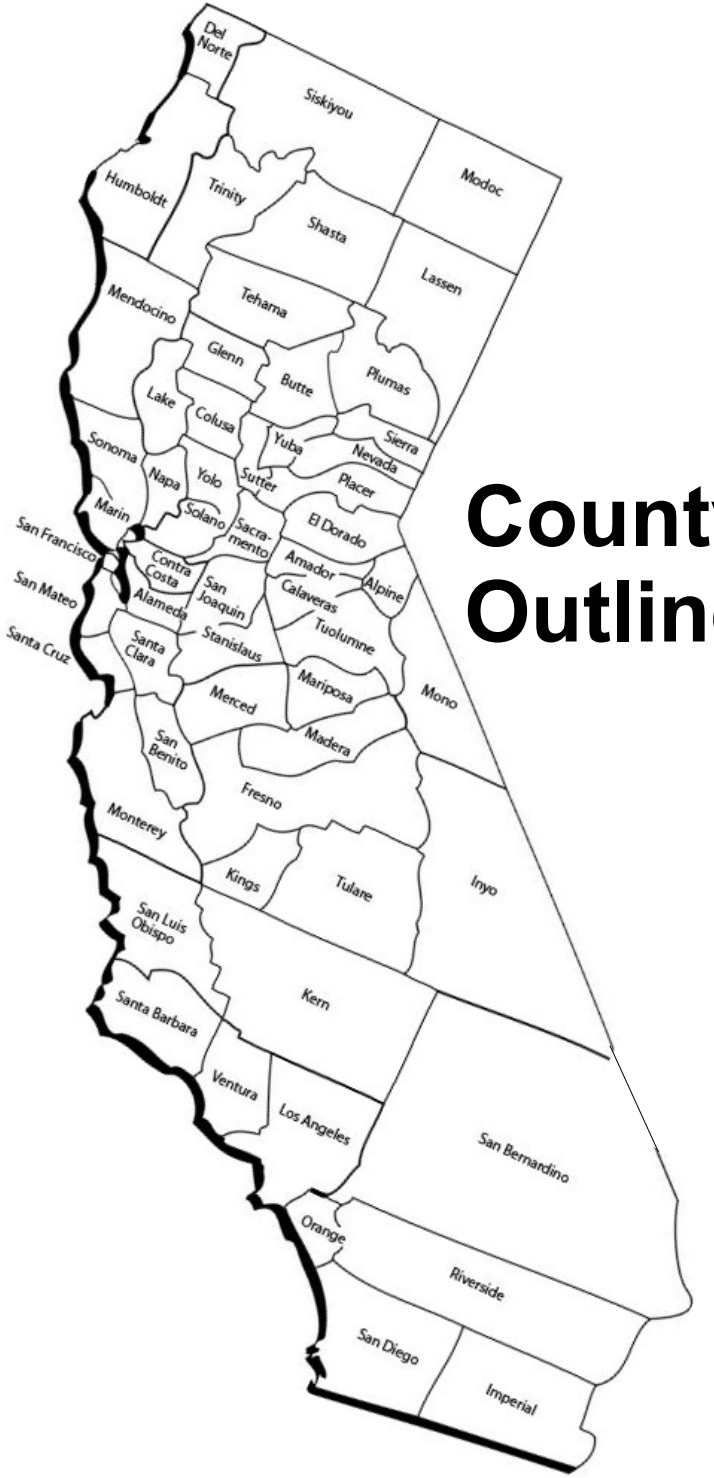
iNaturalist vs. E.G. Riley



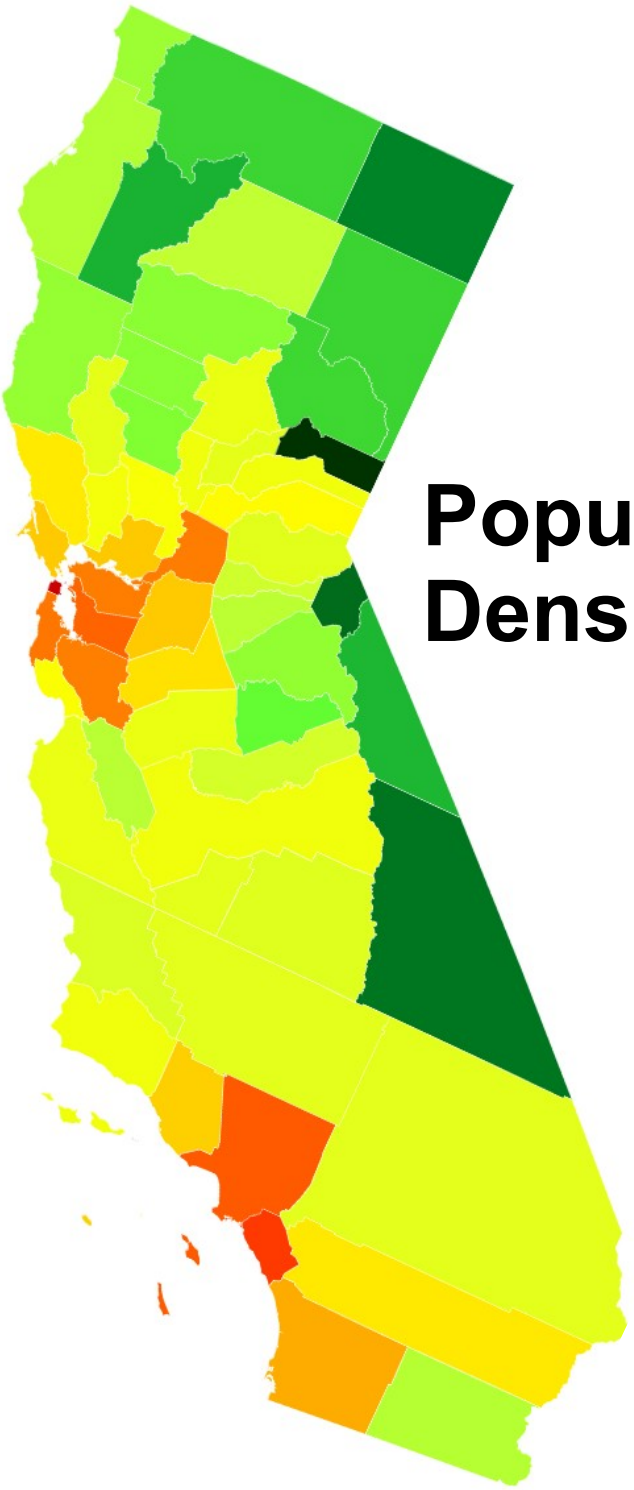
Nov. 2022

iNat Beetle Observations by Country or State

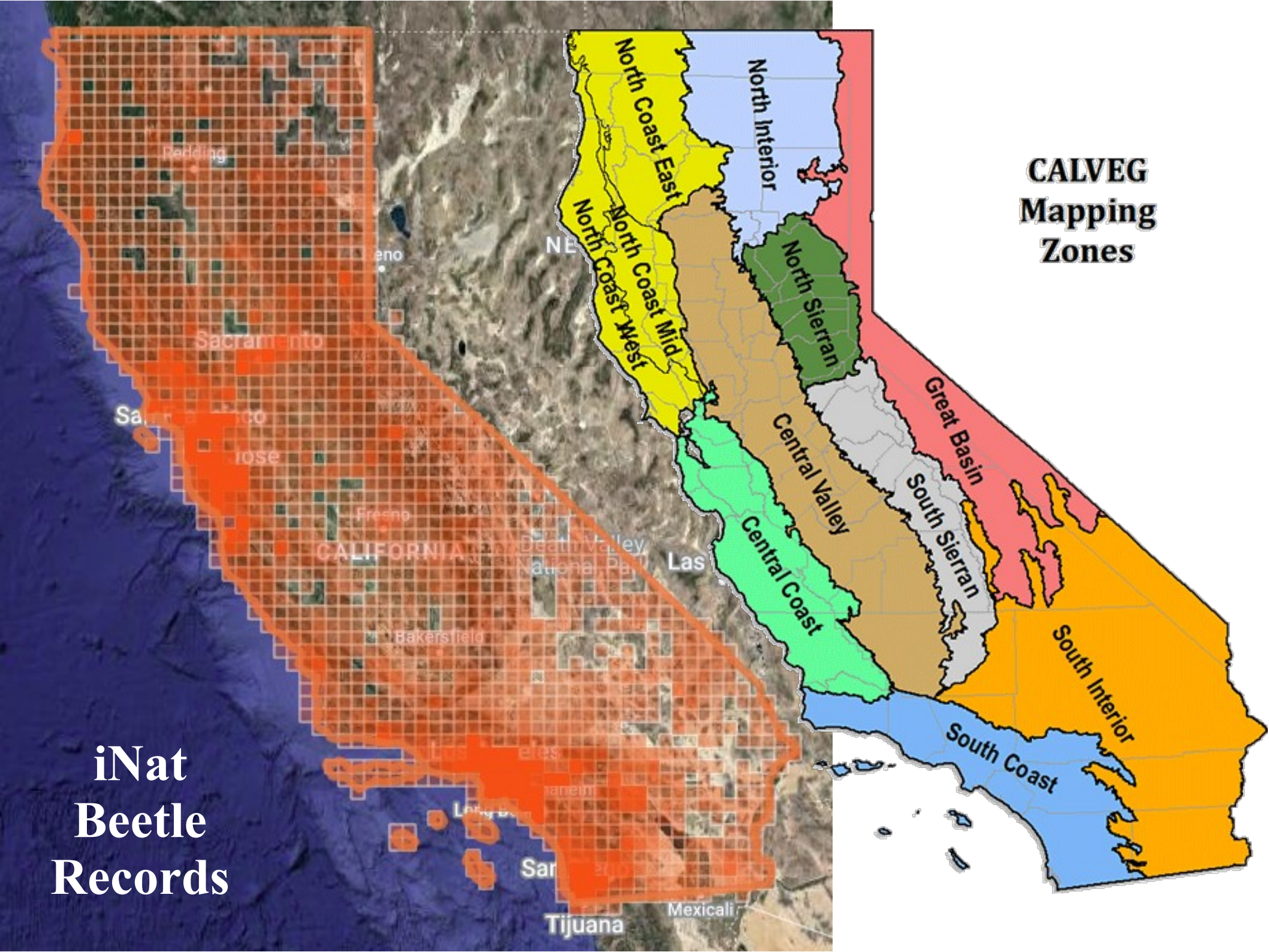




County Outlines



Population Density


iNat
Beetle
Records
CALVEG
Mapping
Zones
North Coast East
North Interior
North Coast West
North Coast Mid
North Sierran
Great Basin
Central Valley
South Sierran
Central Coast
South Interior
South Coast
Sacramento
Fresno
Bakersfield
Las
Tijuana
Mexicali

Mike Quinn, Ed Riley

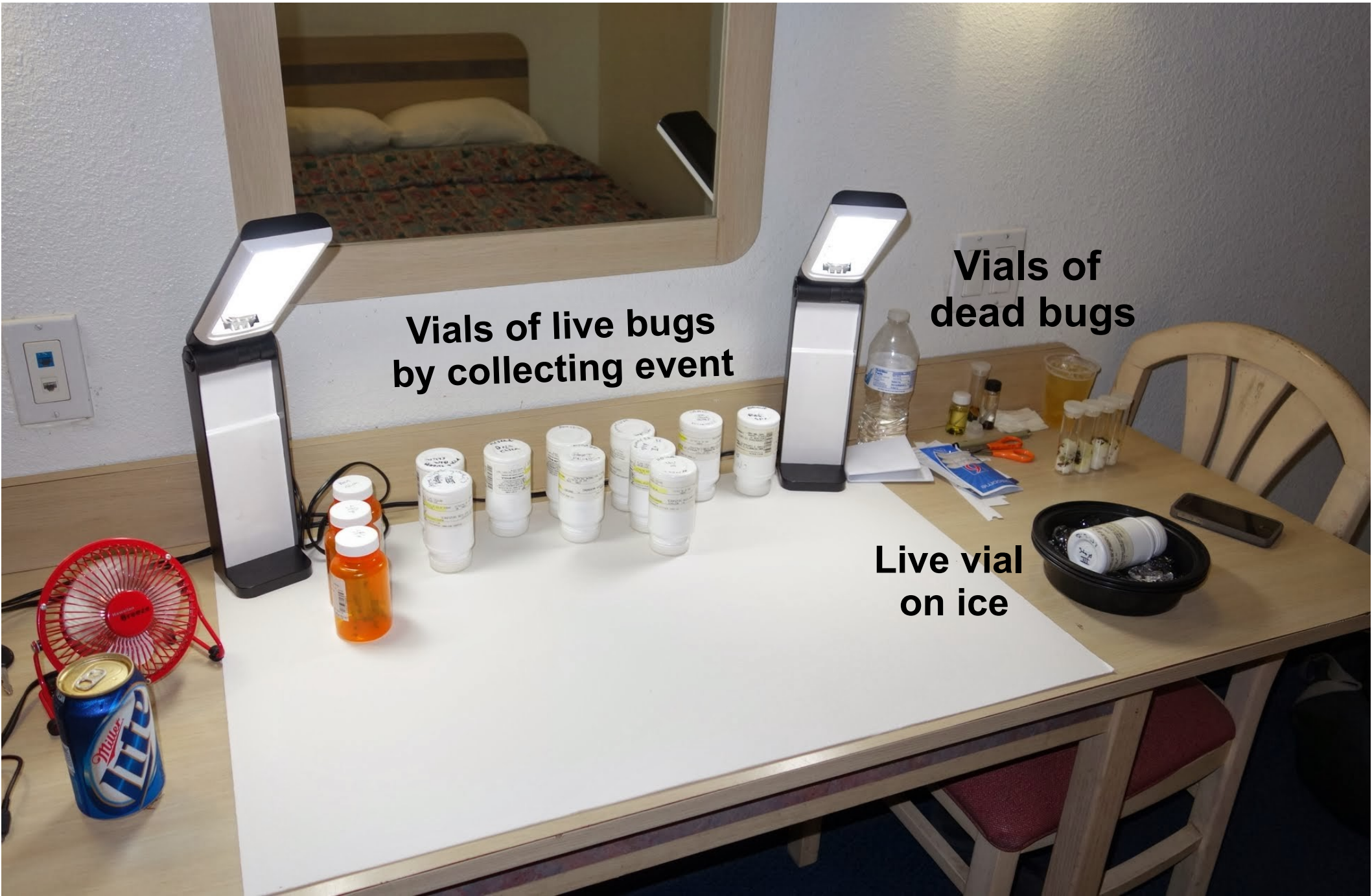
Gómez Farías, Tamaulipas, Mexico - 1993

Boca Chica, 2009

Terlingua Ranch, 2015


THE
DEATH SCARAB
KNOWS WHO
YOU ARE!

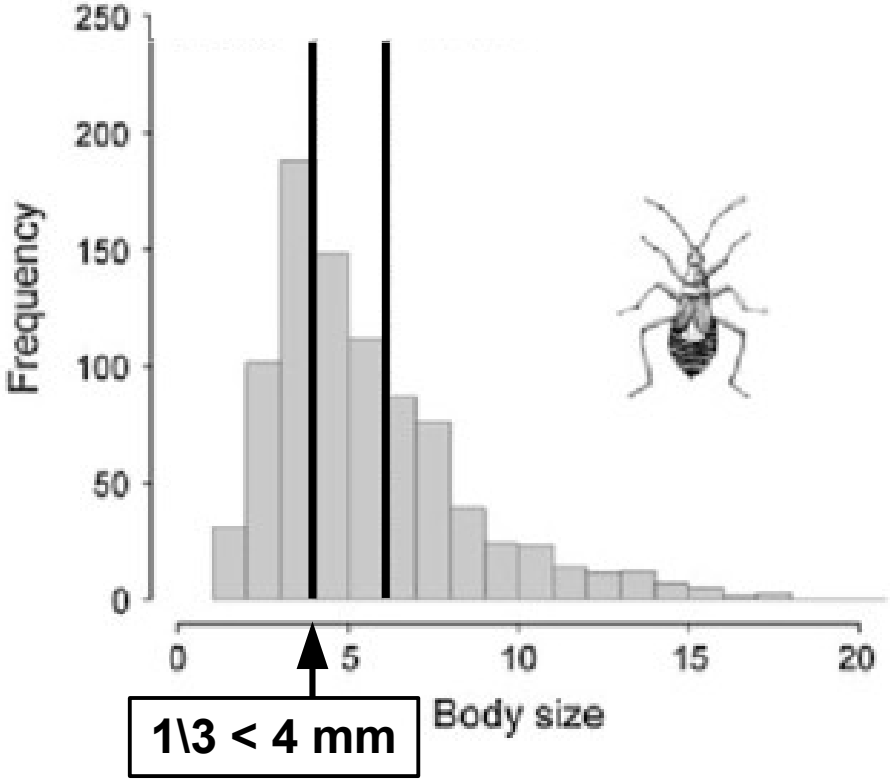
End of the Day Motel 6 Studio Set Up



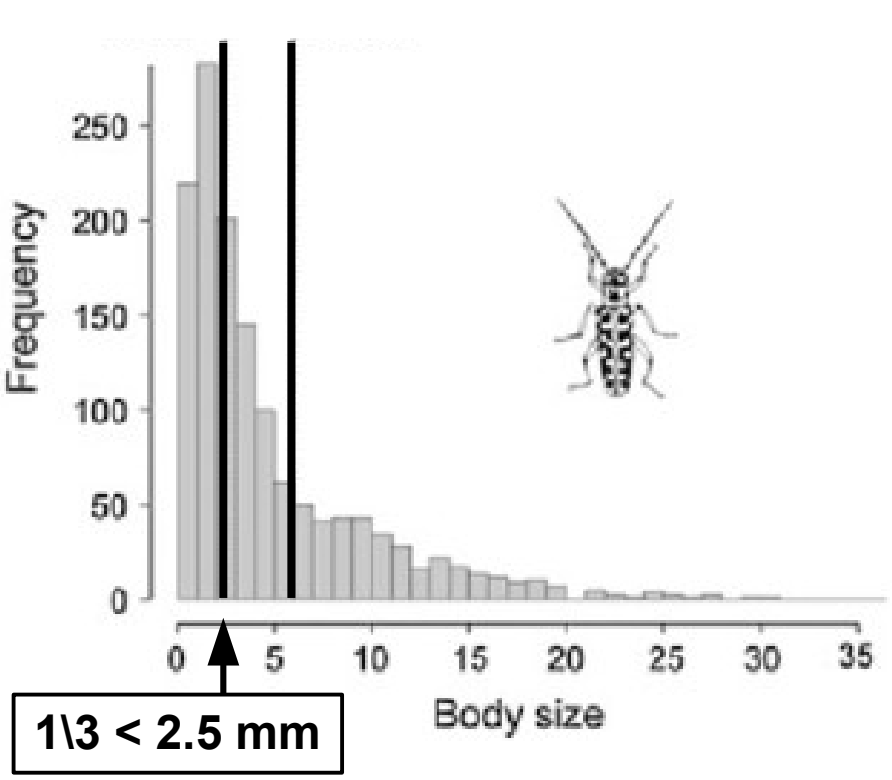
Frequency by Body Length

66% of insects (n=2,257) less than 6.1 mm

True Bugs



Saproxylic Beetles

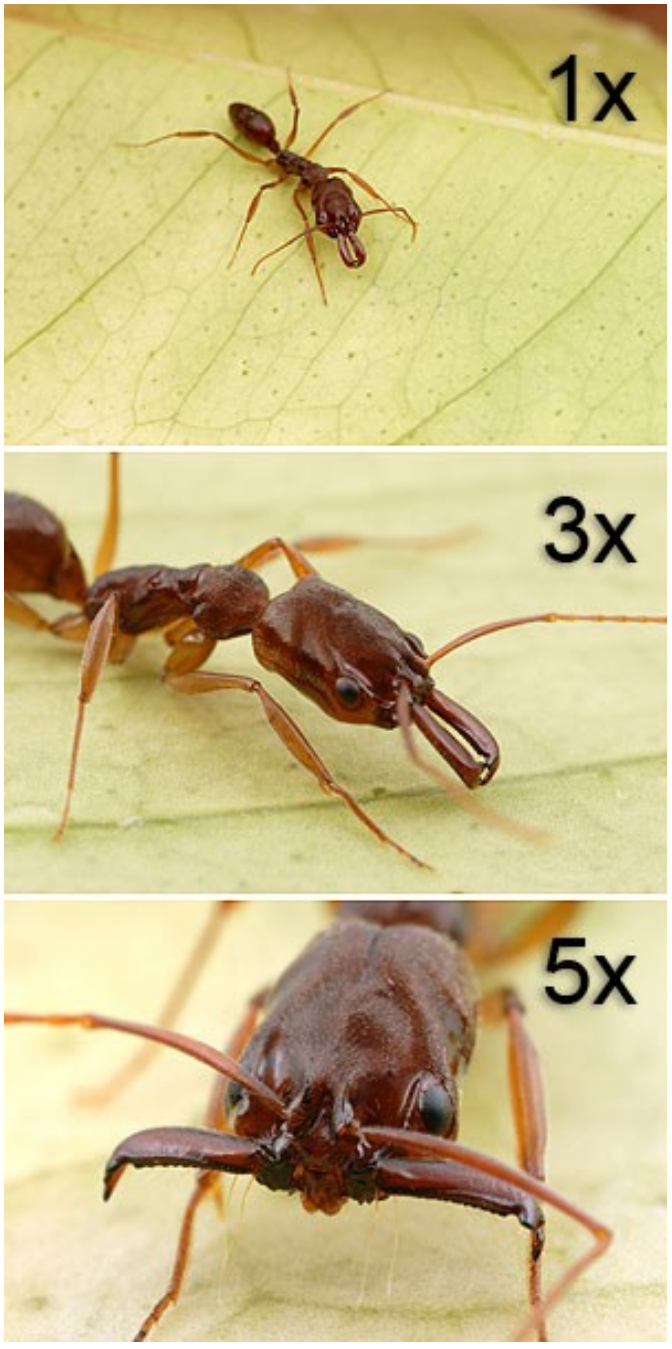


Gossner & Müller (2011)

Canon's MP-E 65mm 1-5x Macro Lens

Postage Stamp

Grain of Rice



Trap-jaw Ant

Photos courtesy Alex Wild

Summary

Observational Data are Increasing Exponentially, but Species Numbers are Growing More Slowly

Texas is an Active Center of iNaturalist Data

Cities are 'Working Centers' of Biodiversity Data

Travis Co. is the Urban Diversity Hotspot of Texas

I-35 Corridor/Blackland Prairie Ecoregion/Domain Ecotone Diversity is Underappreciated

iNaturalist still <50% of Texas Arthropod species

Contact

iNat @entomike

www.TexasEnto.net

EntoMike@gmail.com

References

BugGuide. Jan. 2023. Month, number of images. https://bugguide.net/node/view/11181

Carlton, C.E.., Chandler, D.S., Leschen, R.A.B., Riley, E.G., Skelley, P.E. 2005. Obituary and Dedication: Karl Heinz Stephan 1931-2005. The Coleopterists Society, 59(3): 277-283.

Heberling JM, Isaac BL. 2018. iNaturalist as a tool to expand the research value of museum specimens. Applications in Plant Sciences 6: e1193.

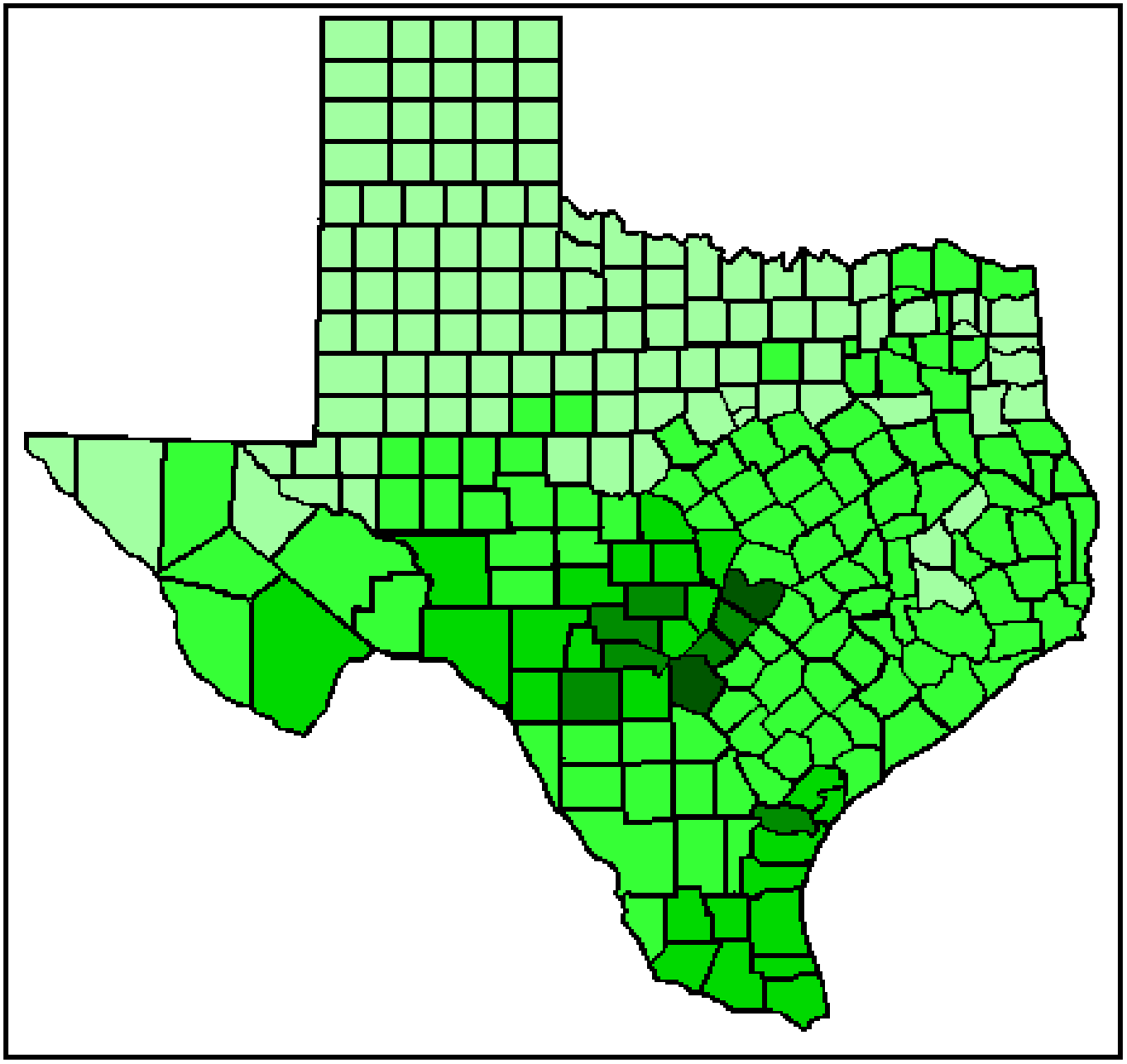
Martin M. Gossner, M.M. and J. Müller. 2011. The influence of species traits and q-metrics on scale-specific β-diversity components of arthropod communities of temperate forests. Landscape Ecology 26(3):411-424.

Pinson, J. 2021. Who observes the observers? Scientists conduct large-scale study of iNaturalist users. Community Science: https://bit.ly/3hqWQni

Ridgely, R.S. and G. Tudor. 1994. The Birds of South America, Vol. 2: The Suboscine Passerines. UT Press, Austin. 940 pp.

Riley, E.G., pers. comm., ca. 2022. https://entomology.tamu.edu/people/riley-edward-g/

Endemic Plants per Texas County



Color Key (number of endemic taxa in county) :

1-19 | 20-38 | 39-57 | 58-75 | 76-93

Source?

iNaturalist All-taxa College Project

Overview

101,437 OBSERVATIONS	6,735 SPECIES	5,323 IDENTIFIERS	944 OBSERVERS
101.4k Obs.	**6.7k Spp.**	**5.3k ID'ers**	**944 Obsrvs**

Stats

Jan. '22

Leaderboard Sort By: Observations | Species | Observers

Curtis Eckerman
Asso. Professor @ ACC

ACC Faculty	16,905	
2019 Spring - ACC BIOL 1407 Class Biodiversity Project [Eckerman]	11,486	**11.5k Obs., Sp. '19**
2017 Fall - ACC BIOL 1407 Class Biodiversity Project (Eckerman)	8,675	**8.7k Obs., Fall '17**
2018 Fall - ACC BIOL 1407 Class Biodiversity Project [Eckerman]	8,649	**8.6k Obs., Fall '18**
2019 Fall - ACC BIOL 1407 Class Biodiversity Project [Eckerman]	8,247	**8.2k Obs., Fall '19**
2018 Spring - ACC BIOL 1407 Class Biodiversity Project [Eckerman]	7,848	**7.8k Obs., Sp. '18**
2021 Fall - ACC BIOL 1407 Class Biodiversity Project [Eckerman]	5,928	**5.9k Obs., Fall '21**

/acc-faculty

https://www.inaturalist.org/projects/acc-biology