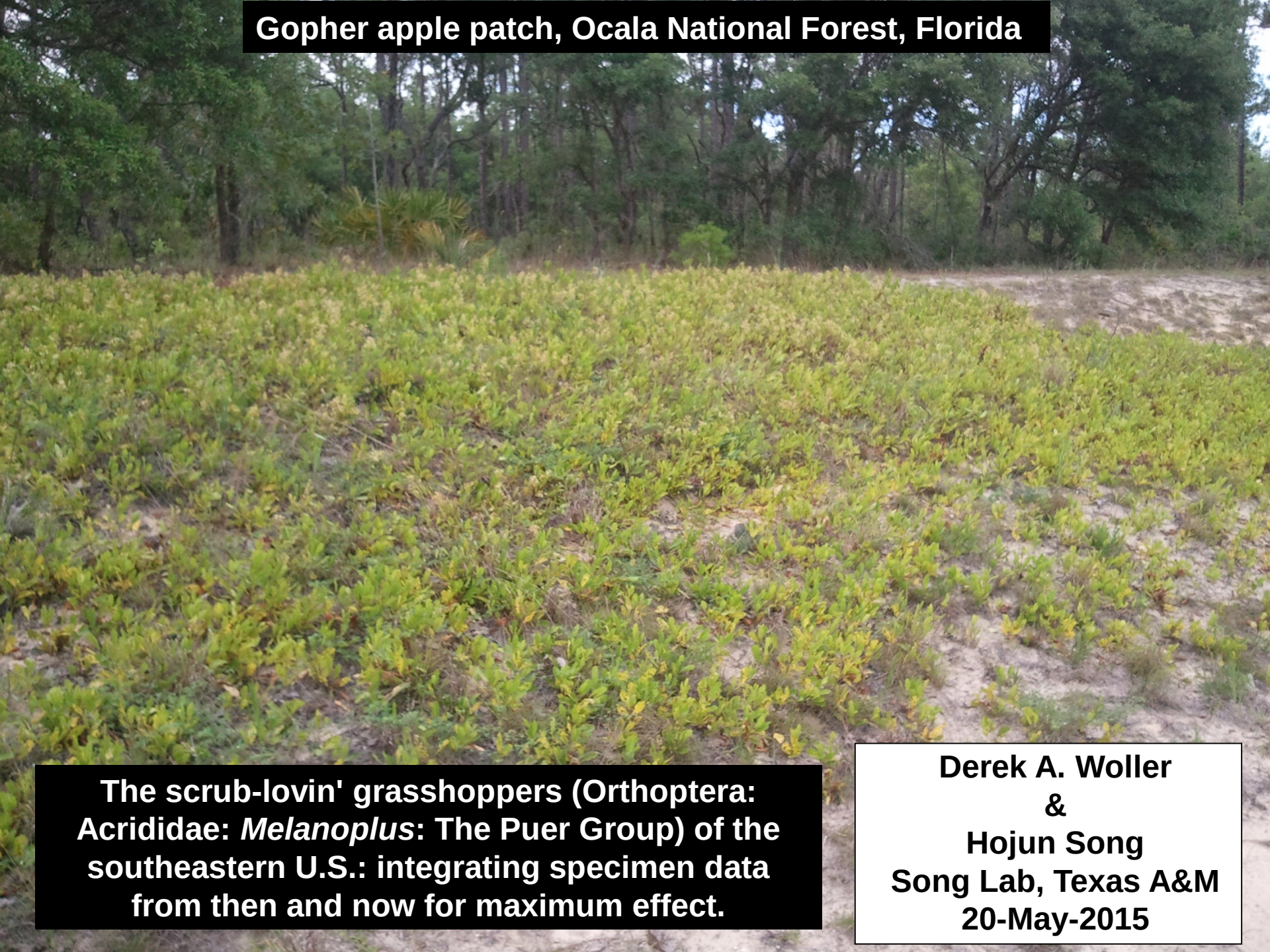
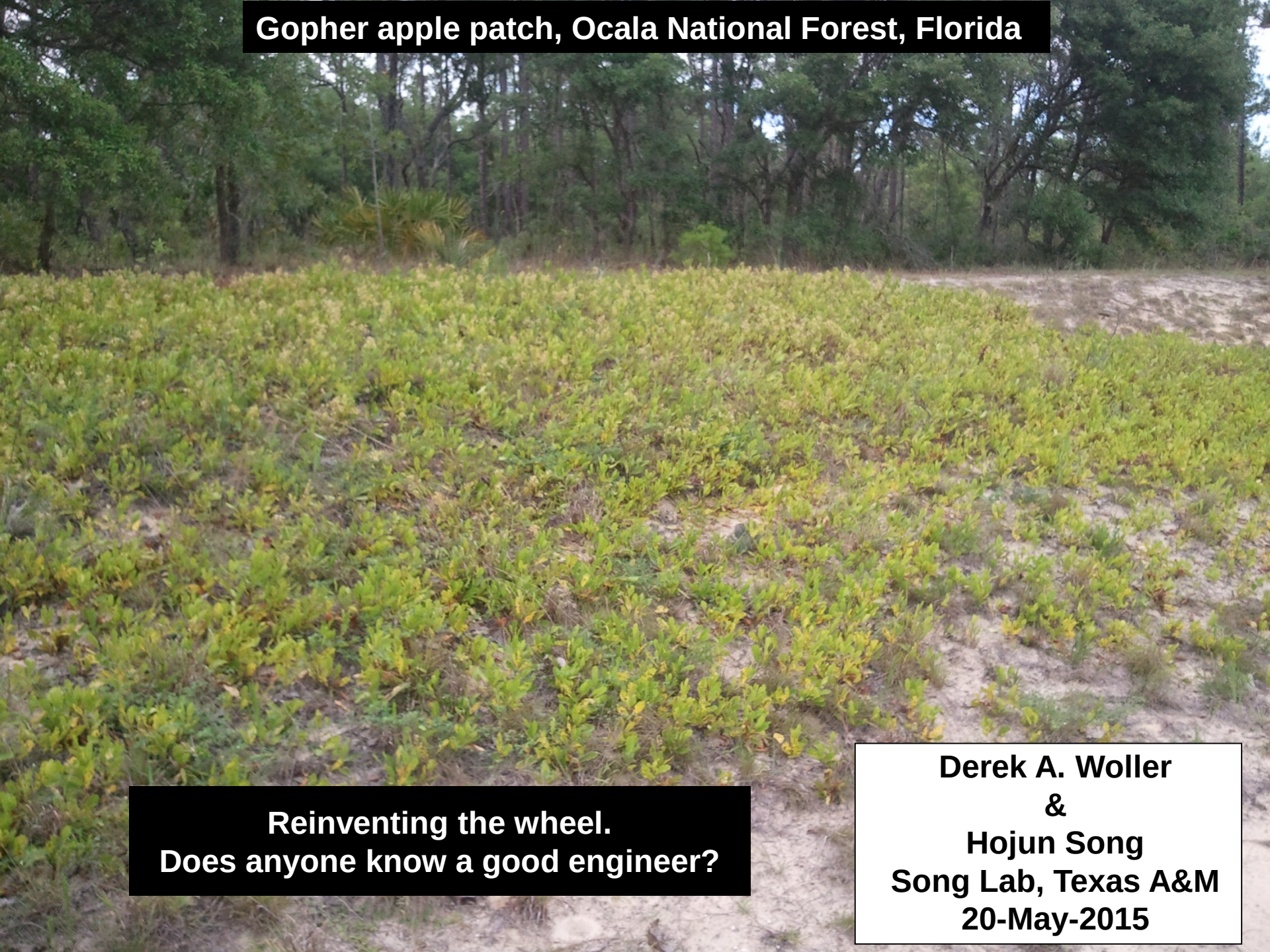


The scrub-lovin' grasshoppers (Orthoptera: Acrididae: *Melanoplus*: The Puer Group) of the southeastern U.S.: integrating specimen data from then and now for maximum effect.

Derek A. Woller
&
Hojun Song
Song Lab, Texas A&M
20-May-2015



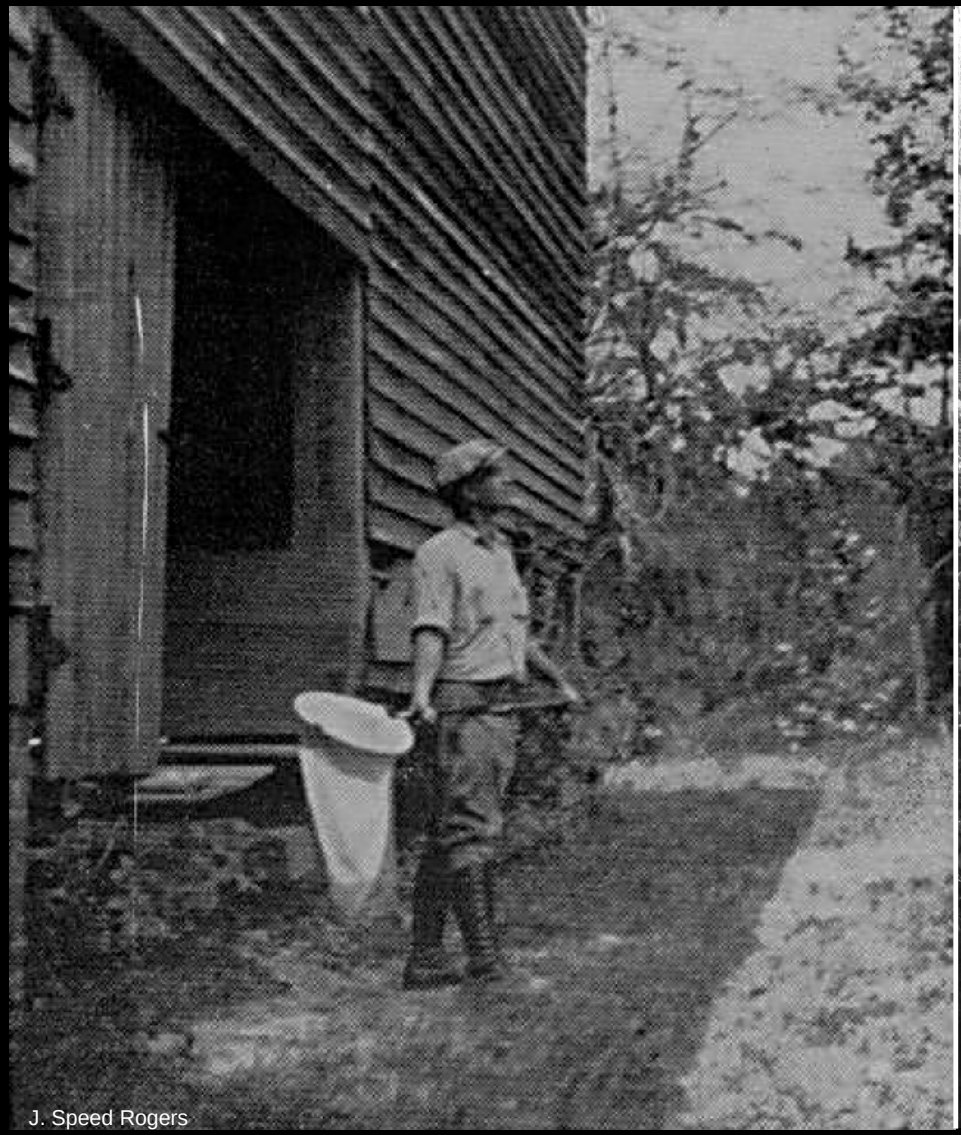
Reinventing the wheel.
Does anyone know a good engineer?

Derek A. Woller
&
Hojun Song
Song Lab, Texas A&M
20-May-2015


Scrub rosemary bald, Orlando, FL
I. Introduction
II. Collection Data Usage
III. Trials & Tribulations

I. Introduction

I. Introduction



Theodore H. “Hub” Hubbell, Rock Bluff Landing, FL on April 4, 1927

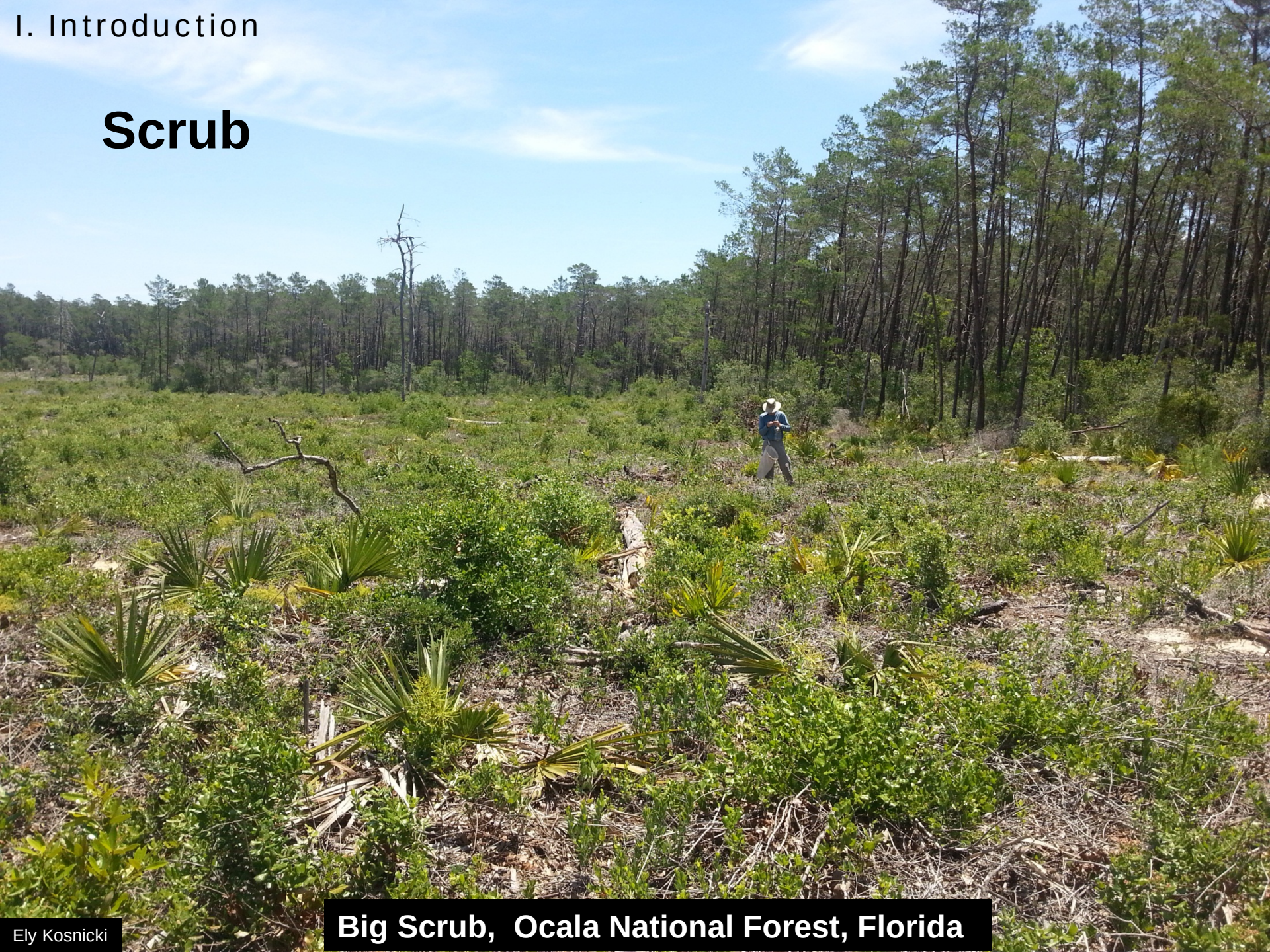
Derek A. Woller, Orlando, FL on April 4, 2013

In a nutshell

I’m investigating the speciation process by examining the two primary mechanisms driving the evolutionary history of a group of scrub-lovin’ grasshoppers:

Allopatry and Sexual Selection

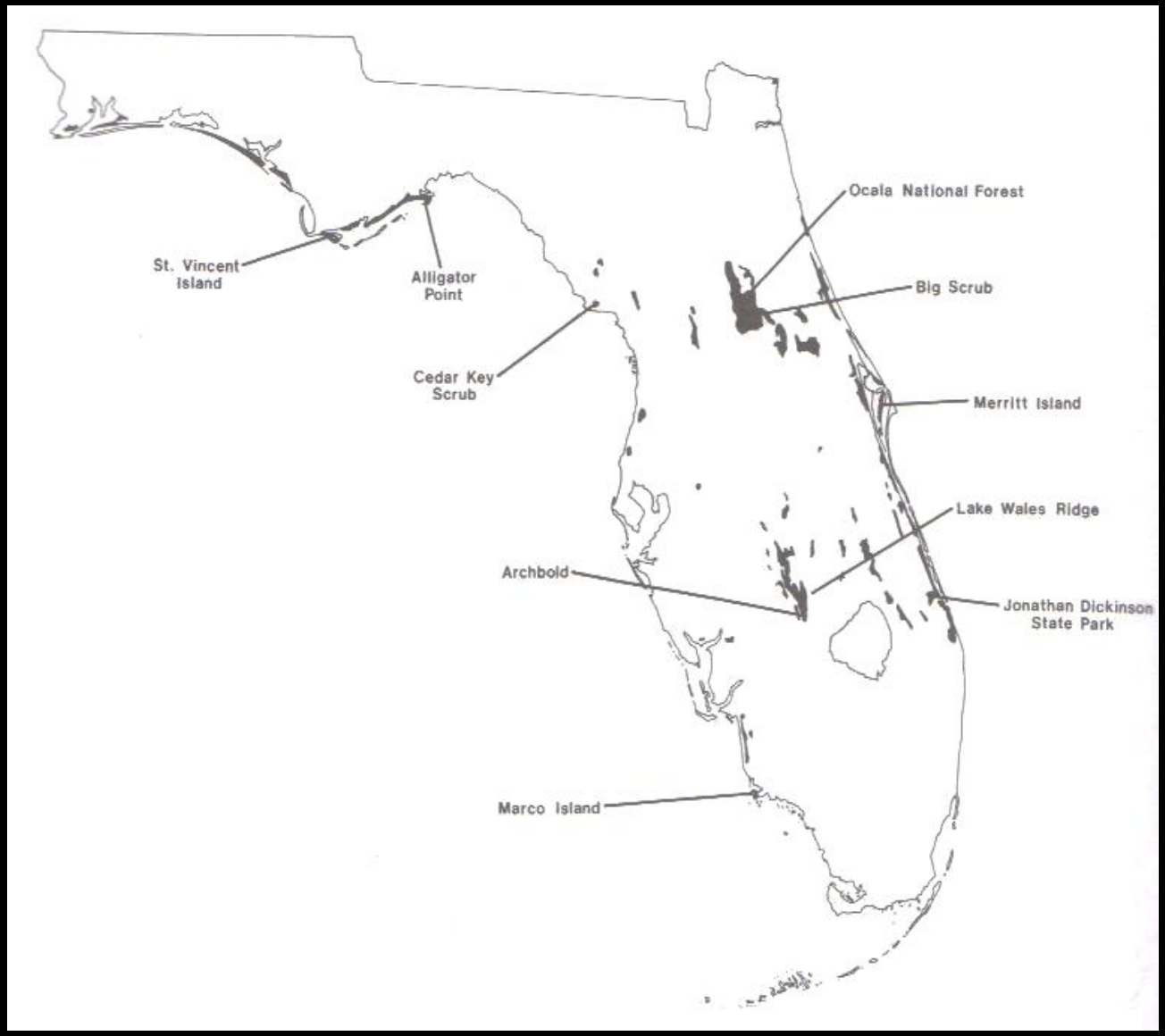
Scrub



Big Scrub, Ocala National Forest, Florida

Ely Kosnicki

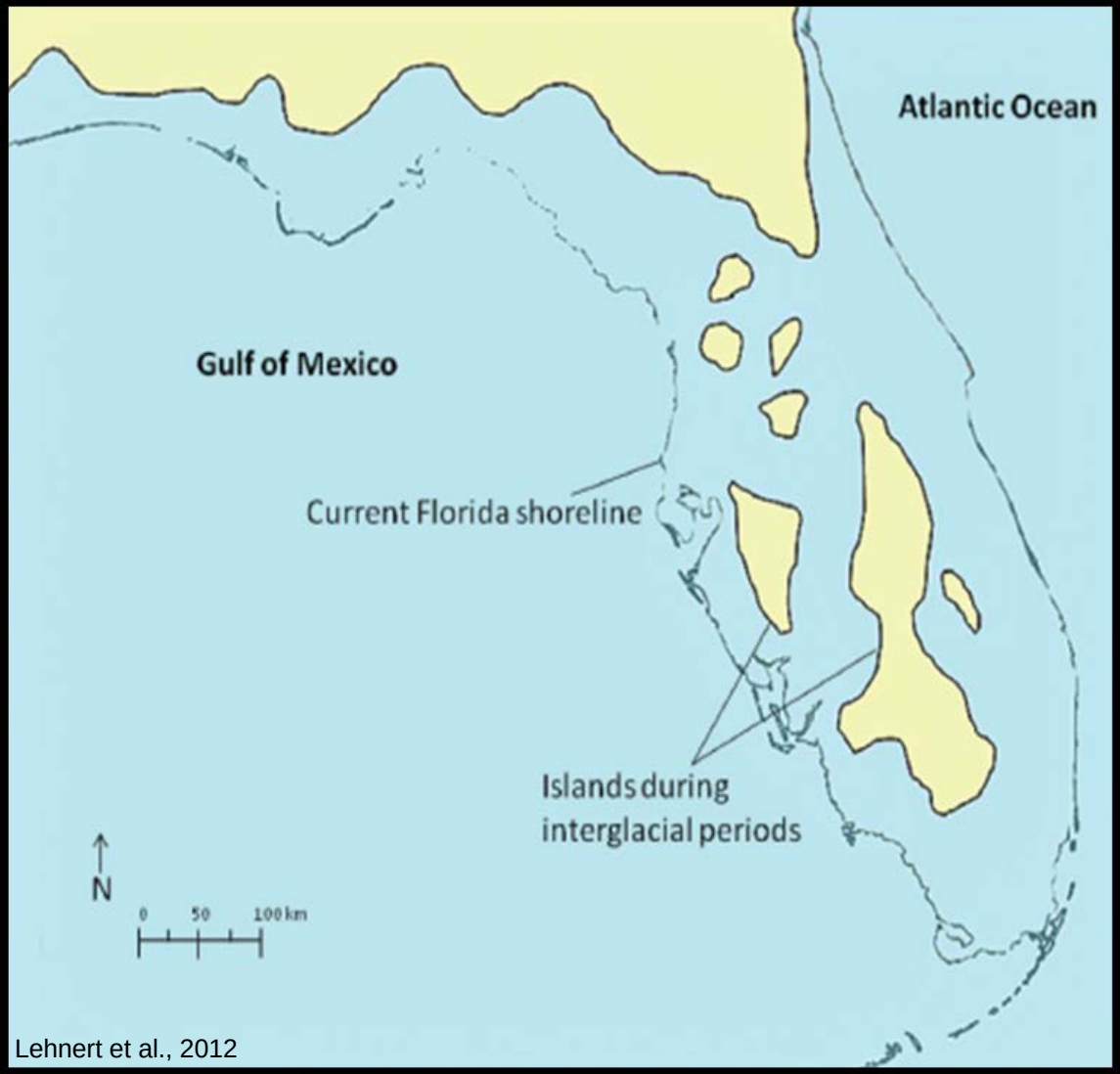
I. Introduction



Location of scrub habitats in FL (adapted from Myers, 1990)

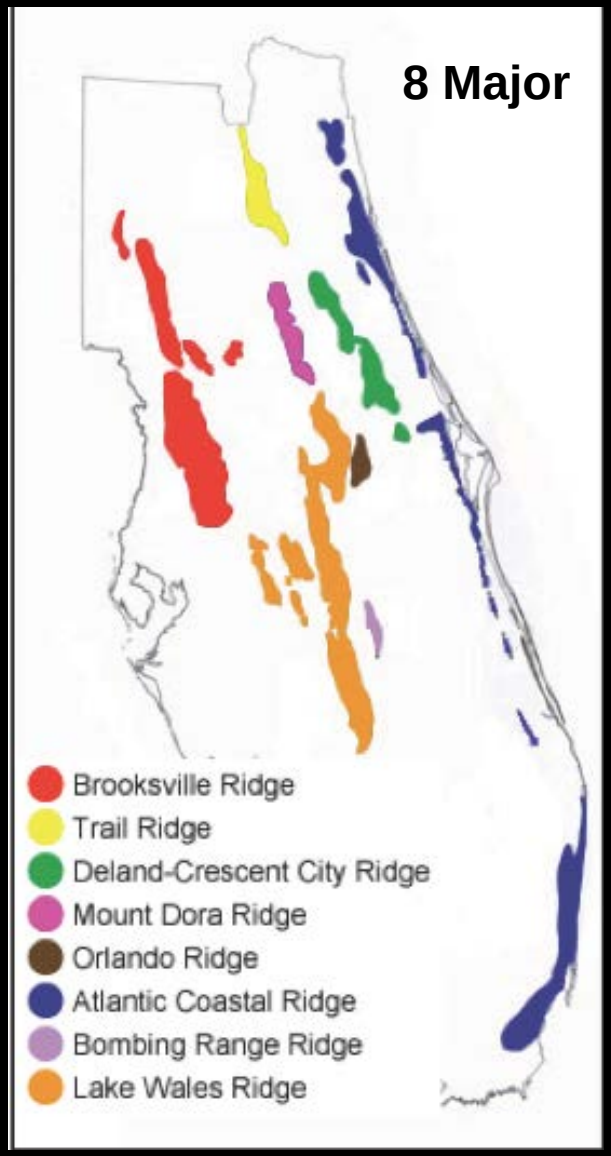
Florida is the exposed portion of the Florida Platform and is estimated to be 530 MYO

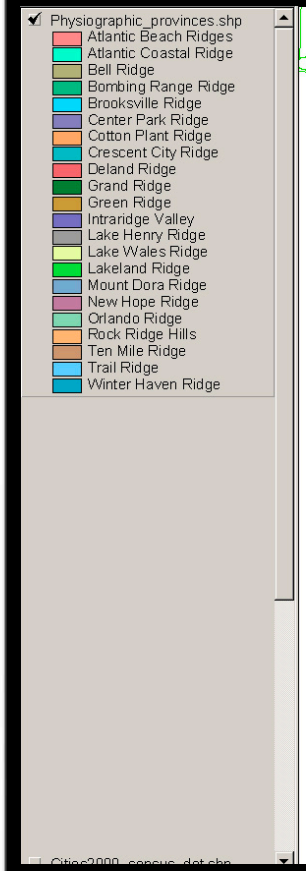
For 95% of its geologic history, majority of FL was beneath the sea

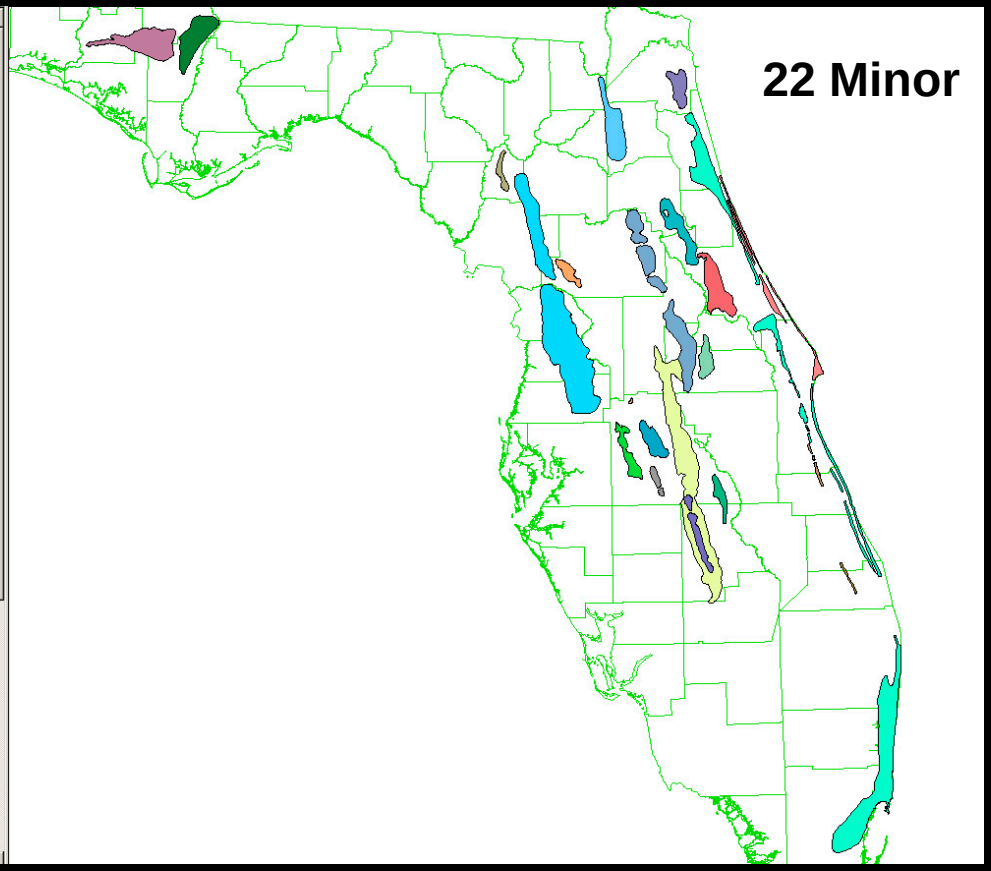


Lehnert et al., 2012

The ridge systems of Florida: ancient islands







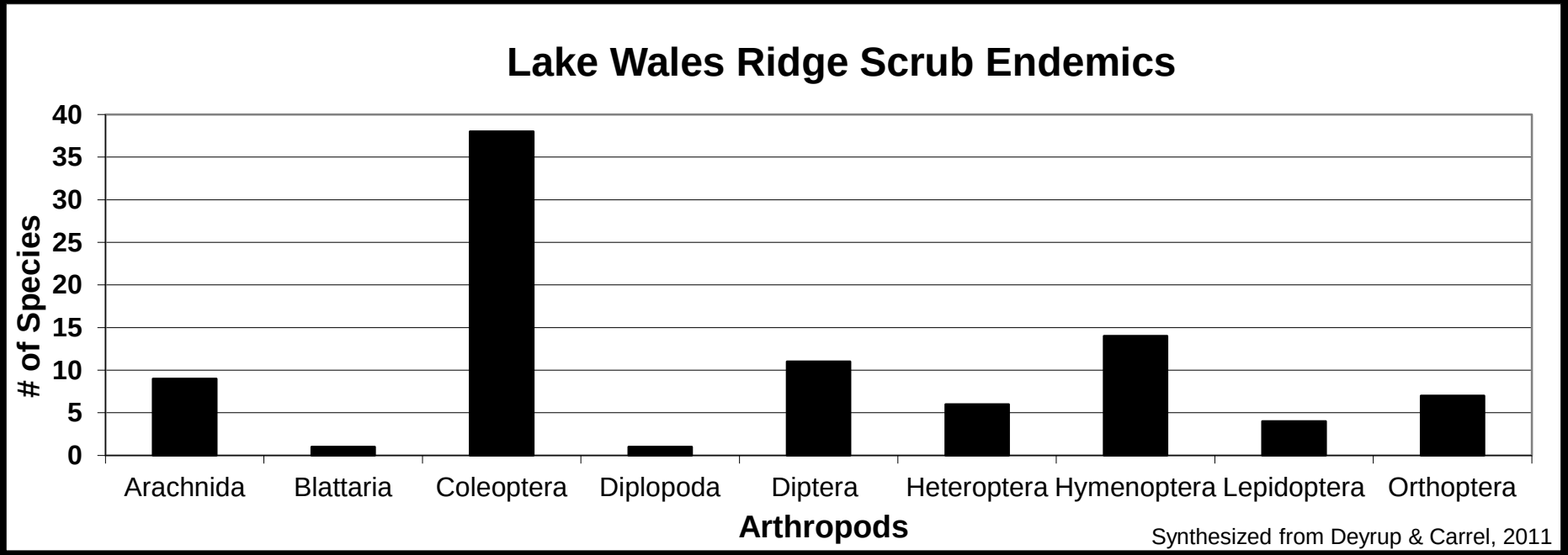
I. Introduction

Toothcercus spurthroat grasshopper
Melanoplus forcipatus

Endemics

St. Johns spurthroat grasshopper
Melanoplus adelogyrus

prior to 2011: only 46 endemic arthropod species known from FL scrub



91 endemic arthropod species in Lake Wales Ridge scrub alone

The Puer Group (*sensu lato*) (PG (*s.l.*)): composed of 24 species (6 *sensu stricto* (*s.s.*) groups) of flightless, scrub-lovin' *Melanoplus* spp. of the southeastern U.S.

Overall	Within	Group	Species	Map Code	Distribution	Range
1	1	Forcipatus	apalachicolae	AP	FL	narrow
2	2	Forcipatus	forcipatus	FO	FL	narrow
3	3	Forcipatus	gurneyi	GU	FL	narrow
4	4	Forcipatus	indicifer	IN	FL	narrow
5	5	Forcipatus	nanciae	NA	FL	narrow
6	6	Forcipatus	ordwayae	OR	FL	narrow
7	1	Puer	adelogyrus	AD	FL	narrow
8	2	Puer	bonita	BO	FL	narrow
9	3	Puer	kissimmee	KI	FL	narrow
10	4	Puer	peninsularis	PE	FL	narrow
11	5	Puer	puer	PU	FL	widespread
12	6	Puer	seminole	SE	FL	narrow
13	1	Rotundipennis	pygmaeus	PY	FL	narrow
14	2	Rotundipennis	rotundipennis	RO	FL, GA	widespread
15	3	Rotundipennis	withlacoocheensis	WI	FL	narrow
16	1	Scapularis	mirus	MI	NC	narrow
17	2	Scapularis	scapularis	SC	FL, GA	widespread
18	3	Scapularis	stegocercus	ST	GA	narrow
19	4	Scapularis	tumidicercus	TU	GA	narrow
20	1	Strumosus	foxi	FOX	GA	narrow
21	2	Strumosus	strumosus	STR	FL, SC	widespread
22	1	Tequestae	childsi	CH	FL	narrow
23	2	Tequestae	sebringi	SEB	FL	narrow
24	3	Tequestae	tequestae	TE	FL	narrow


M. rotundipennis

- united by similar morphology
- Only 1/6 are considered to be widespread
- Speciated due to a combination of allopatry, sexual selection, & ecological preferences

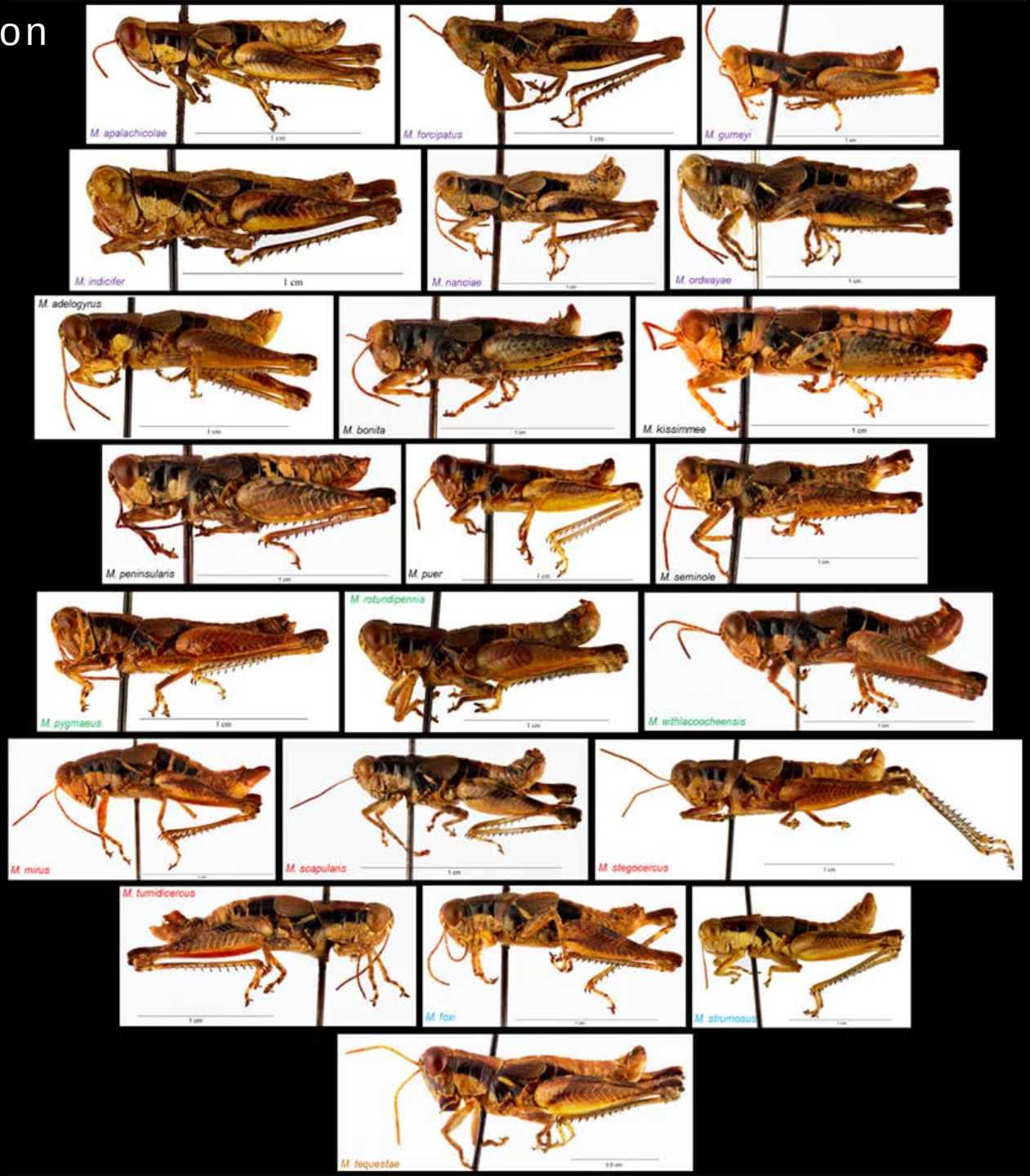
I. Introduction

M. forcipatus

I. Introduction

M. tequestae

I. Introduction




M. apalachicolae
M. forcipatus
M. gurneyi


M. indicifer
M. nanciae
M. ordwayae

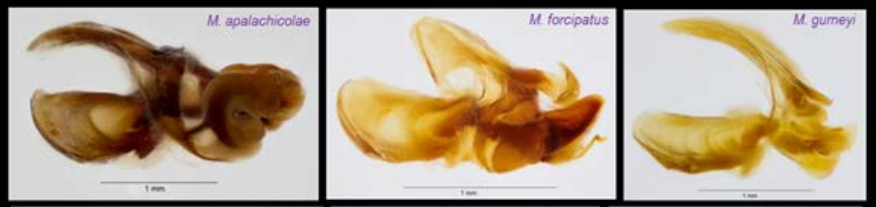

M. adelogyrus
M. peninsularis
M. puer


M. seminole
M. pygmaeus
M. rotundipennis


M. withlacoocheensis
M. mirus
M. scapularis

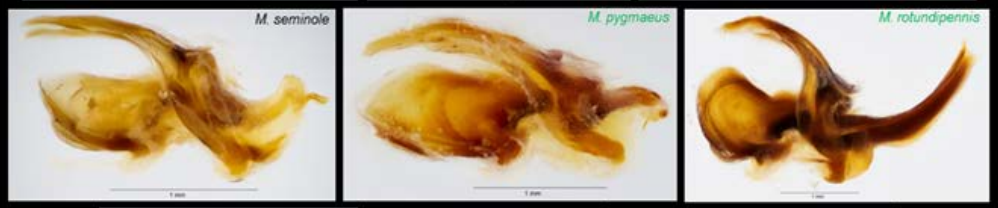

M. stegocercus
M. tumidicercus
M. foxi


M. strumosus
M. tequestae


M. apalachicolae
M. forcipatus
M. gurneyi


M. indicifer
M. nanciae
M. ordwayae


M. adelogyrus
M. peninsularis
M. puer


M. seminole
M. pygmaeus
M. rotundipennis


M. withlacoocheensis
M. mirus
M. scapularis


M. stegocercus
M. foxi
M. strumosus


M. tequestae

II. Collection Data Usage

II. Collection Data Usage

1. General Mapping

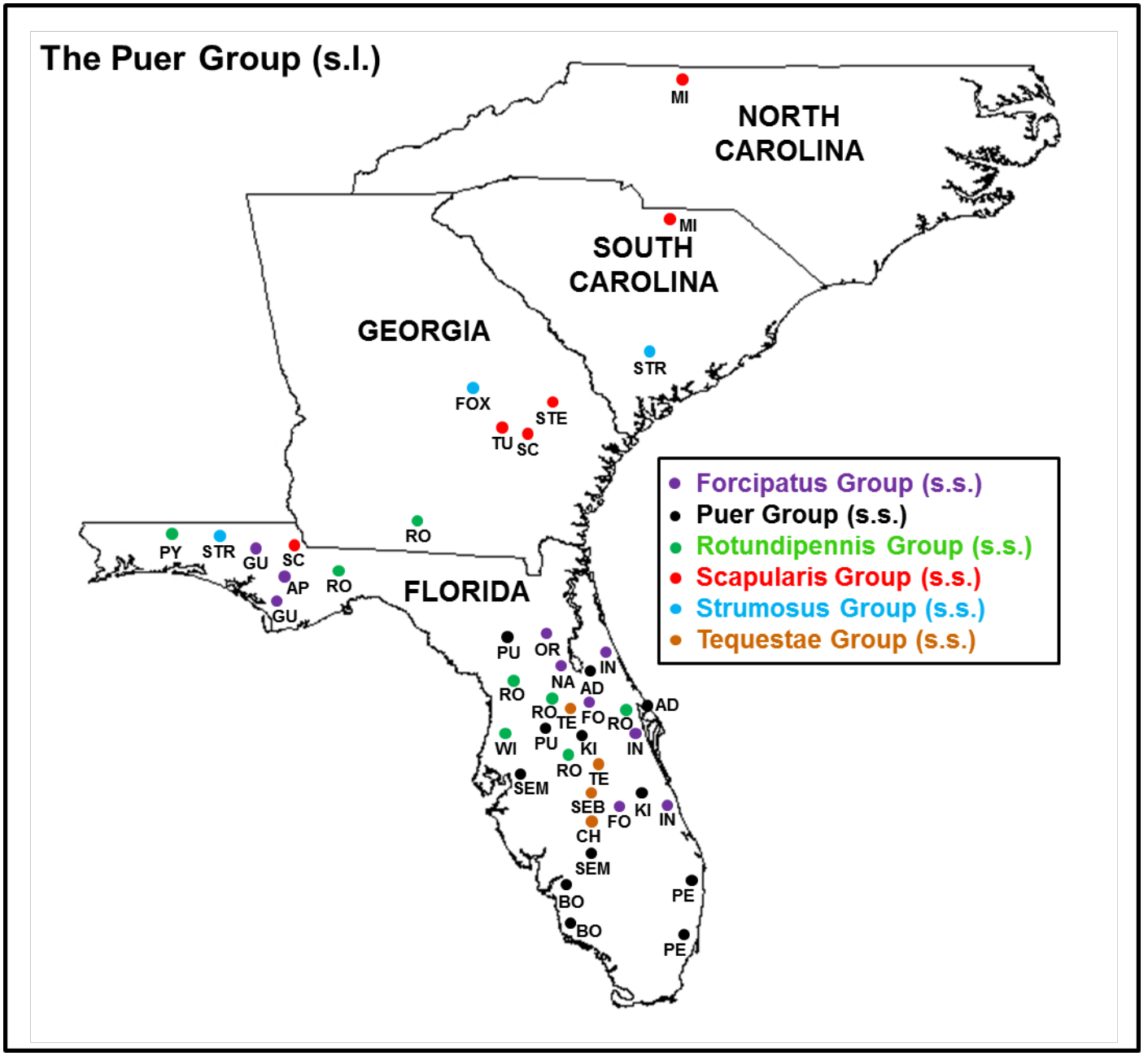
Based on

5,100 specimens

-4,011 Historical specimens from 10 U.S. collections

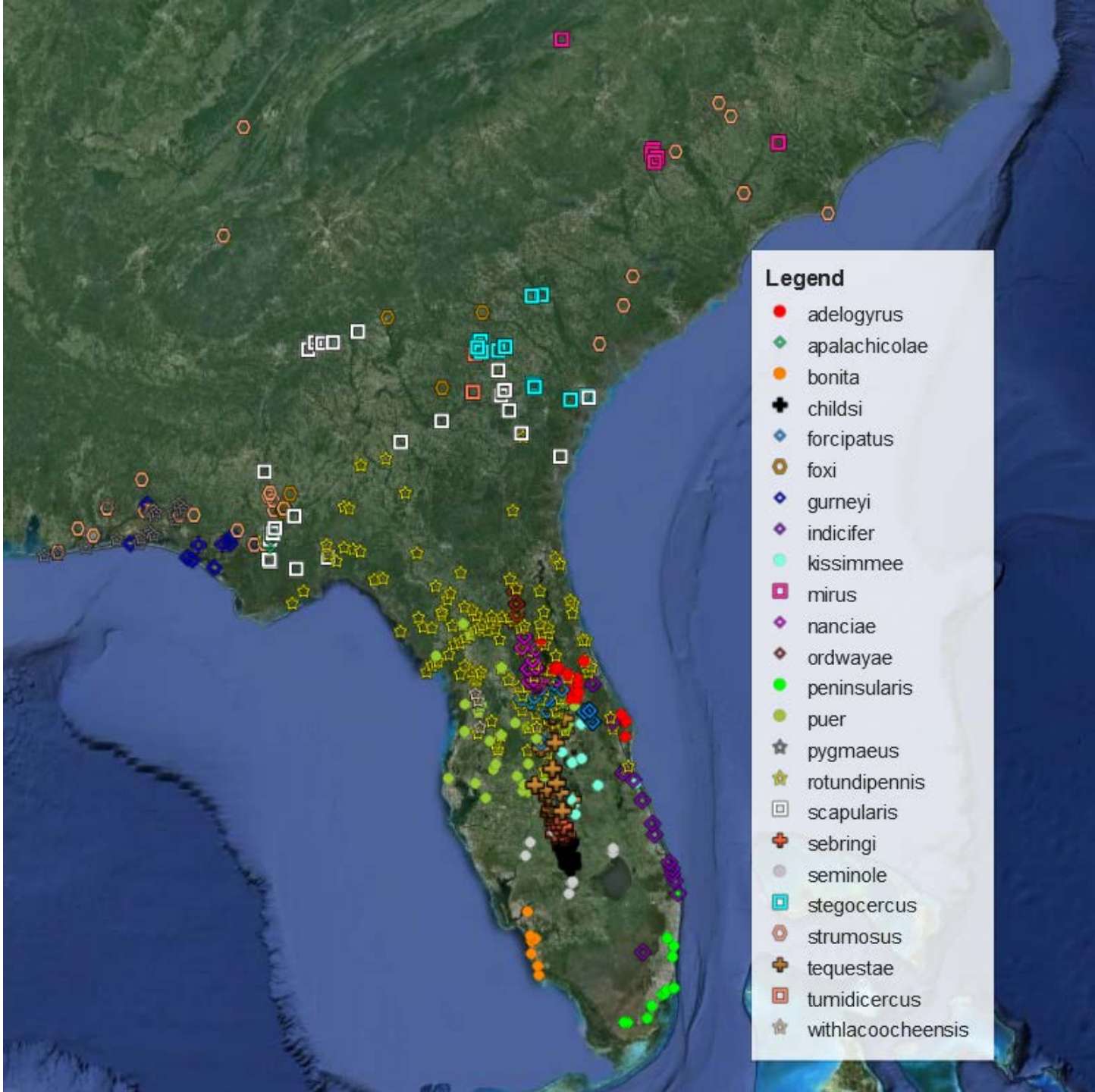
-1,089 specimens I collected during the past 3 years

Consensus Distribution Map

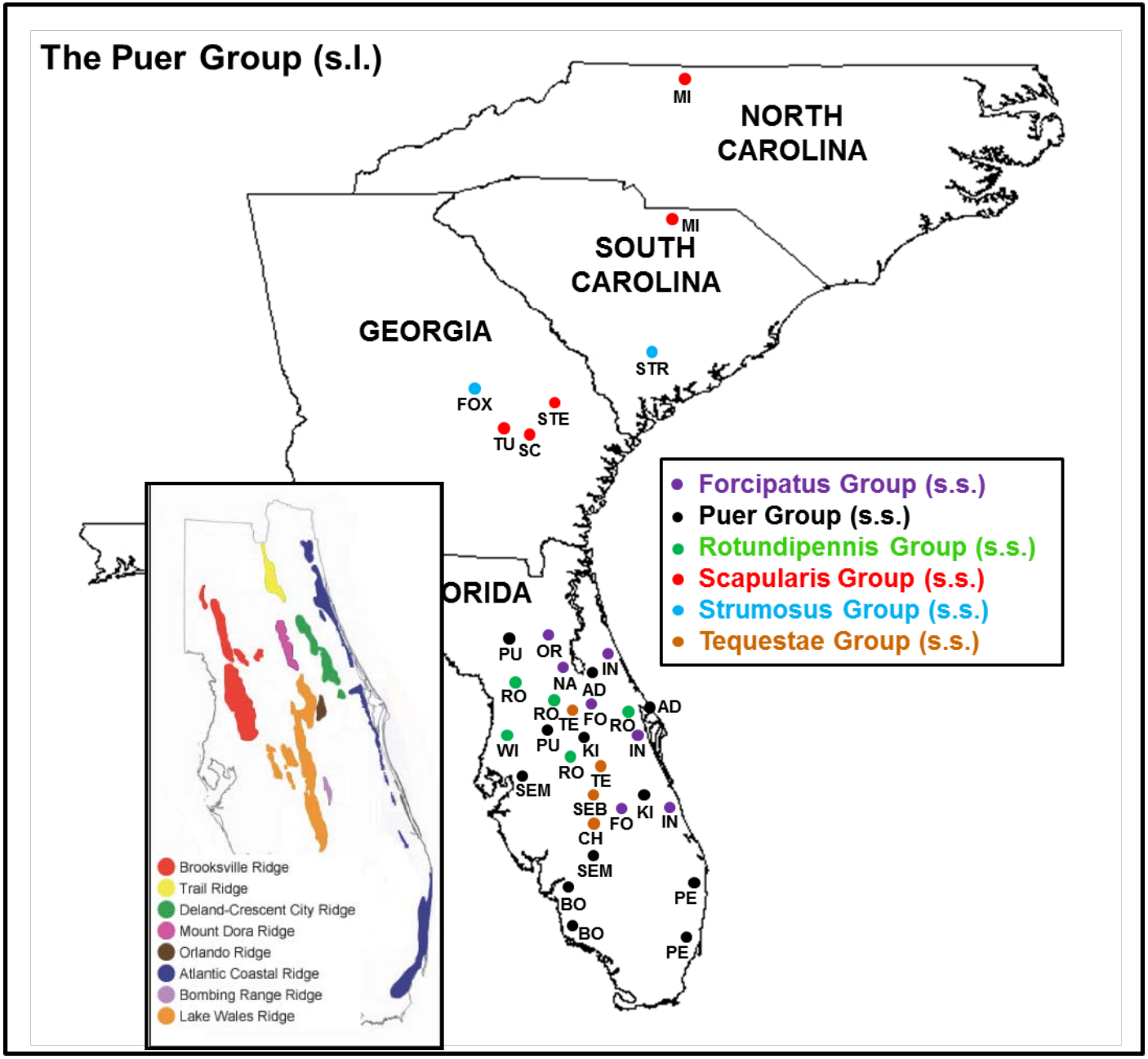


II. Collection Data Usage

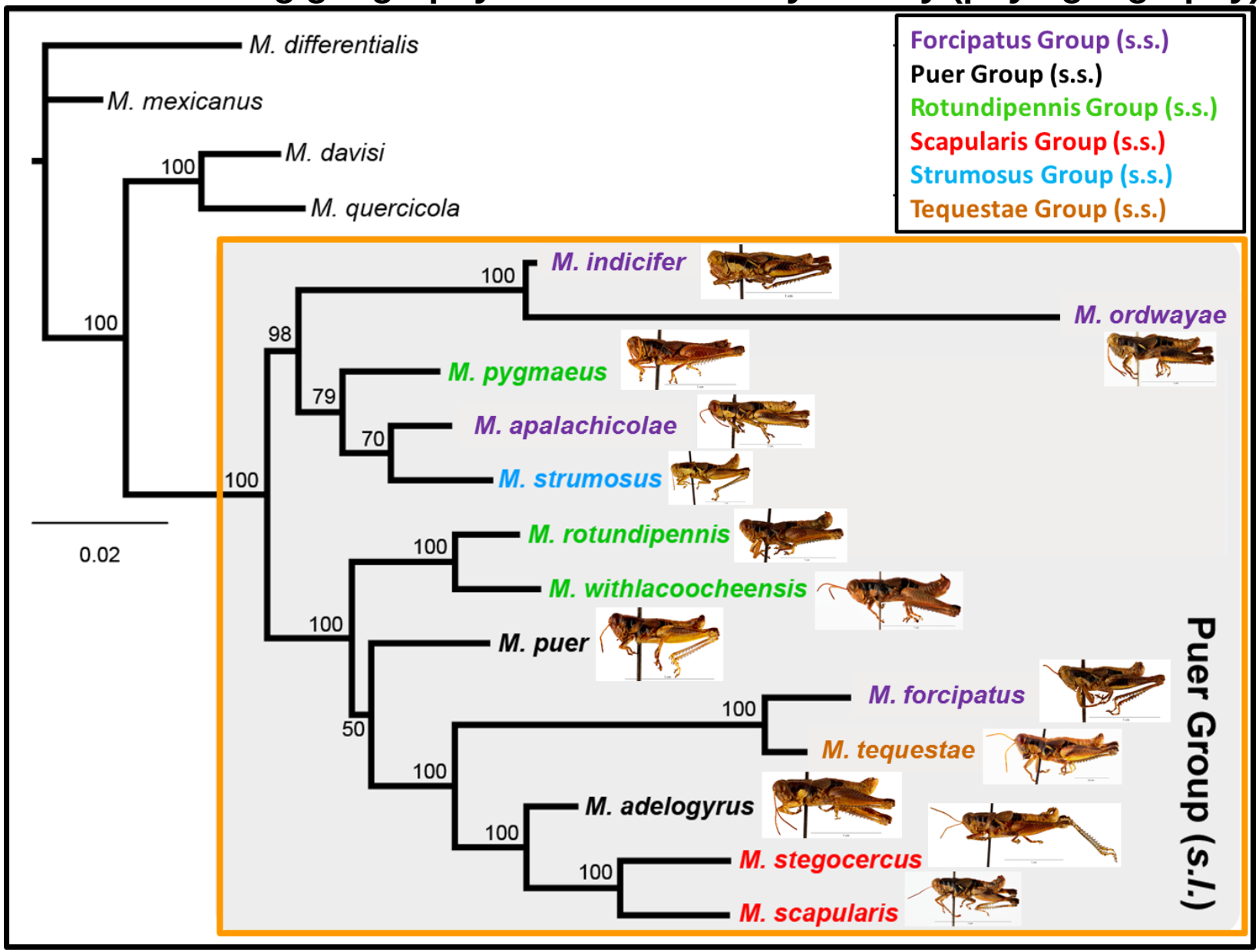
Full Distribution Map



II. Collection Data Usage

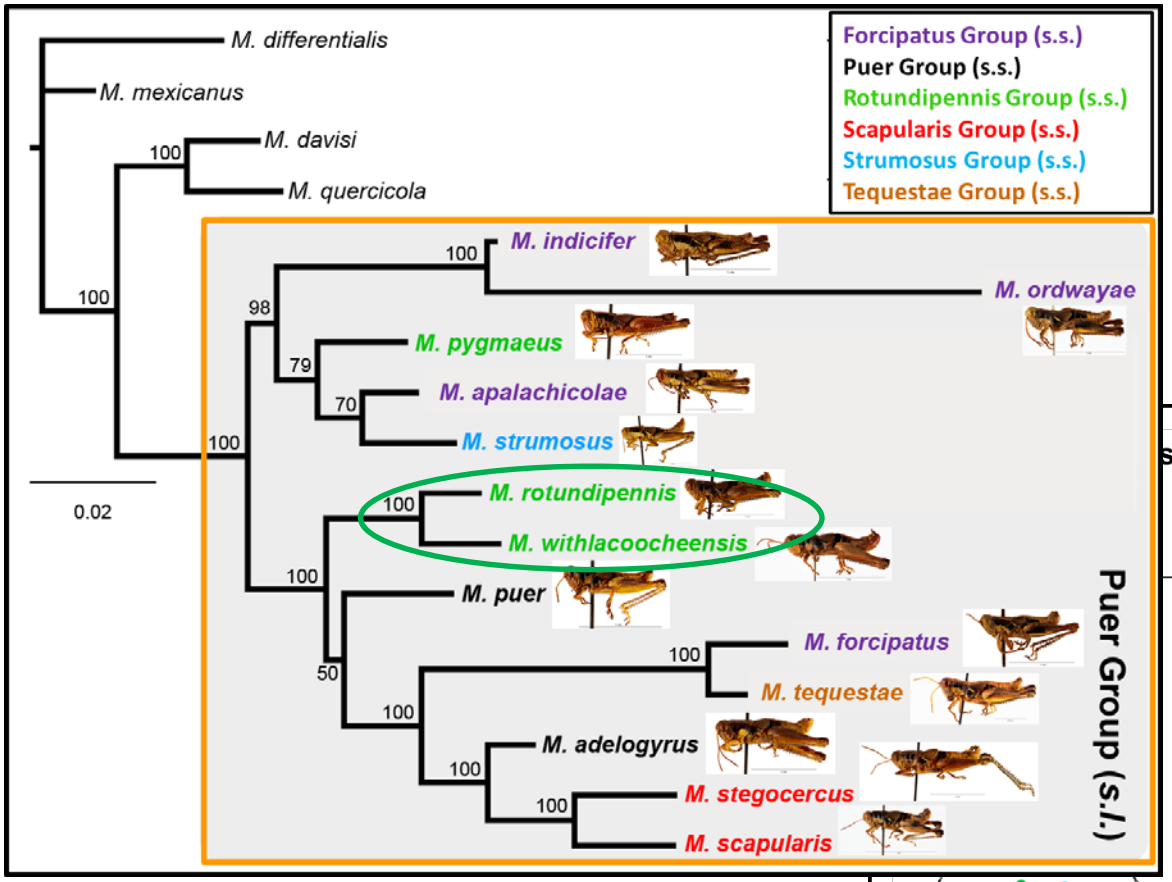


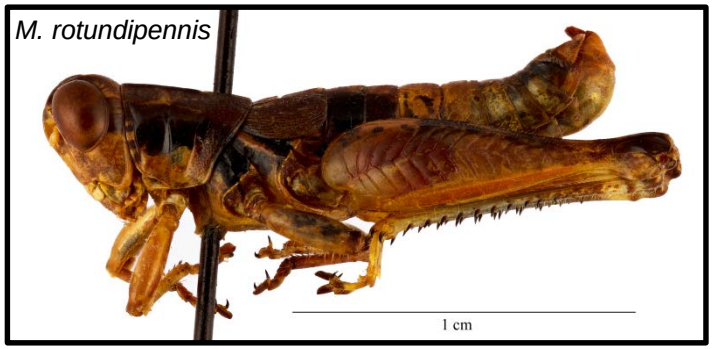
2. Combining geography with evolutionary history (phylogeography)

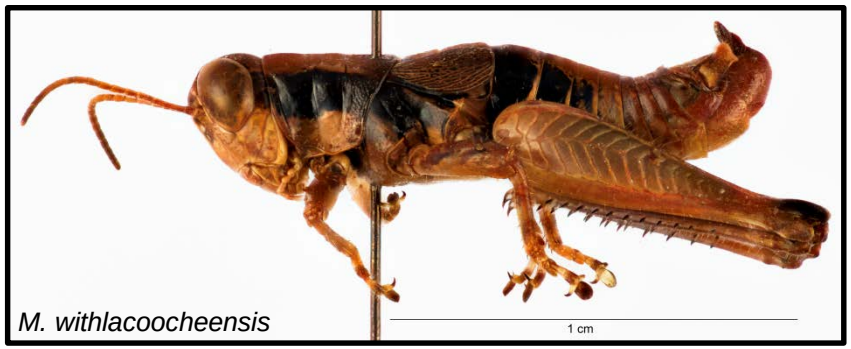


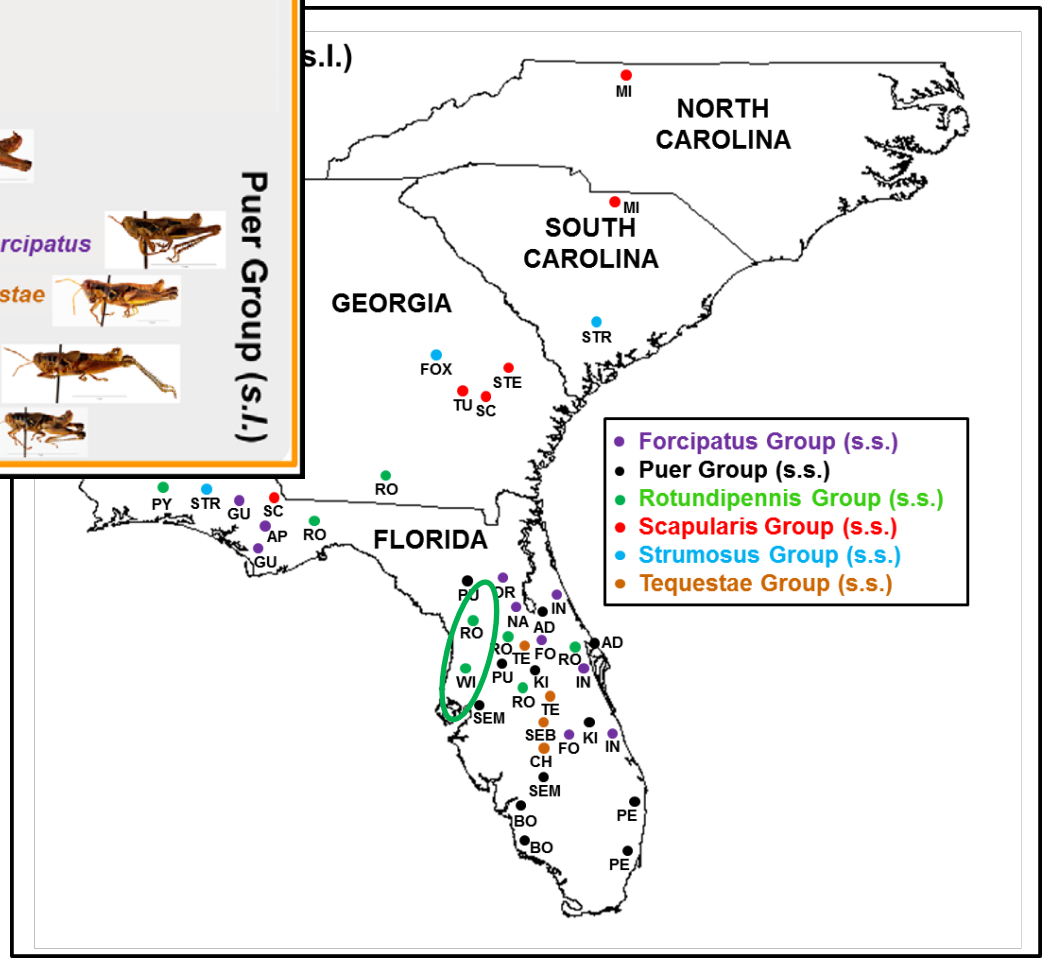
Preliminary phylogeny reconstructed from 4 genes, 13 ingroup species, and 4 outgroups using MUSCLE, MrModeltest, and MrBayes

II. Collection Data Usage

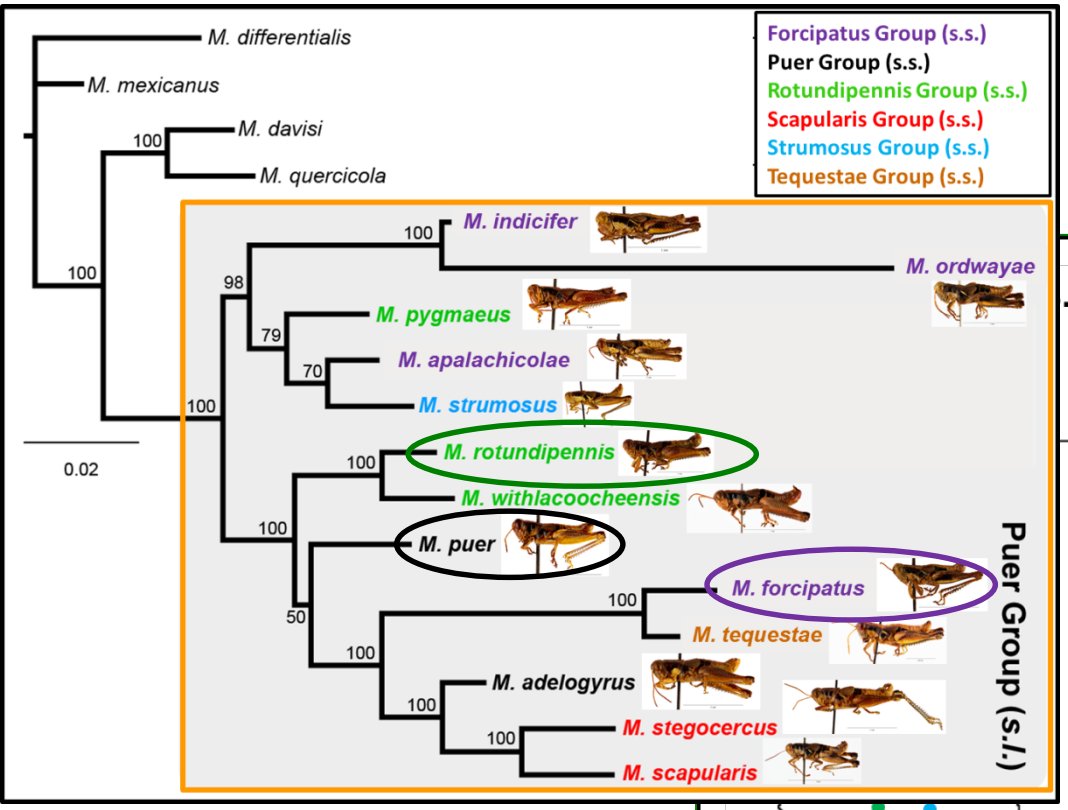




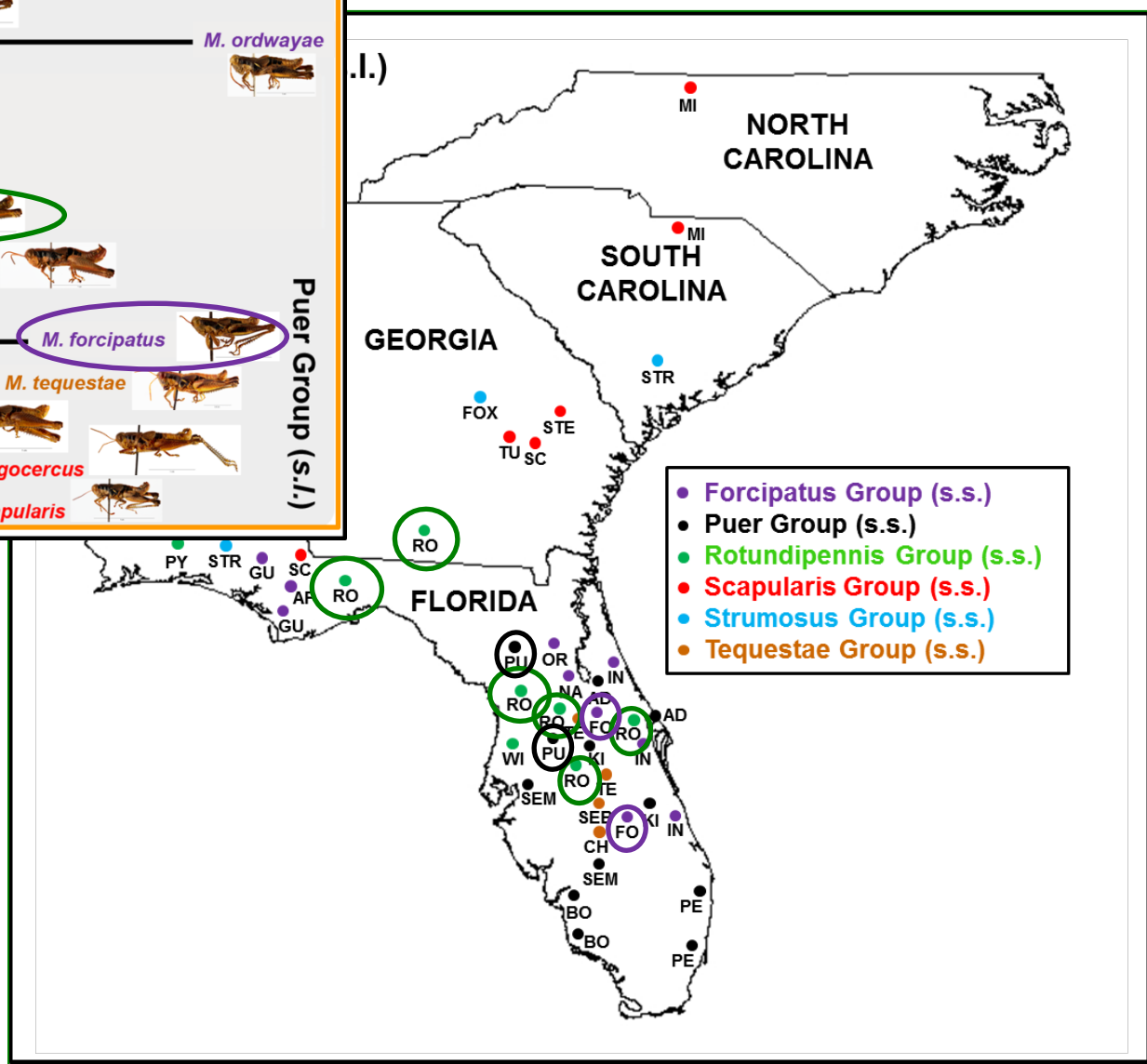




II. Collection Data Usage

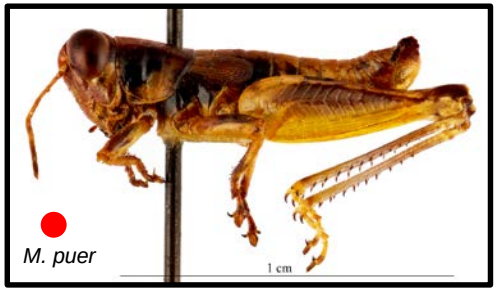


3. Investigating speciation

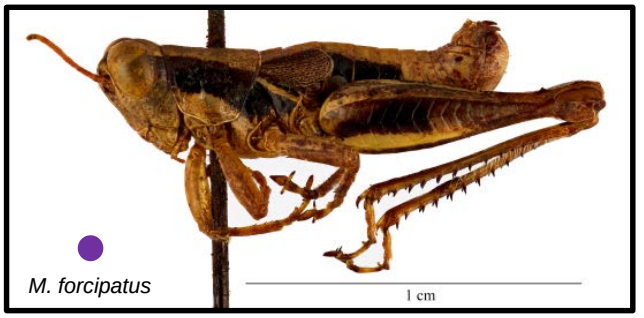


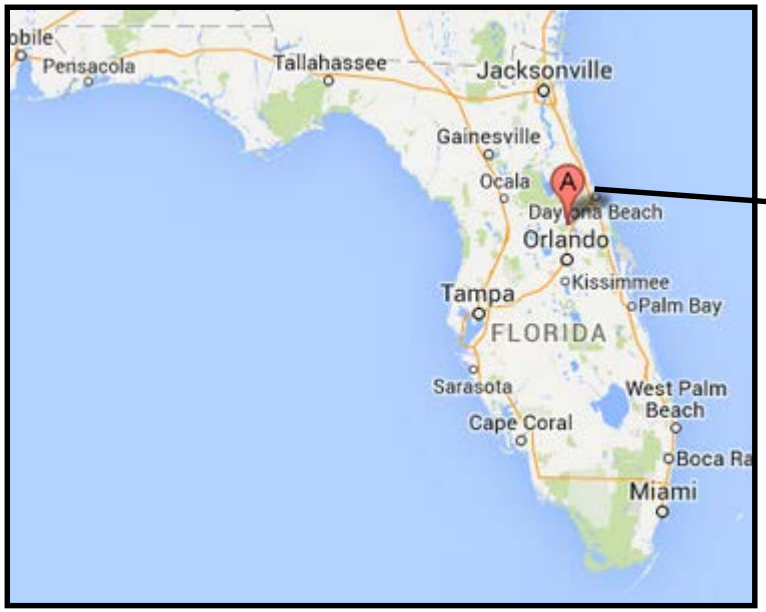
II. Collection Data Usage

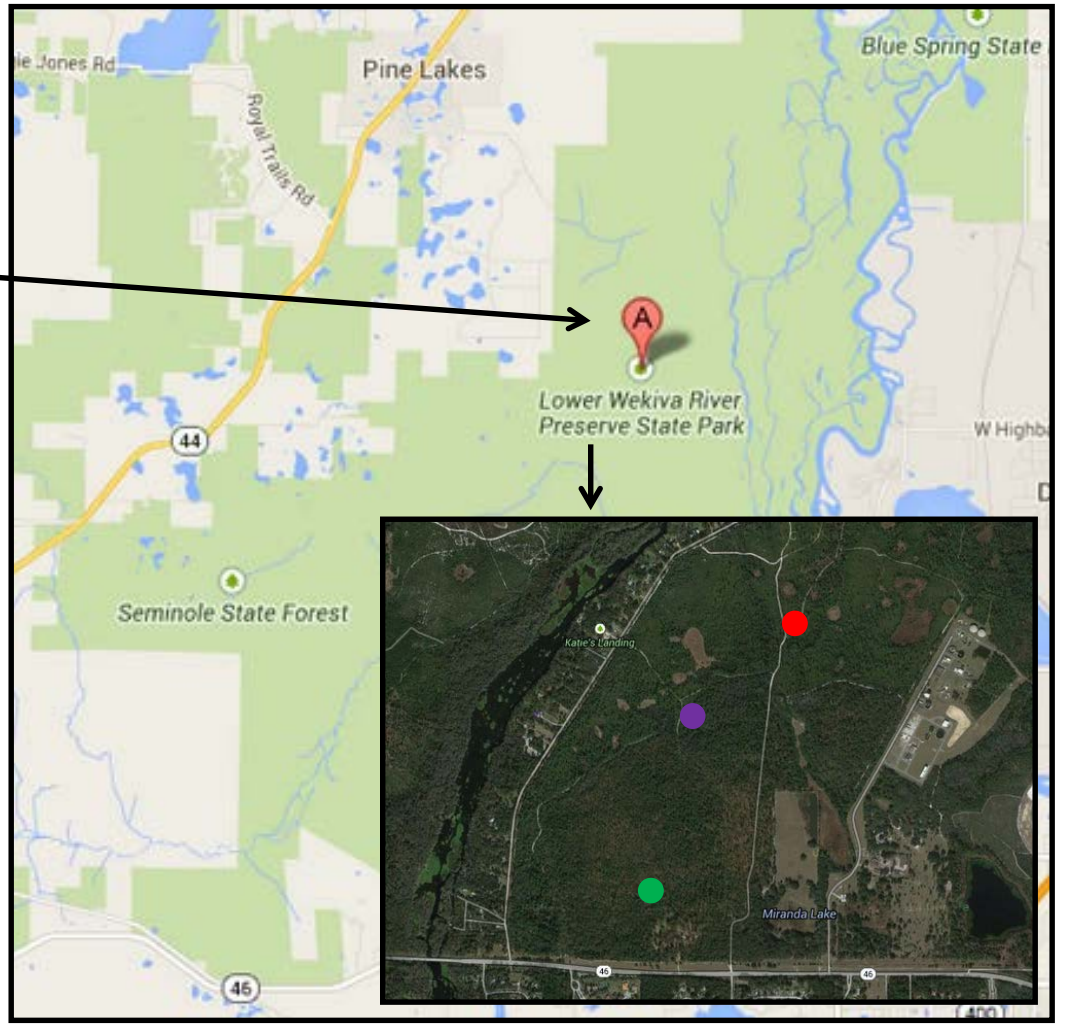
Vicariance?

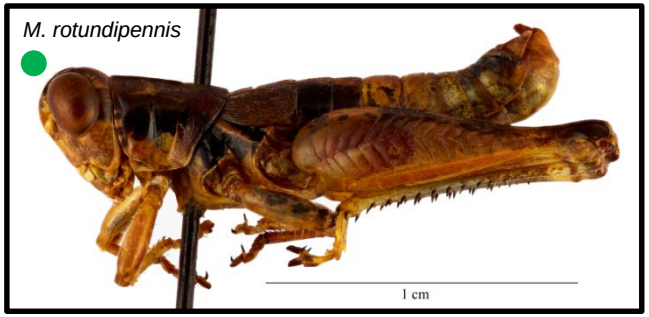


Lower Wekiva River Preserve State Park, Lake Co., FL



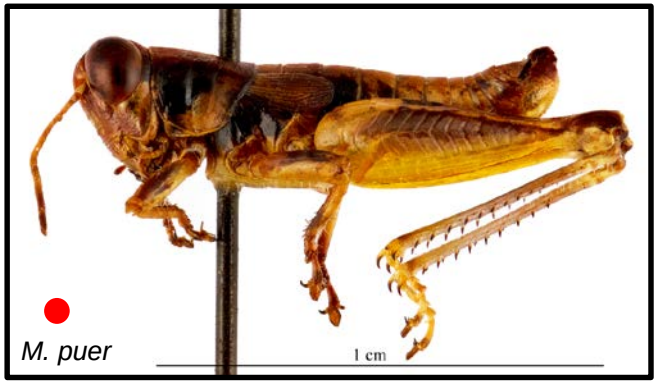


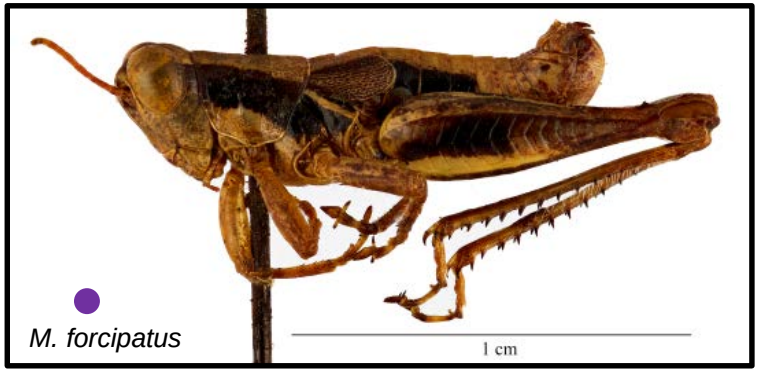


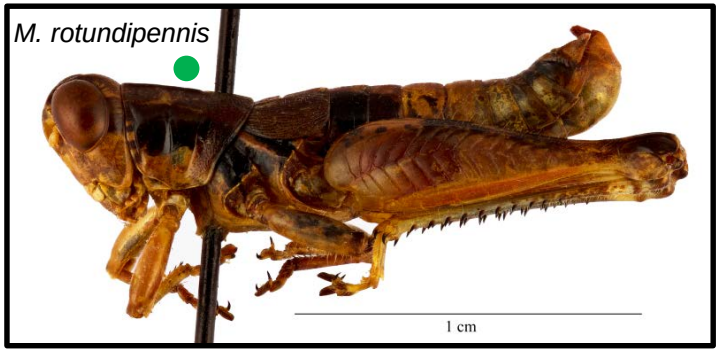


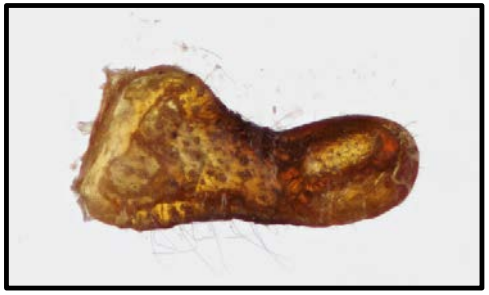
II. Collection Data Usage

Sexual selection via cryptic female choice?









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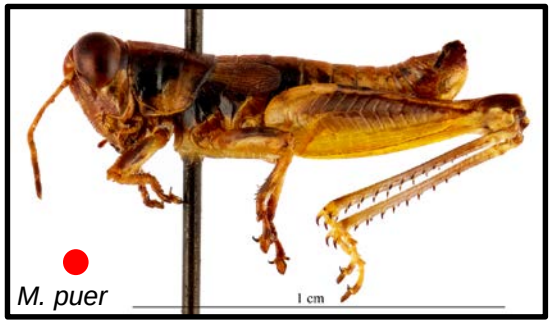
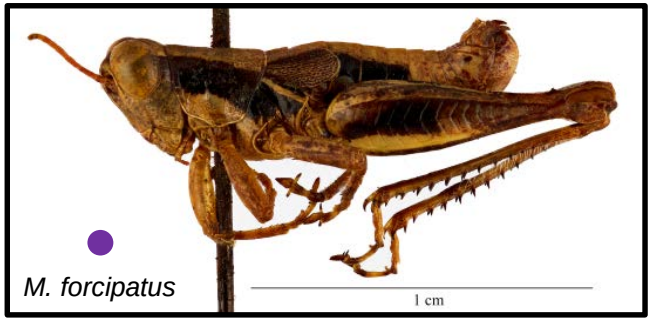


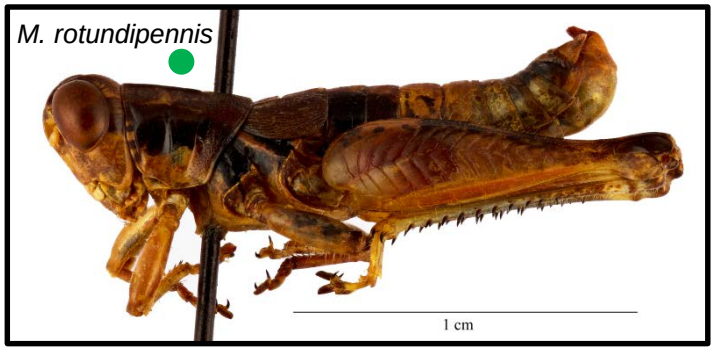
Ecology?



Scrubby Flatwoods Habitat

Sandhill Habitat

Overgrown Scrub Habitat



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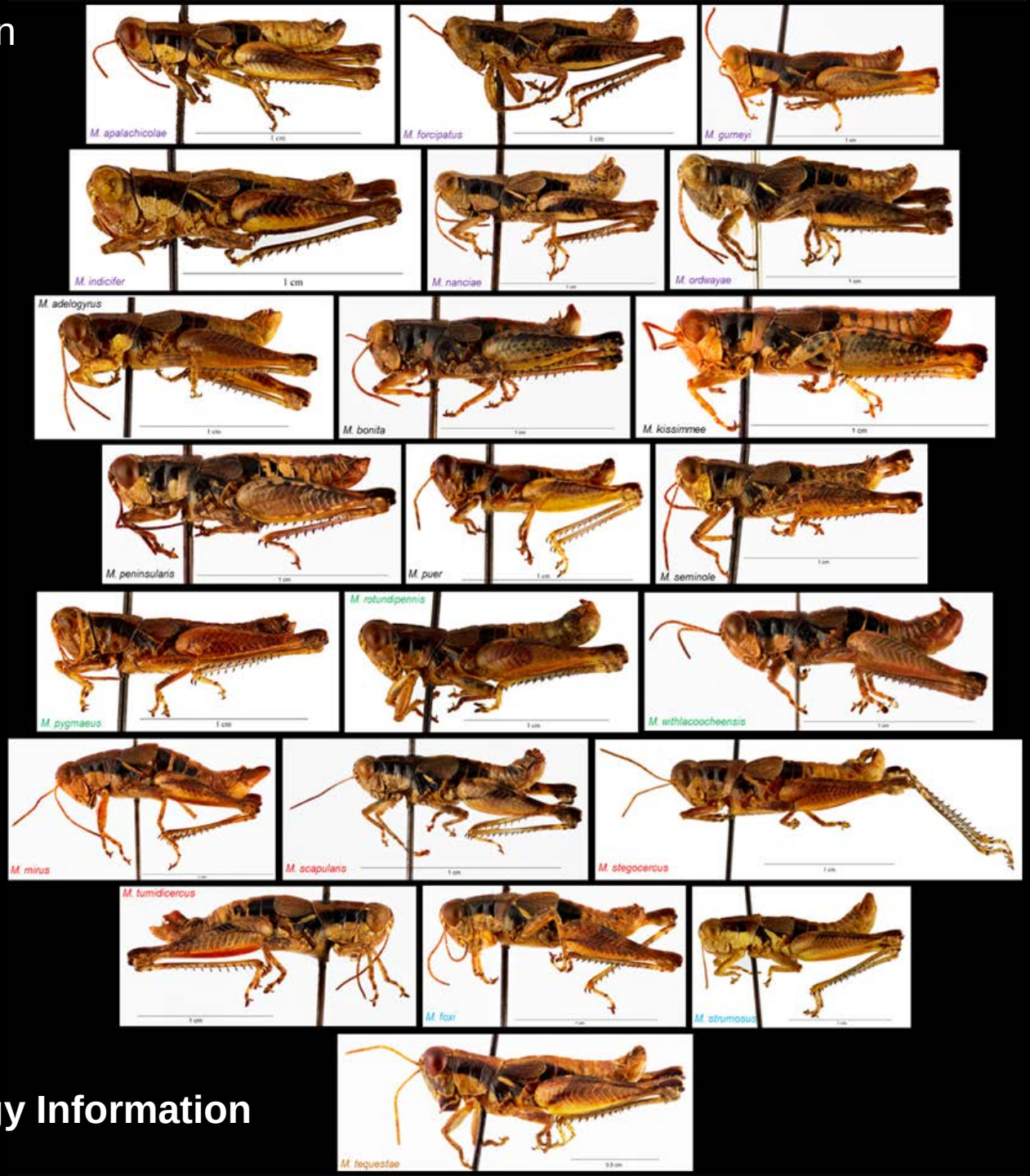
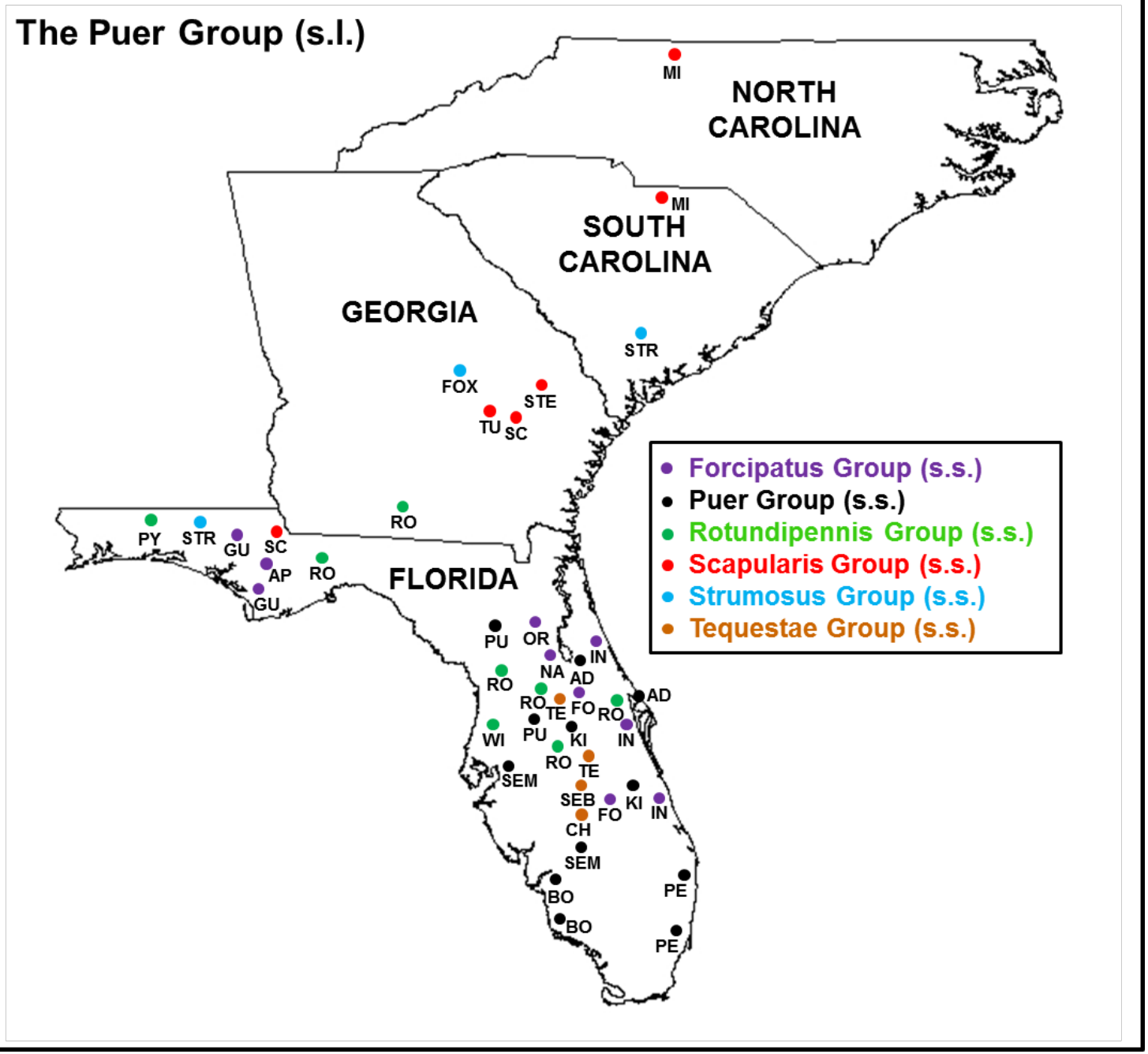
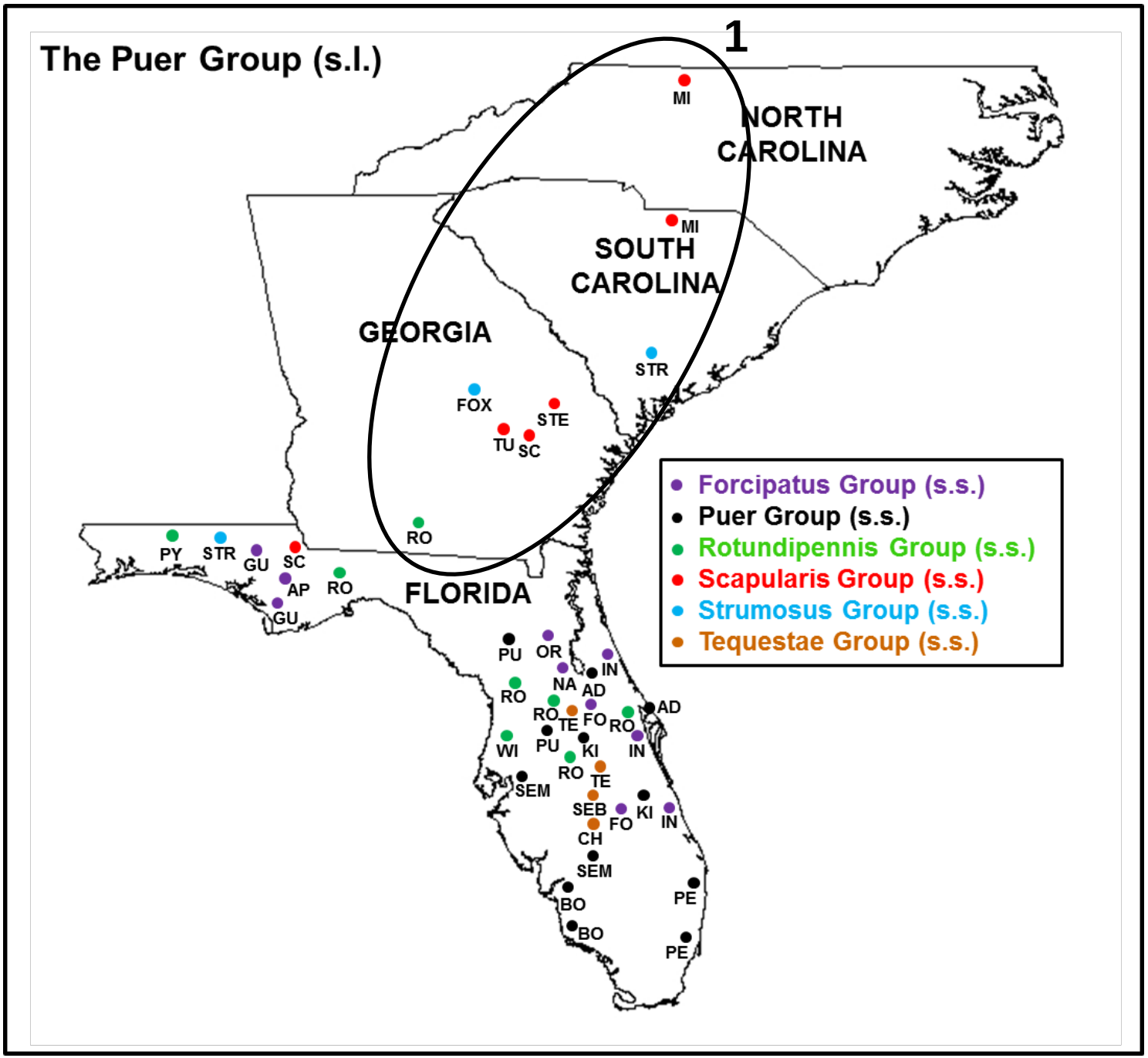


4. Phenology Information

II. Collection Data Usage



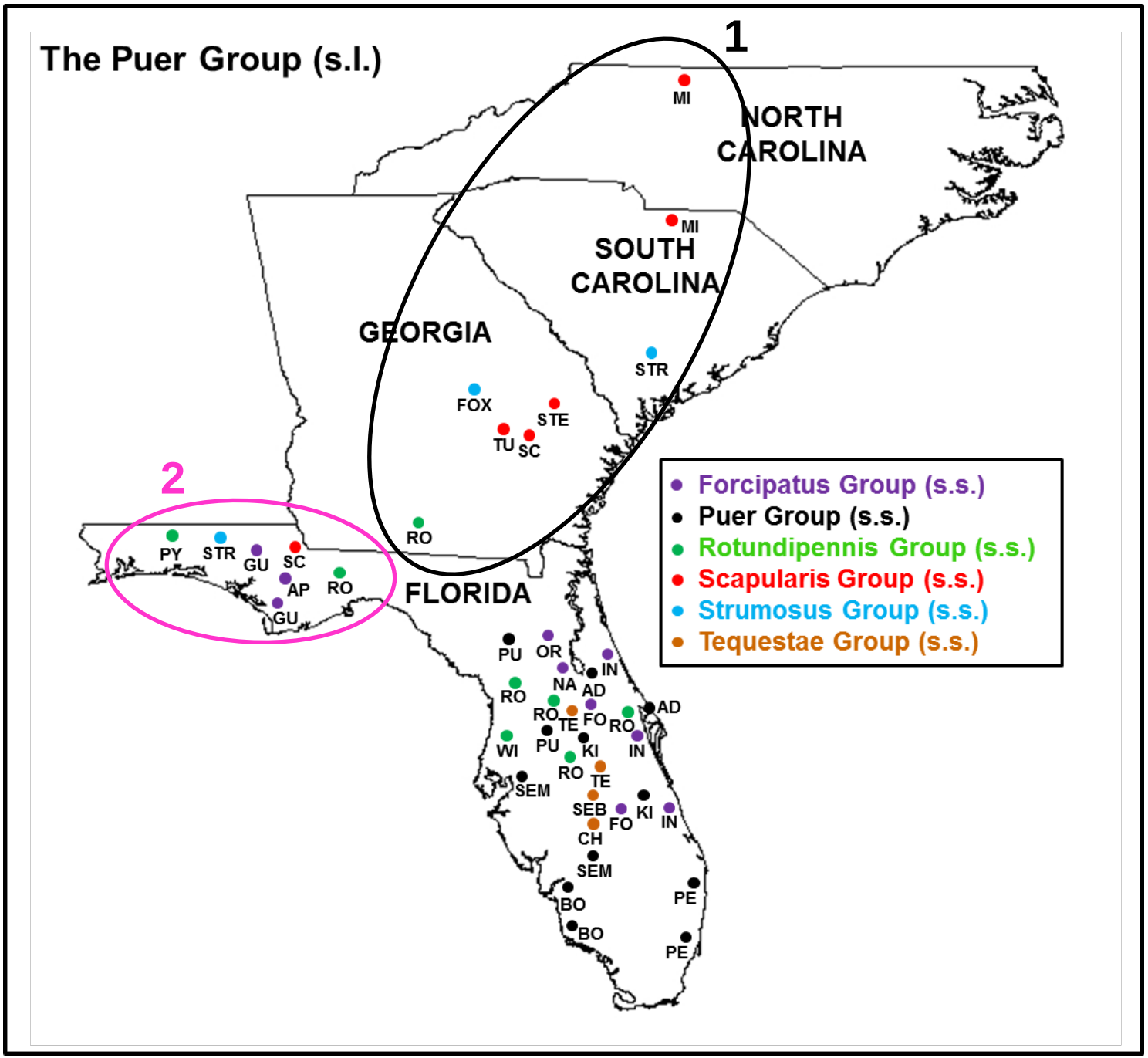
II. Collection Data Usage



3 main phenological shifts:

1. Smallest seasonal window – April to October

II. Collection Data Usage

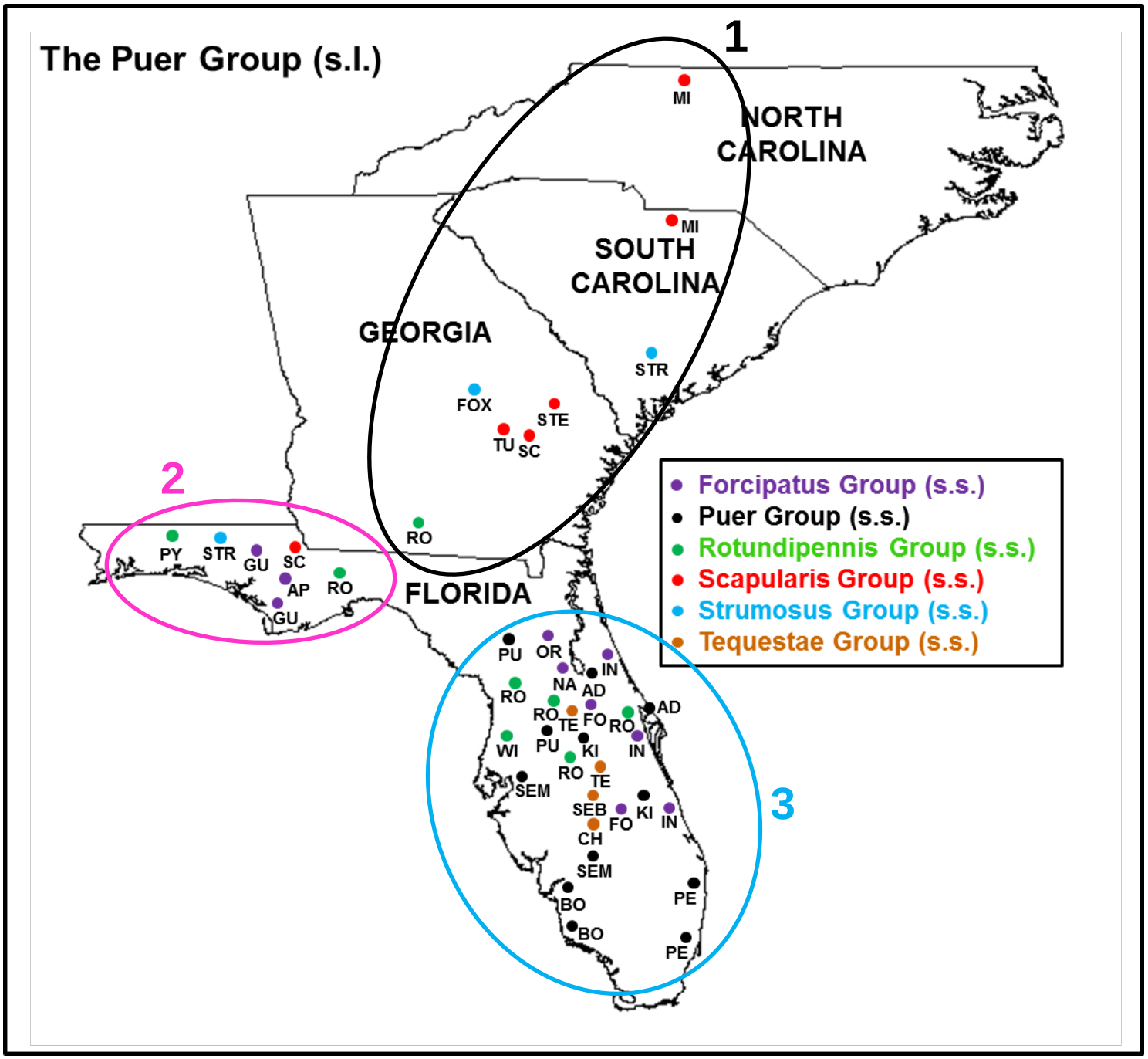


3 main phenological shifts:

1. Smallest seasonal window – April to October

2. "Medium" window – varies by geography, but usually February to November

II. Collection Data Usage



3 main phenological shifts:

1. Smallest seasonal window – April to October

2. "Medium" window – varies by geography, but usually February to November

3. All year round!

III. Trials and Tribulations

Issues I've encountered on my quest to use data

1. Data is rarely available digitally
    *when I create it, it returns with the borrowed specimens

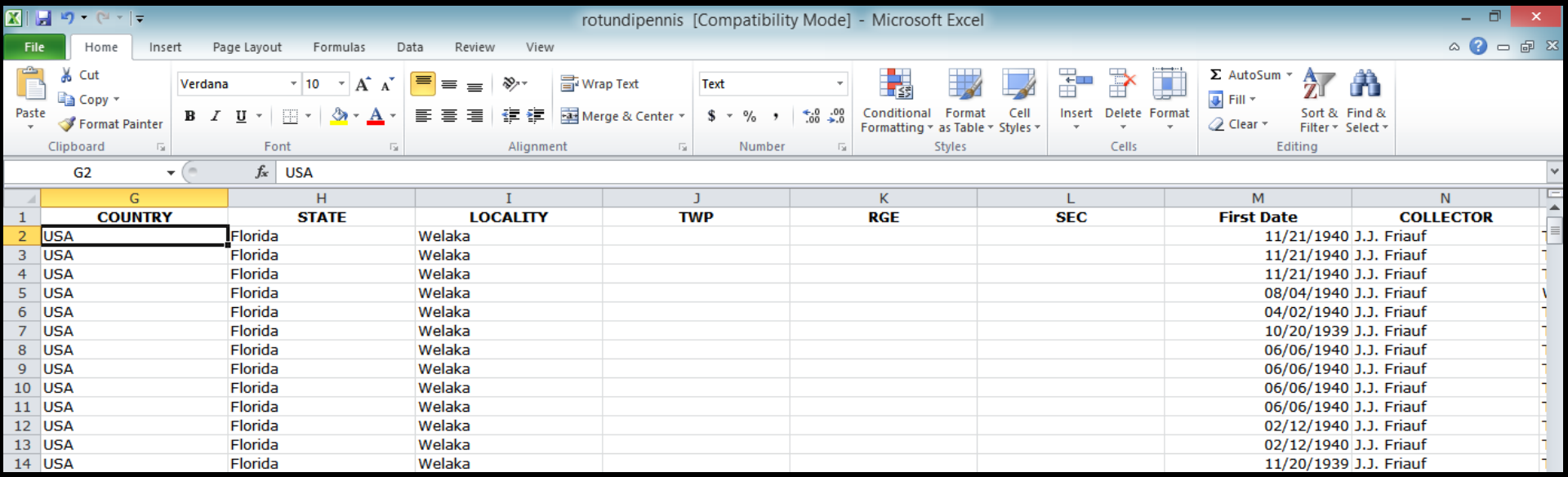
Issues I've encountered on my quest to use data

1. Data is rarely available digitally
   *when I create it, it returns with the borrowed specimens

2. Specimens often lack a unique I.D.

3. Data format is not “plug and play” and often needs to be “cleaned”

Original

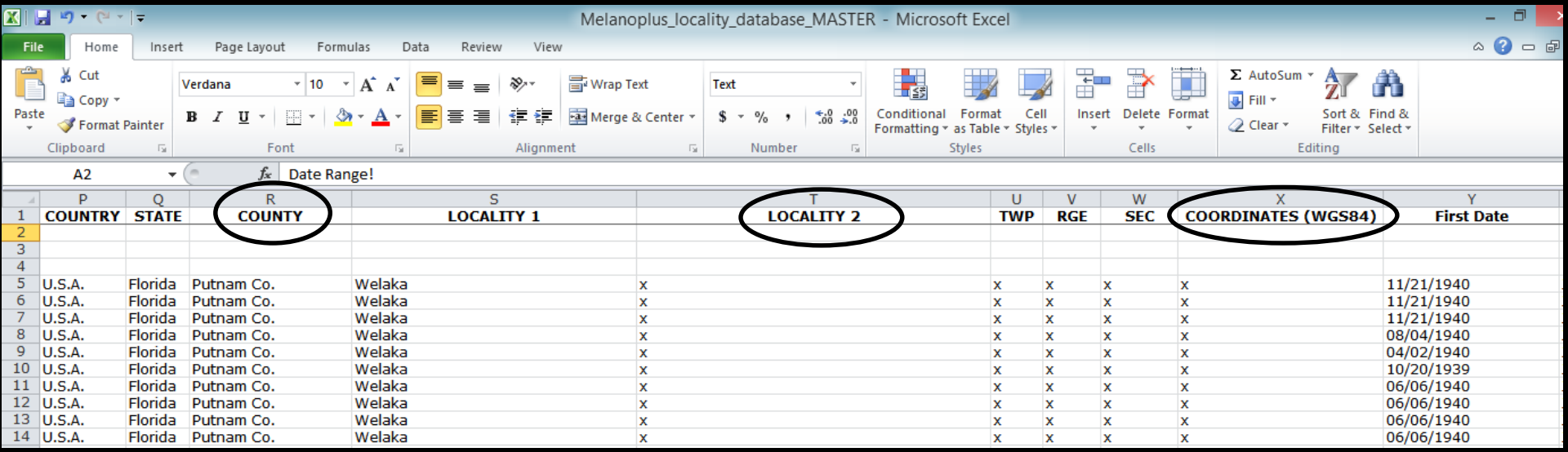


rotundipennis [Compatibility Mode] - Microsoft Excel

G2: USA

	G	H	I	J	K	L	M	N
1	COUNTRY	STATE	LOCALITY	TWP	RGE	SEC	First Date	COLLECTOR
2	USA	Florida	Welaka				11/21/1940	J.J. Friauf
3	USA	Florida	Welaka				11/21/1940	J.J. Friauf
4	USA	Florida	Welaka				11/21/1940	J.J. Friauf
5	USA	Florida	Welaka				08/04/1940	J.J. Friauf
6	USA	Florida	Welaka				04/02/1940	J.J. Friauf
7	USA	Florida	Welaka				10/20/1939	J.J. Friauf
8	USA	Florida	Welaka				06/06/1940	J.J. Friauf
9	USA	Florida	Welaka				06/06/1940	J.J. Friauf
10	USA	Florida	Welaka				06/06/1940	J.J. Friauf
11	USA	Florida	Welaka				06/06/1940	J.J. Friauf
12	USA	Florida	Welaka				02/12/1940	J.J. Friauf
13	USA	Florida	Welaka				02/12/1940	J.J. Friauf
14	USA	Florida	Welaka				11/20/1939	J.J. Friauf

Modified



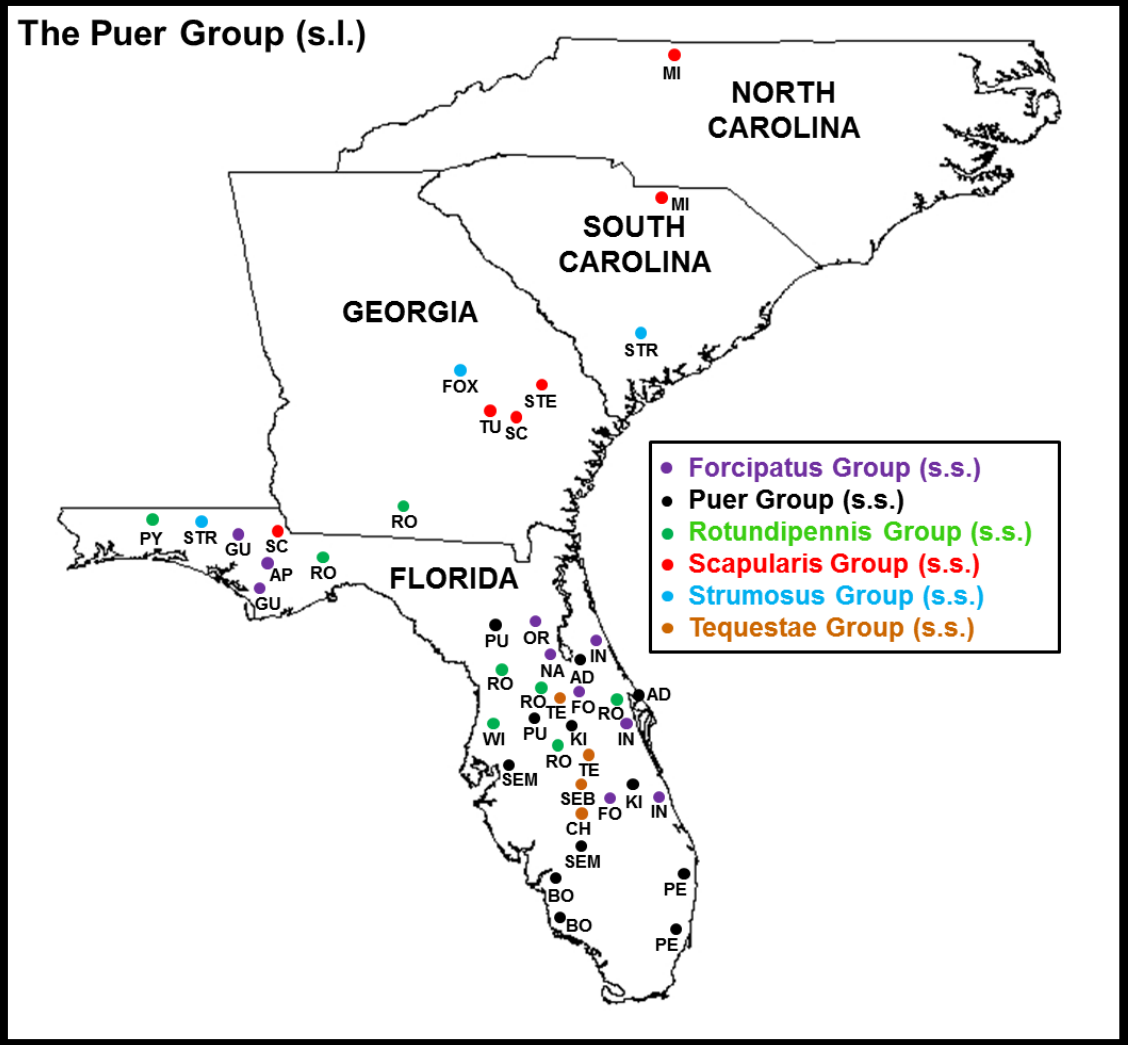
Melanoplus_locality_database_MASTER - Microsoft Excel

A2: Date Range!

	P	Q	R	S	T	U	V	W	X	Y
1	COUNTRY	STATE	COUNTY	LOCALITY 1	LOCALITY 2	TWP	RGE	SEC	COORDINATES (WGS84)	First Date
2										
3										
4										
5	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	11/21/1940
6	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	11/21/1940
7	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	11/21/1940
8	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	08/04/1940
9	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	04/02/1940
10	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	10/20/1939
11	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	06/06/1940
12	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	06/06/1940
13	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	06/06/1940
14	U.S.A.	Florida	Putnam Co.	Welaka	x	x	x	x	x	06/06/1940

4. Georeferencing is an arduous task

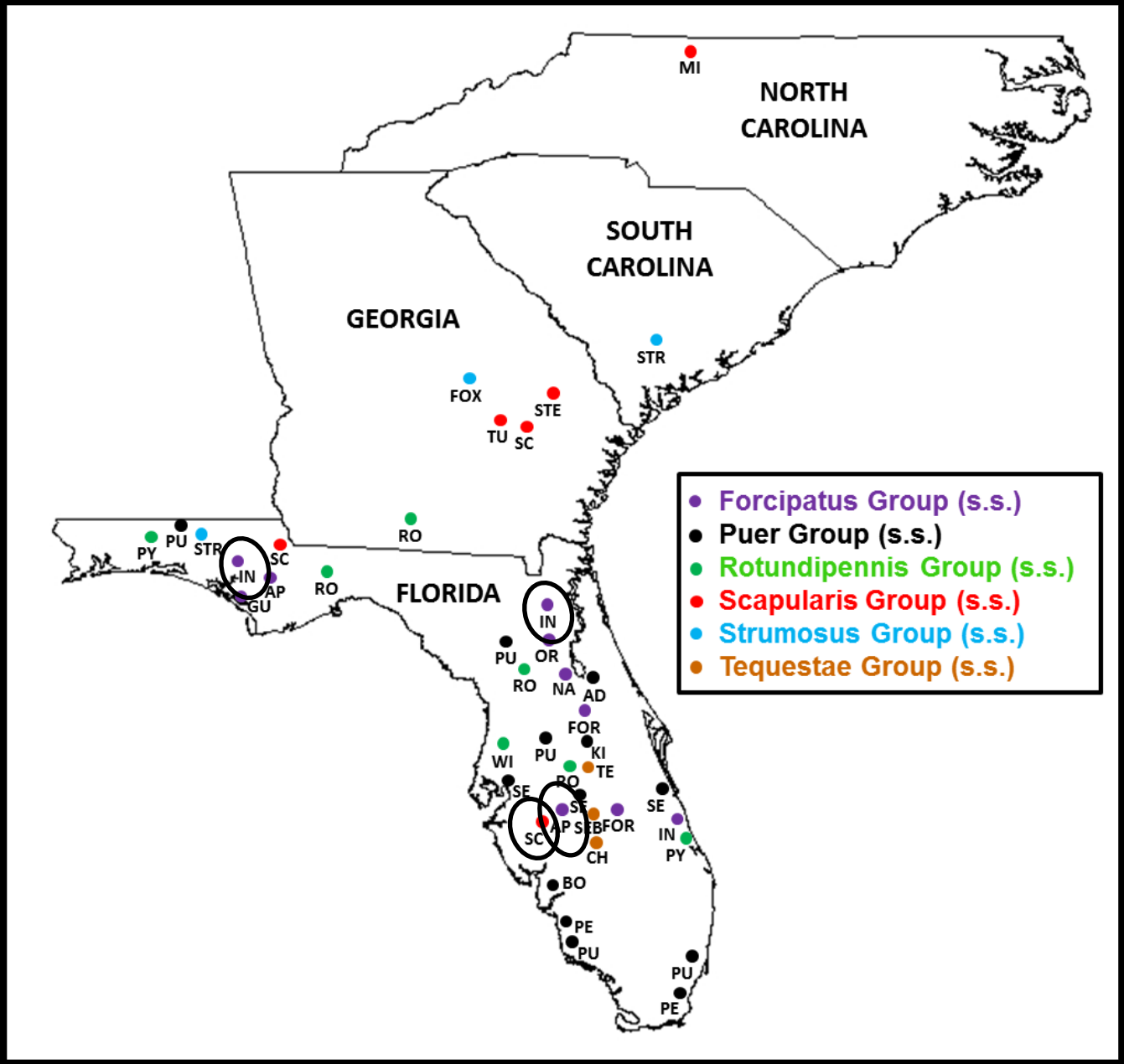
GEOLocate: http://www.museum.tulane.edu/geolocate/



III. Trials and Tribulations

-Georeferencing can assist in species identifications

-Knowing your study system is incredibly important as well



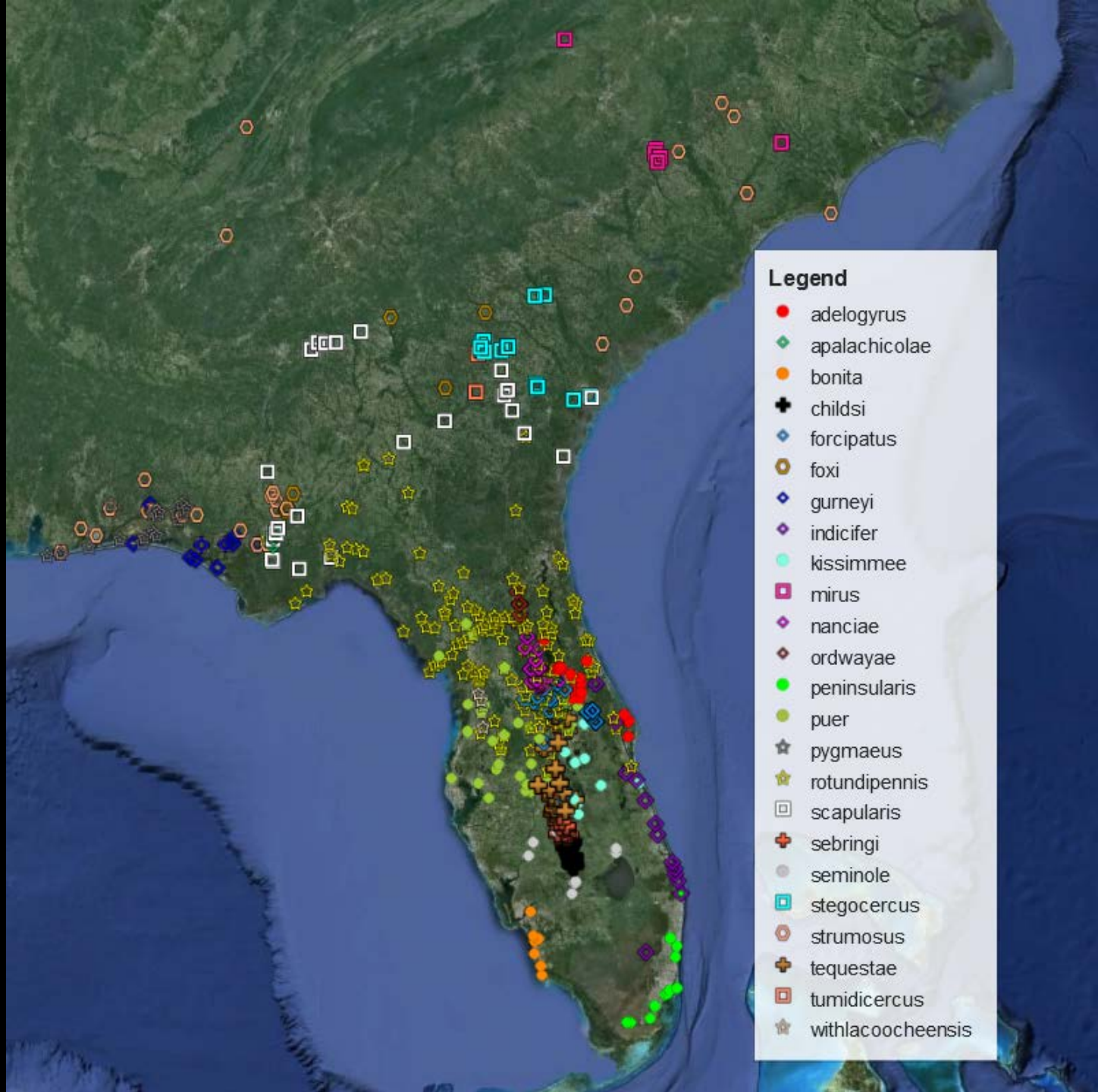
III. Trials and Tribulations

To build this map

-For each species, whittled down locality list to unique entries (648 total)

-manually georeferenced all unique entries

-used a website to generate a KML file from an Excel file and used Google Earth to open the resulting map



5. Map creation could be streamlined

An application to create maps quickly with key features is desired by many, but remains elusive.

5. Map creation could be streamlined

Best so far? Google Earth in conjunction with:

http://www.earthpoint.us/ExcelToKml.aspx#GoogleEarthIcons

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Pros

- Easy to use
- Able to choose from large array of colors and symbols
- GE has good export capabilities

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http://www.earthpoint.us/ExcelToKml.aspx#GoogleEarthIcons

Pros

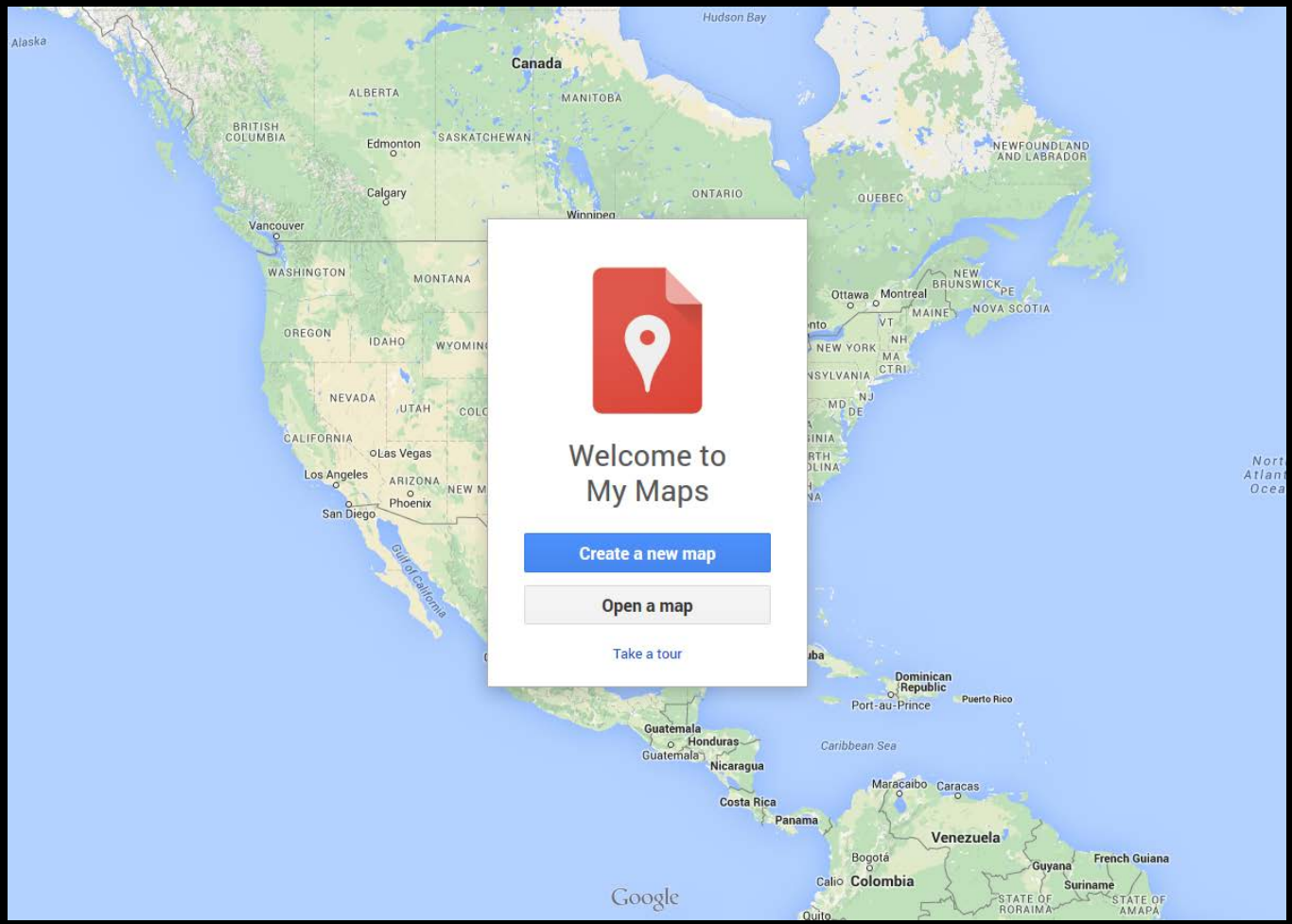
- Easy to use
- Able to choose from large array of colors and symbols
- GE has good export capabilities

Cons

- **Multiple steps**
- EP limited to 200 lines (there's a workaround)
- GE has limited background layers (can be modified to a degree)

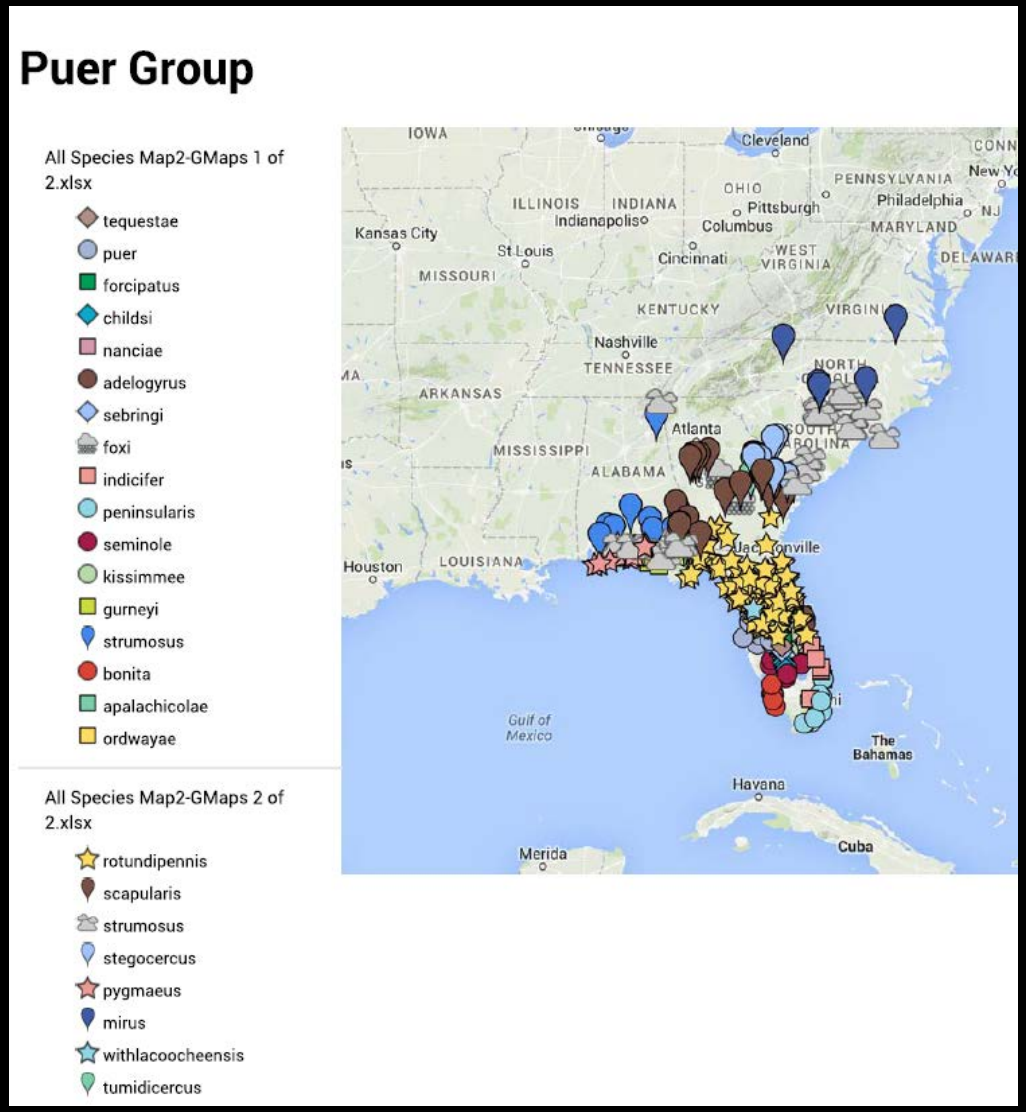
5. Map creation could be streamlined

Another strong candidate:
My Google Maps

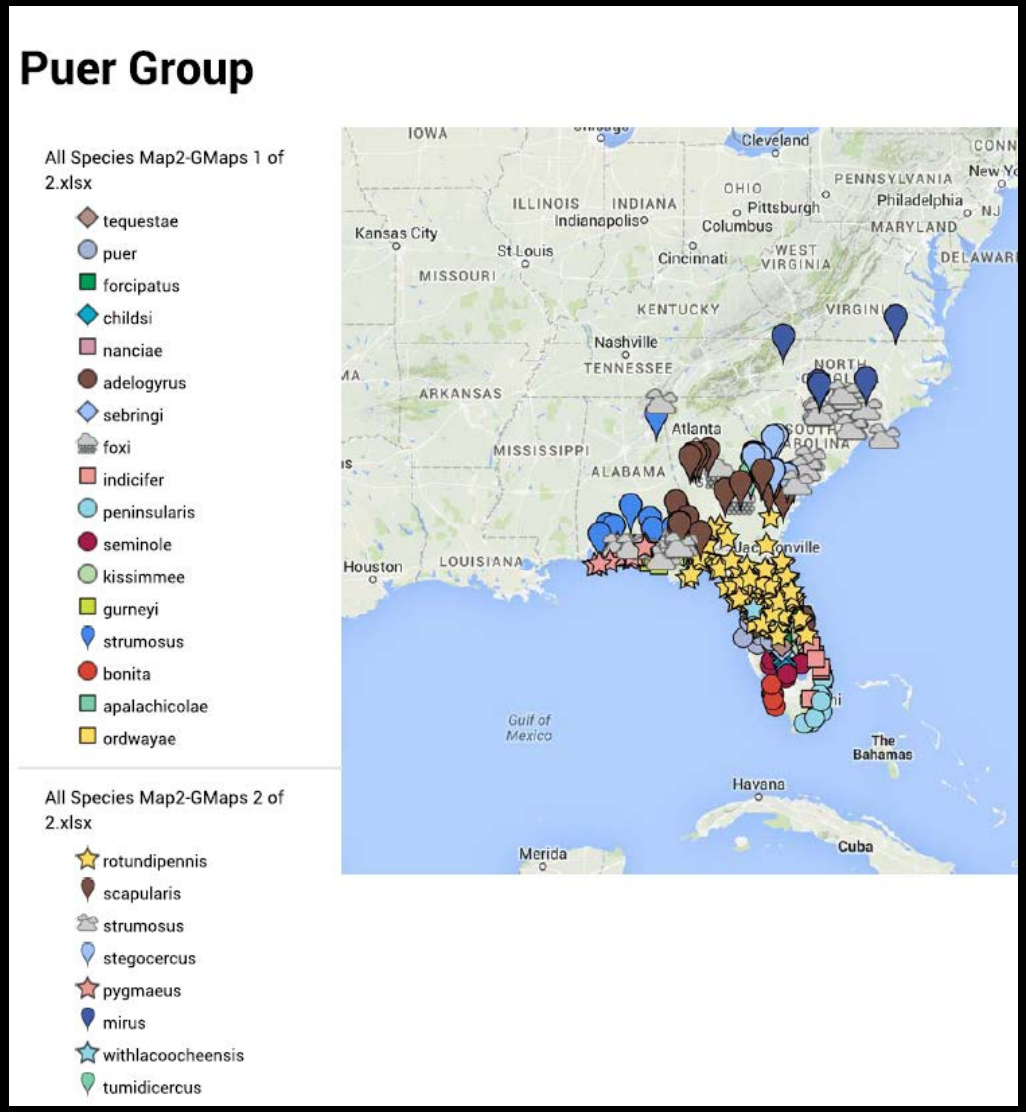


https://www.google.com/maps/d/u/0/

5. Map creation could be streamlined



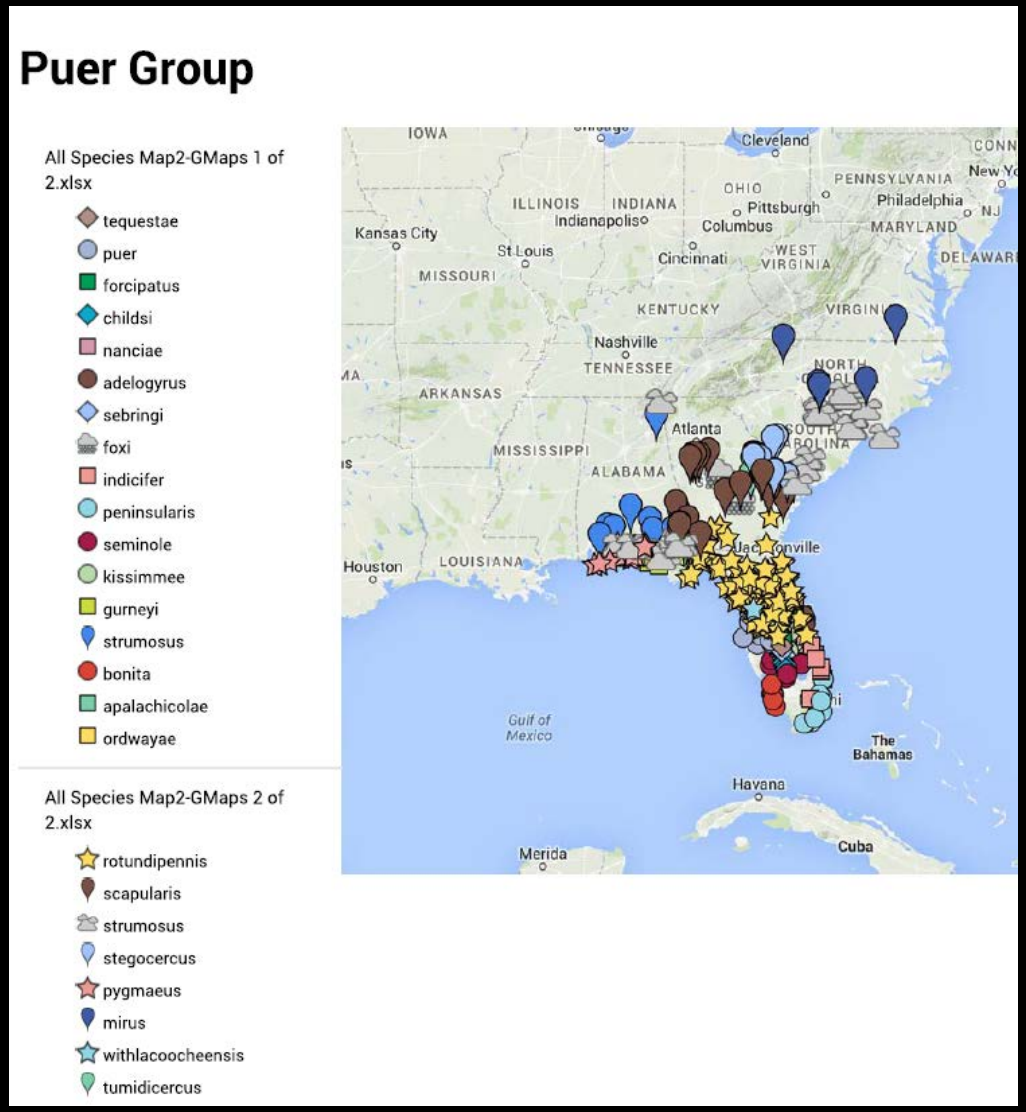
5. Map creation could be streamlined



Pros

- Fairly easy to use
- On-line only and saves directly to linked Google Drive
- Can choose from many background layers
- Decent export capabilities
- Can import data from Excel or input directly

5. Map creation could be streamlined



Pros

- Fairly easy to use
- On-line only and saves directly to linked Google Drive
- Can choose from many background layers
- Decent export capabilities
- Can import data from Excel or input directly

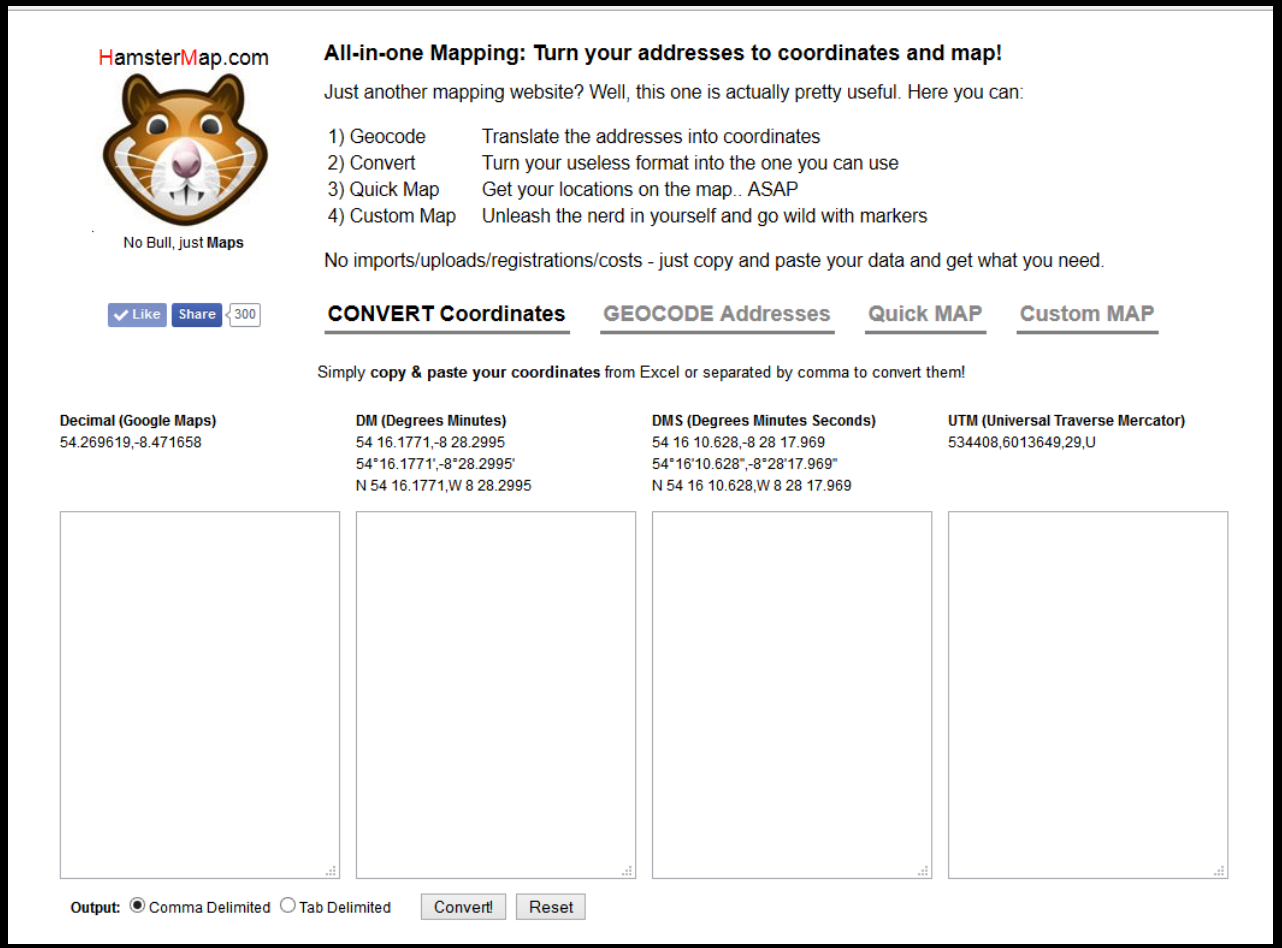
Cons

- Wouldn’t correctly read all of my data (workaround)
- Only 5 symbols can be colored
- Scaling issues
- Can’t erase individual points

5. Map creation could be streamlined

Another good candidate:

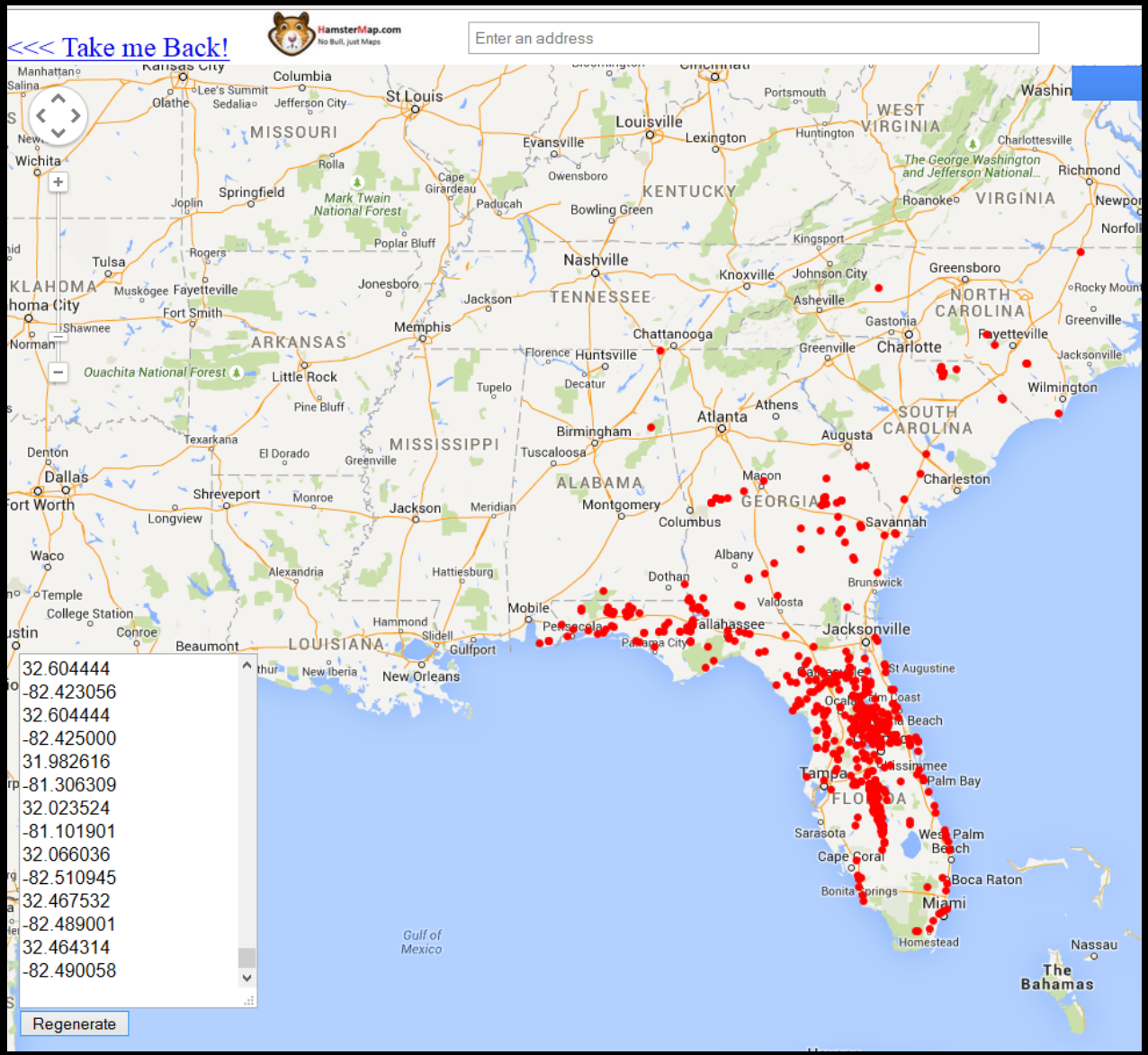
HamsterMap



http://hamstermap.com/

5. Map creation could be streamlined

“Quick MAP”



Pros

- Easy to use overall
- On-line only
- VERY fast
- THE best for checking georeferenced lists of coordinates
- 4 abilities

Cons

- “Custom MAP” lacks some things, like a good range of colors
- Interface not the easiest, but does use Excel
- Unknown creator

What have I learned?

- **Collection data is invaluable!**
- **We have a long ways to go with insect collection data…**
- **Know a better mapping system that can make maps better fit for publication?**
  ***PLEASE* let me know!**

Acknowledgments

- **iDigBio (especially Deb Paul)**
- **Trip Lamb**
- **Elizabeth Kerr-Woller**
- **NSF DEB-1064082**
- **All my field assistants**

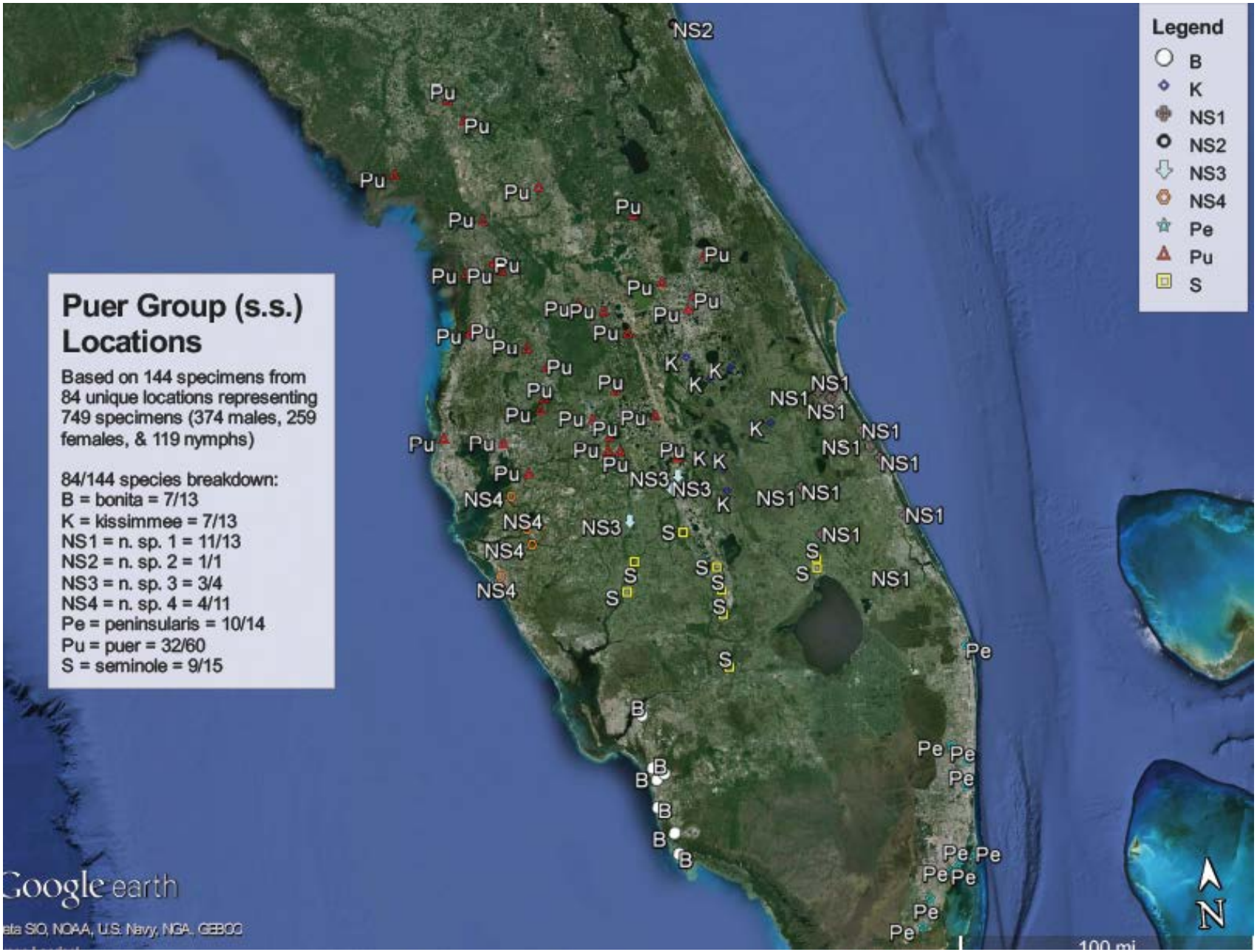
Inside Swampy, the World's Largest Gator, Christmas, FL, 2014

EL FIN

Kunming, China, 2013

QUESTIONS?

Identifying new species



- **Taxon sampling: 4 *Melanopus* outgroups, 13 out of 24 PG species (DNA extracts from Lamb and Justice, 2005)**
- **Character sampling: COI, SCNP-85, SCNP-102, and SCNP-140 (from Carsten and Knowles, 2006)**
- **Aligned in MUSCLE using default parameters: 3,556 aligned bp**
- **Model selection in MrModeltest**
- **Partitioned mixed-model Bayesian analysis in MrBayes: 5 million generations, 4 runs, 4 chains, sampling every 1,000 generations**