Gopher apple patch, Ocala National Forest, Florida

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

Gopher apple patch, Ocala National Forest, Florida

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



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



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



The ridge systems of Florida: ancient islands





Melanoplus forcipatus



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

Lake Wales Ridge Scrub Endemics



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	СН	FL	narrow
23	2	Tequestae	sebringi	SEB	FL	narrow
24	3	Tequestae	tequestae	TE	FL	narrow



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



M. forcipatus







1. General Mapping

Consensus Distribution Map

Based on

5,100 specimens

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

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



> 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







Sexual selection via cryptic female choice?























Scrubby Flatwoods Habitat

Ecology?

Sandhill Habitat







Overgrown Scrub Habitat





4. Phenology Information







3 main phenological shifts:

 Smallest seasonal window – April to October



3 main phenological shifts:

- Smallest seasonal window – April to October
- "Medium" window – varies by geography, but usually February to November



3 main phenological shifts:

- Smallest seasonal window – April to October
- "Medium" window – varies by geography, but usually February to November
- 3. All year round!

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

- 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"

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9 L	JSA	Florida	Welaka						06/06/1940	J.J. Friauf
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4. Georeferencing is an arduous task

GEOLocate:

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



> -Georeferencing can assist in species identifications

-Knowing your study system is incredibly important as well



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:

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

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Best so far? Google Earth in conjunction with:

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Pros

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

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

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<u>Pros</u>

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

<u>Cons</u>

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

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

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



- ☆ withlacoocheensis
- V tumidicercus

5. Map creation could be streamlined



<u>Pros</u>

- 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

<u>Cons</u>

- 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

	Just another mapp	oing website?	Well, this one is actually pre	tty useful. Here	e you can:	
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http://hamstermap.com/

5. Map creation could be streamlined

"Quick MAP"



<u>Pros</u>

- 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?
 <u>PLEASE</u> 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







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