The scrub-lovin' grasshoppers (Orthoptera: Acriddidae: *Melanoplus*: The Puer Group) of the southeastern U.S.: integrating specimen data from then and now for maximum effect.
Reinventing the wheel.
Does anyone know a good engineer?

Gopher apple patch, Ocala National Forest, Florida

Derek A. Woller & Hojun Song
Song Lab, Texas A&M
20-May-2015
I. Introduction
II. Collection Data Usage
III. Trials & Tribulations
I. Introduction
I. Introduction

J. Speed Rogers

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

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

Scrub

Big Scrub, Ocala National Forest, Florida
I. Introduction

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

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.

I. Introduction

Lehnert et al., 2012
1. Introduction

The ridge systems of Florida: ancient islands

8 Major

22 Minor
I. Introduction

Endemics

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.

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

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1. Introduction

M. forcipatus
I. Introduction
I. Introduction
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
II. Collection
Data Usage

Full Distribution Map
II. Collection Data Usage

The Puer Group (s.l.)

- Forcipatus Group (s.s.)
- Puer Group (s.s.)
- Rotundipennis Group (s.s.)
- Scapularis Group (s.s.)
- Strumosus Group (s.s.)
- Tequestae Group (s.s.)

Legend:
- Brooksville Ridge
- Trail Ridge
- Deland-Crescent City Ridge
- Mount Dora Ridge
- Orlando Ridge
- Atlantic Coastal Ridge
- Bombing Range Ridge
- Lake Wales Ridge

Map of the southeastern United States showing the distribution of different groups.
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

Forcipatus Group (s.s.)
Puer Group (s.s.)
Rotundipennis Group (s.s.)
Scapularis Group (s.s.)
Strumosus Group (s.s.)
Tequestae Group (s.s.)
II. Collection Data Usage

Vicariance?

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

M. rotundipennis

M. puer

M. forcipatus

Map showing locations of Lower Wekiva River Preserve State Park in Florida.
II. Collection Data Usage

Sexual selection via cryptic female choice?
II. Collection Data Usage

Ecology?

Scrubby Flatwoods Habitat

Overgrown Scrub Habitat

Sandhill Habitat
II. Collection
Data Usage

4. Phenology Information
II. Collection Data Usage

The Puer Group (s.l.)

- Forcipatus Group (s.s.)
- Puer Group (s.s.)
- Rotundipennis Group (s.s.)
- Scapularis Group (s.s.)
- Strumosus Group (s.s.)
- Tequestae Group (s.s.)
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
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*
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

2. Specimens often lack a unique I.D.
III. Trials and Tribulations

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

Original

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III. Trials and Tribulations

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
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

III. Trials and Tribulations
III. Trials and Tribulations

5. Map creation could be streamlined

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

5. Map creation could be streamlined

Best so far? Google Earth in conjunction with:

http://www.earthpoint.us/ExcelToKml.aspx#GoogleEarthIcons
III. Trials and Tribulations

5. Map creation could be streamlined

Best so far? Google Earth in conjunction with:

Pros

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

5. Map creation could be streamlined

Best so far? Google Earth in conjunction with:

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)

http://www.earthpoint.us/ExcelToKml.aspx#GoogleEarthIcons
III. Trials and Tribulations

5. Map creation could be streamlined

Another strong candidate:
My Google Maps

https://www.google.com/maps/d/u/0/
III. Trials and Tribulations

5. Map creation could be streamlined
III. Trials and Tribulations

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
III. Trials and Tribulations

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
III. Trials and Tribulations

5. Map creation could be streamlined

Another good candidate:
HamsterMap

http://hamstermap.com/
III. Trials and Tribulations

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
II. Collection Data Usage

Identifying new species

Puer Group (s.s.) Locations

Based on 144 specimens from 84 unique locations representing 749 specimens (374 males, 259 females, & 119 nymphs)

84/144 species breakdown:
B = bonita = 7/13
K = kissimme = 7/13
NS1 = n. sp. 1 = 11/13
NS2 = n. sp. 2 = 1/1
NS3 = n. sp. 3 = 3/4
NS4 = n. sp. 4 = 4/11
Pe = peninsularis = 10/14
Pu = puer = 32/60
S = seminole = 9/15
• 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