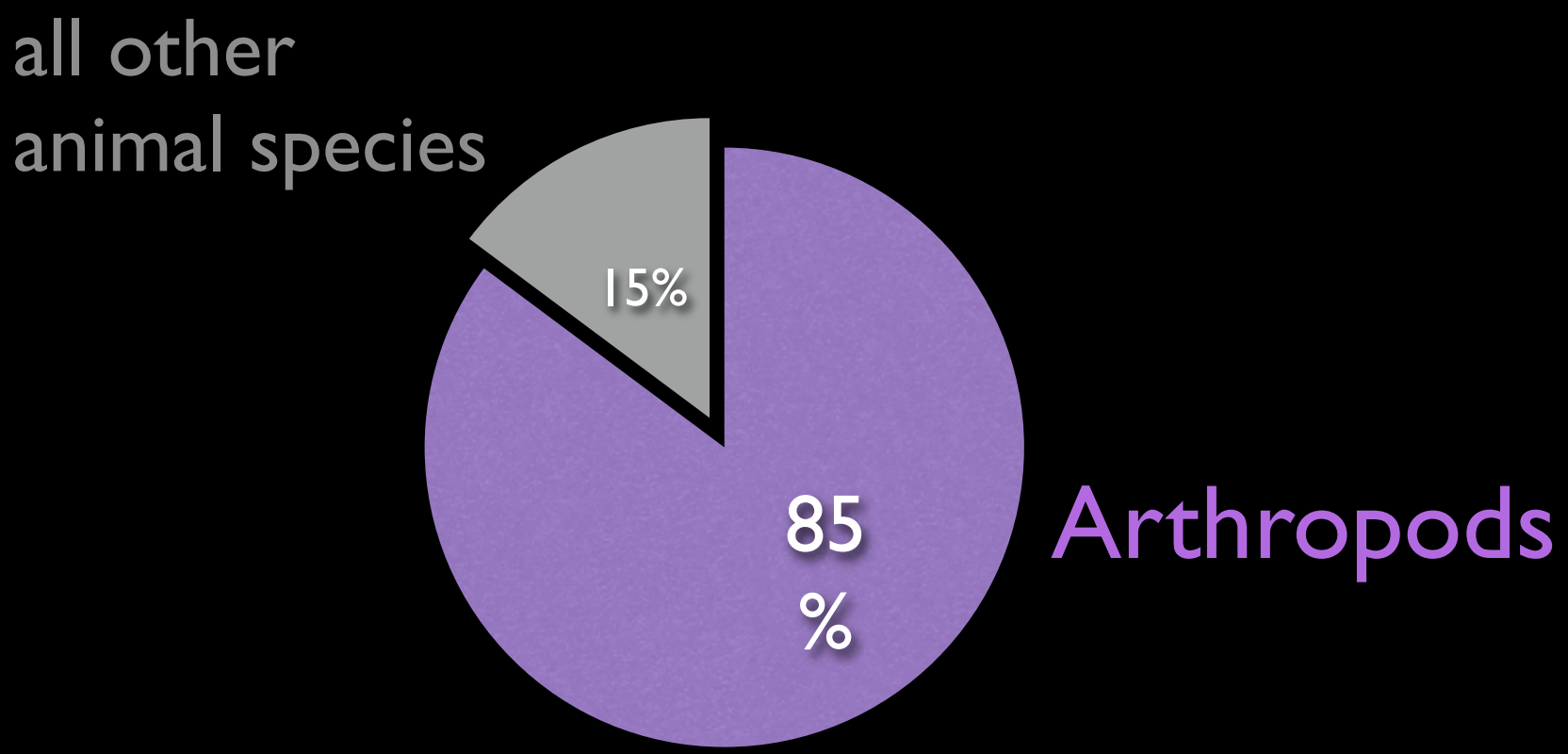
Systematics, Phylogeography and Conservation of Arthropods in the Madrean Sky Island Region

Wendy Moore, PhD
Associate Professor, Insect Systematics
Curator, UA Insect Collection
Department of Entomology
University of Arizona

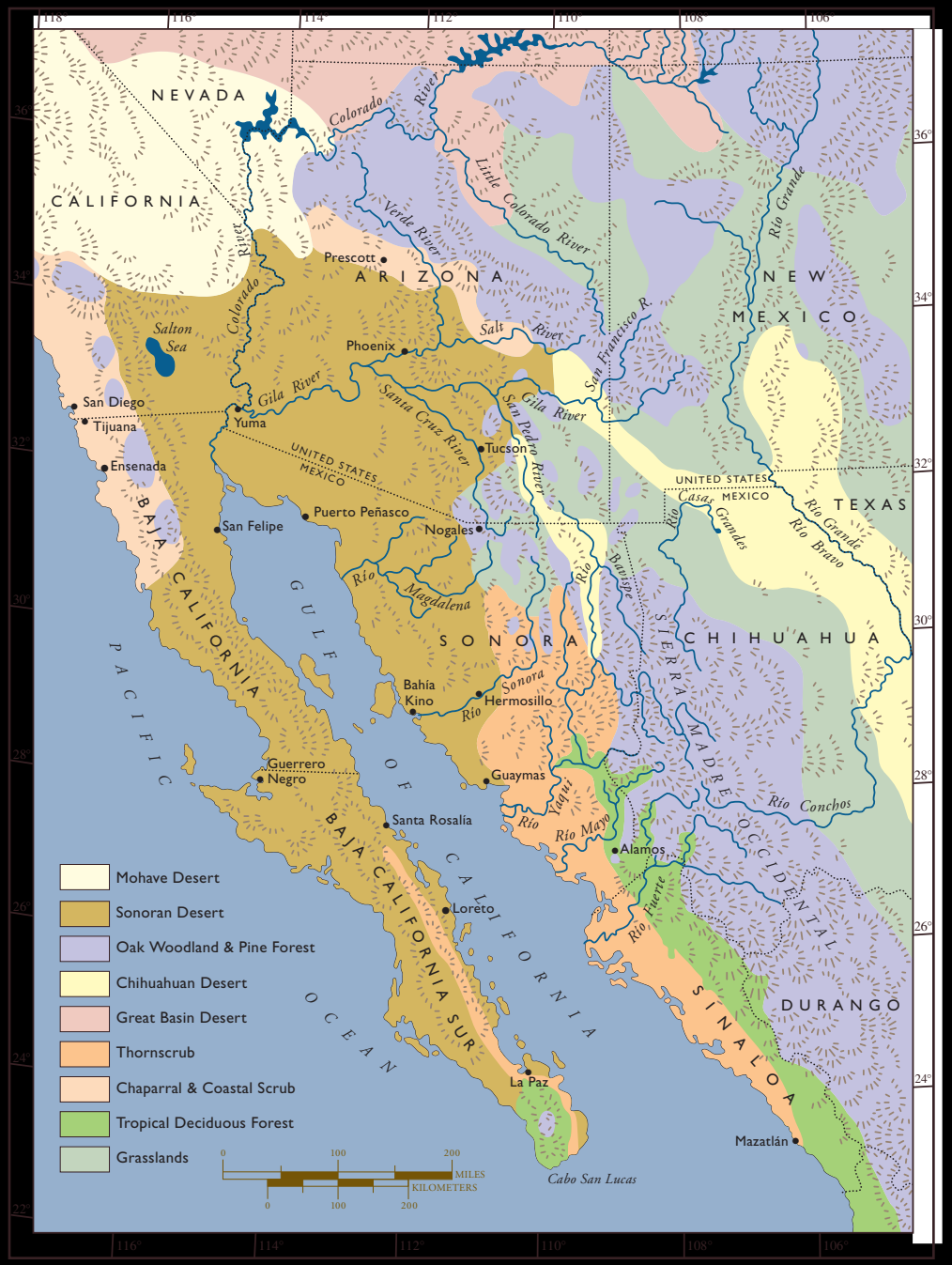
Kingdom Animalia.....1,327,047 species

Arthropods.....1,139,120 species
85% of all animal species



University of Arizona Insect Collection (UAIC)

Our mission is to build and maintain the world's best source of arthropod specimens from the Sonoran Desert Region and host a global center for insect research.



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University of Arizona Insect Collection

University of Arizona Insect Collection

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The University of Arizona's Insect Collection is a UA core facility that is the cornerstone for entomological research and insect diagnostics for the state of Arizona. The UAIC maintains approximately 2.0 million insect specimens and is the most comprehensive in the world for the Sonoran Desert Region. Many holdings are encountered in agricultural or urban environments, of which some are actual or potential pests or vectors of disease. Specimens of these species have been authoritatively identified by leading researchers from around the world, making the UAIC the most complete, modern, and well-curated source of research specimens, and an essential resource for scientists conducting basic and applied entomological research in this biologically rich region.

We are located on the 4th floor of the Forbes Building near the center of the University campus. The collection is open to the public Monday through Friday from 8 am to 4 pm.
Please contact us before you visit to make sure someone will be available to help you with your questions.

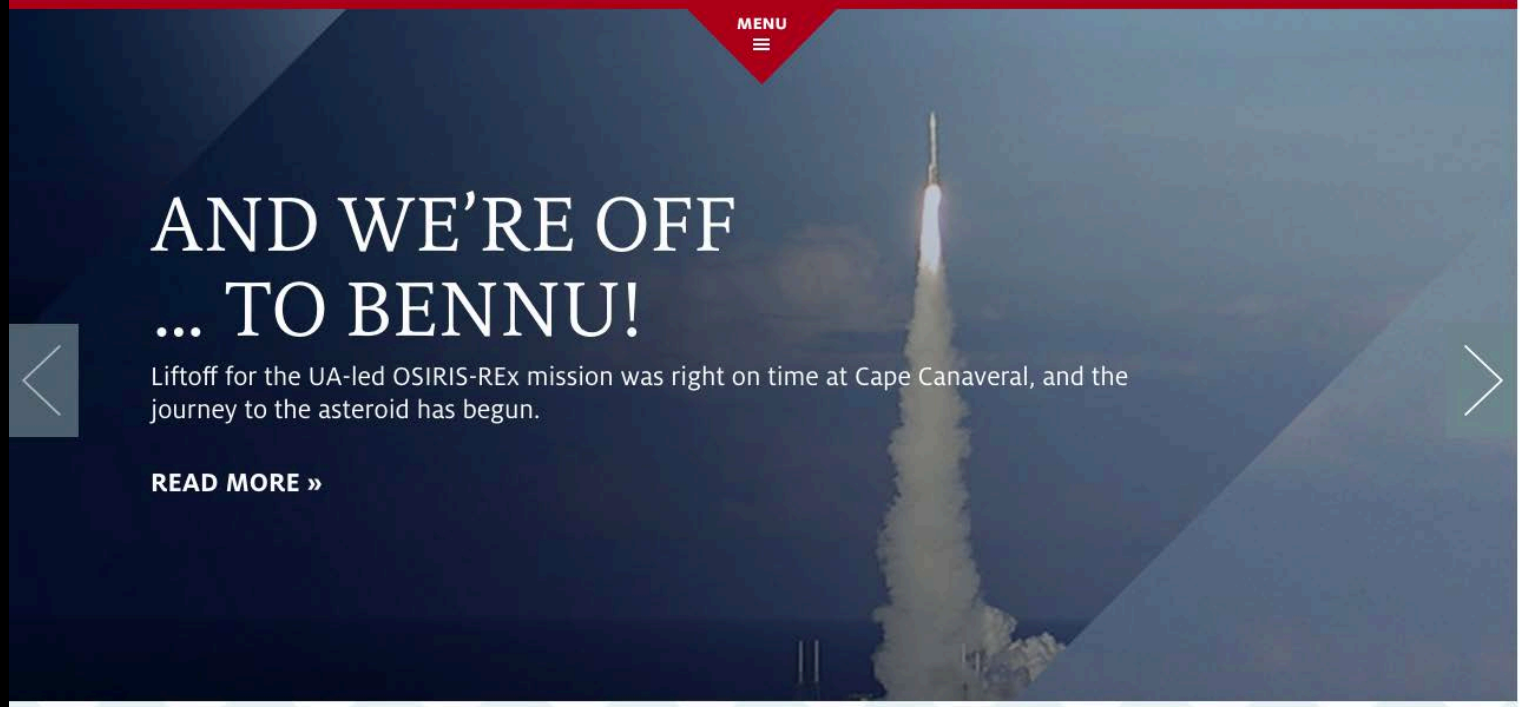
http://www.UAInsectCollection.com/

Collections in Support of Biological Research
(DBI-1203398)

"Critical Renovation and Revitalization of the University of Arizona Insect Collection"

Newly renovated UAIC

2012-13 Renovation



AND WE'RE OFF ... TO BENNU!

Liftoff for the UA-led OSIRIS-REx mission was right on time at Cape Canaveral, and the journey to the asteroid has begun.

READ MORE »

OUR IMPACT

10th

The College of Architecture, Planning, and Landscape Architecture ranked 10th in the nation for annual research generated

Association of American Universities

2M

The number of irreplaceable specimens in the UA's Insect Collection

Department of Entomology

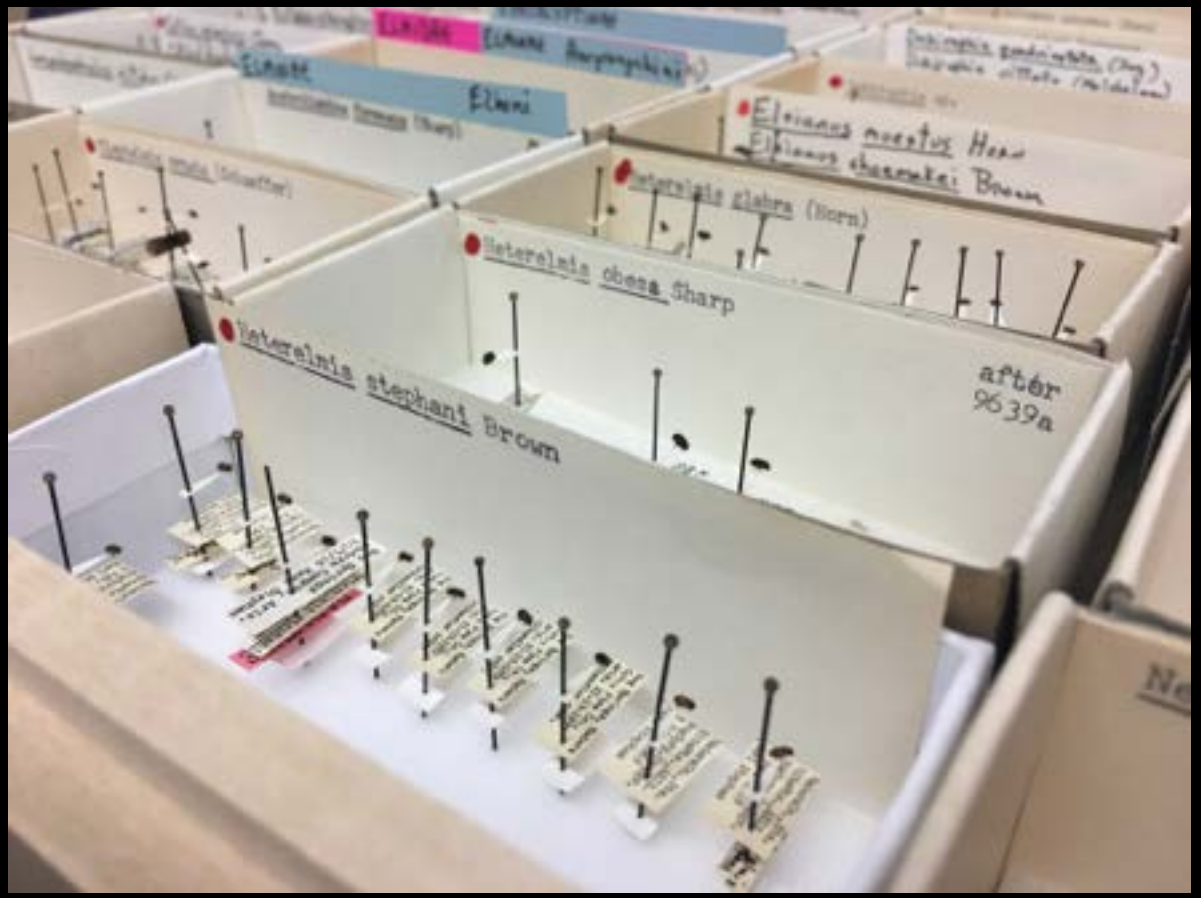
8th

UA's Master of Science in Planning is ranked 8th out of 34 Top Planning Programs in the nation without a PhD

Planetizen

Declared Extinct

10 of those specimens belong to a beetle species, *Heterelmis stephani* (Stephan's riffle beetle)



UAIC riffle beetle collection

The beetle lived in two springs in Madera Canyon, a habitat the Center for Biological Diversity said was degraded by livestock grazing, spring water piping and hiking trails.

Declared Extinct

10 of those specimens belong to a beetle species, *Heterelmis stephani* (Stephan's riffle beetle)

PARATYPE
UAIC1098458

Photos by James Robertson

The beetle lived in two springs in Madera Canyon, a habitat the Center for Biological Diversity said was degraded by livestock grazing, spring water piping and hiking trails.

Moore Lab at The University of Arizona
Arthropod Systematics

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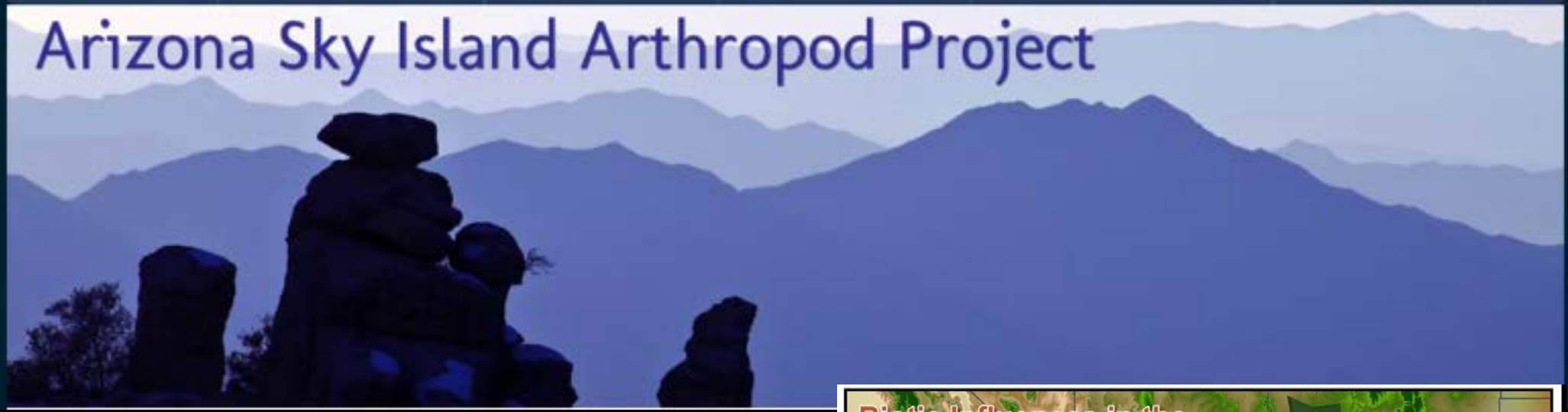
Arizona Sky Island Arthropod Project



Introduction to the Arizona Sky Island Arthropod Project (ASAP): Systematics, Biogeography, Ecology, and Population Genetics of Arthropods of the Madrean Sky Islands

Wendy Moore, Wallace M. Meyer, III, Jeffrey A. Eble, and Kimberly Franklin
Department of Entomology, University of Arizona, Tucson, Arizona
John F. Wiens and Richard C. Brusca
Arizona-Sonora Desert Museum, Tucson, Arizona

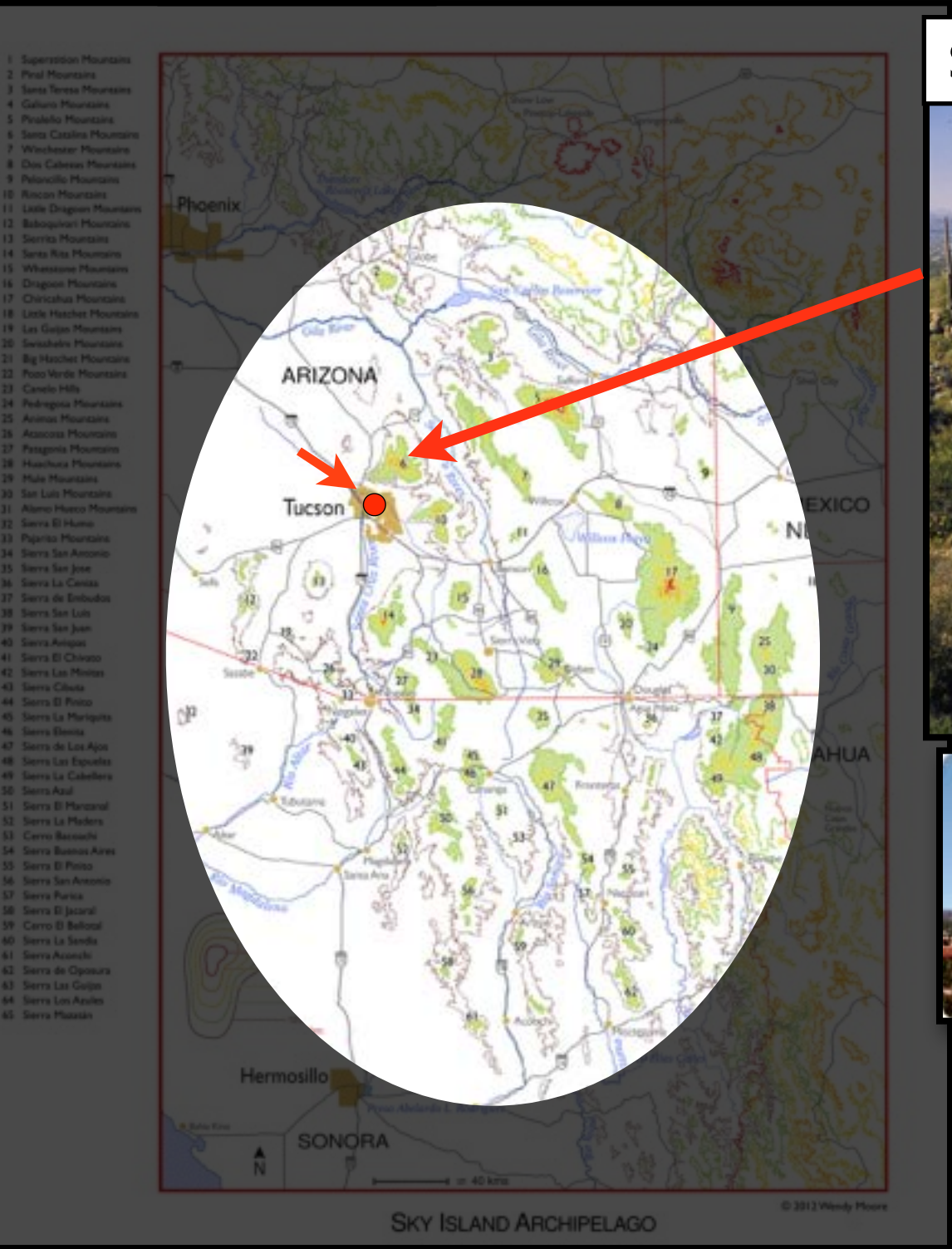
In: Merging science and management in a rapidly changing world: Biodiversity and management of the Madrean Archipelago III; 2012 May 1-5; Tucson, AZ. Proceedings. RMRS-P-67. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Moore et al 2013

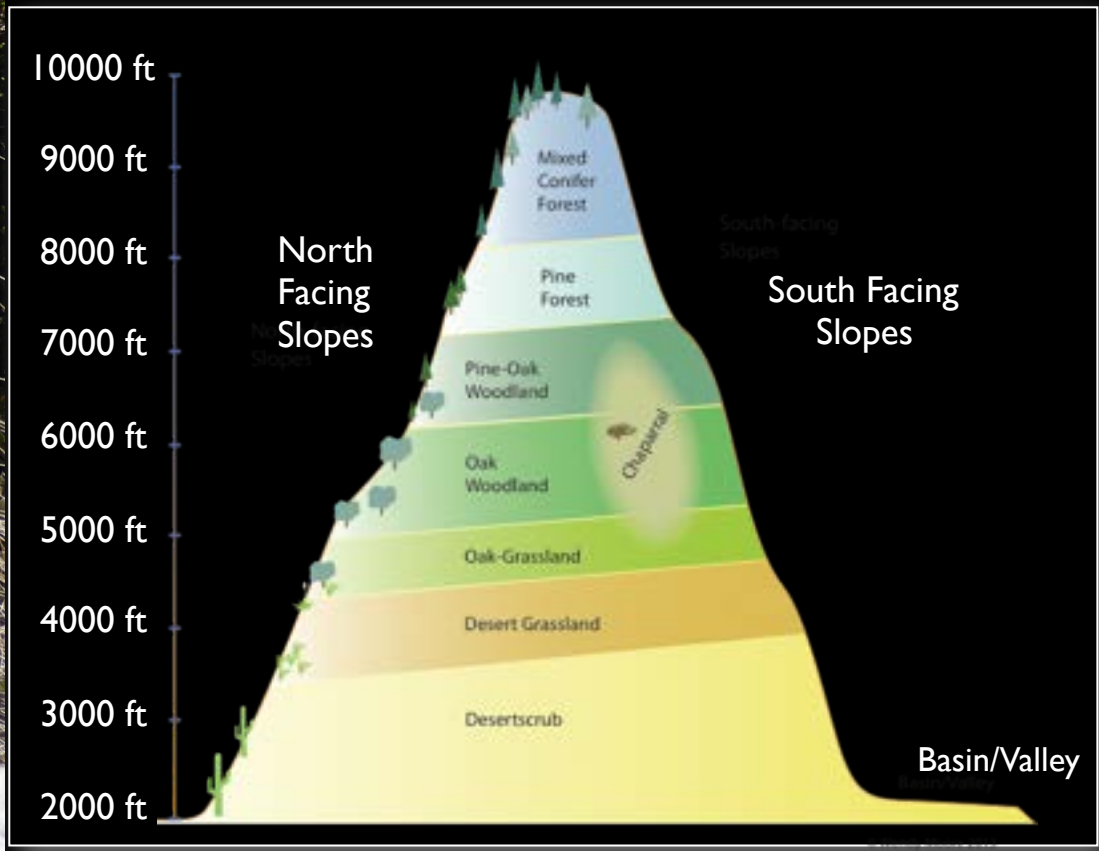
Madrean Sky Island Region

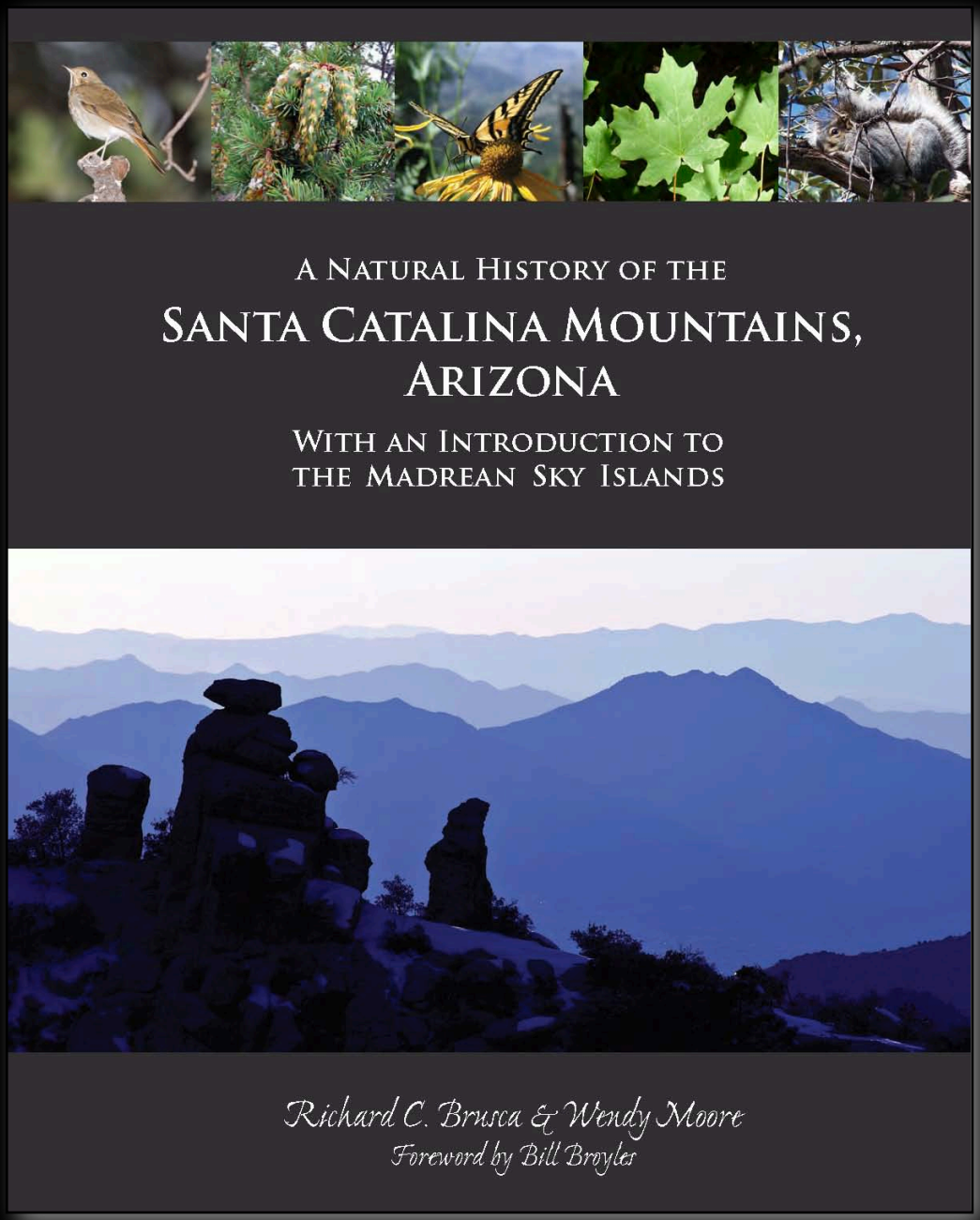
65 mountain ranges

Formed during the Miocene, 15-6 MYA as part of the the Basin-and-Range Extensional Provence.



Santa Catalina Mountains 9157 ft


10000 ft
9000 ft
8000 ft
7000 ft
6000 ft
5000 ft
4000 ft
3000 ft
2000 ft
North Facing Slopes
South Facing Slopes
Mixed Conifer Forest
Pine Forest
Pine-Oak Woodland
Chaparral
Oak Woodland
Oak-Grassland
Desert Grassland
Desertscrub
Basin/Valley



Brusca and Moore 2013

Moore Lab at The University of Arizona
Arthropod Systematics

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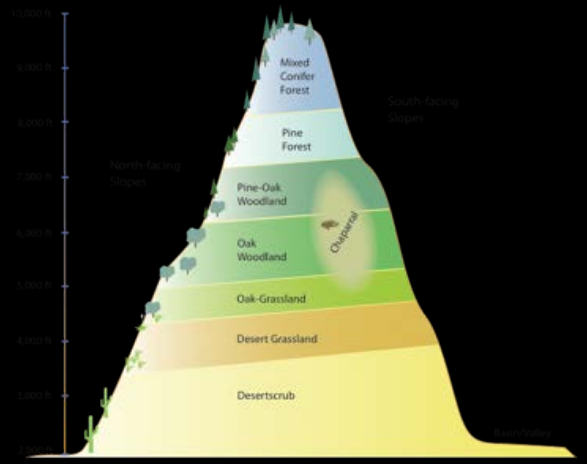
Arizona Sky Island Arthropod Project

- What arthropods inhabit Arizona's Sky Islands?
- How are these species distributed within the region?
- What are their biogeographic affiliations?
- Have arthropods diversified or radiated within the region?
- Are there repeated phylogeographic patterns?

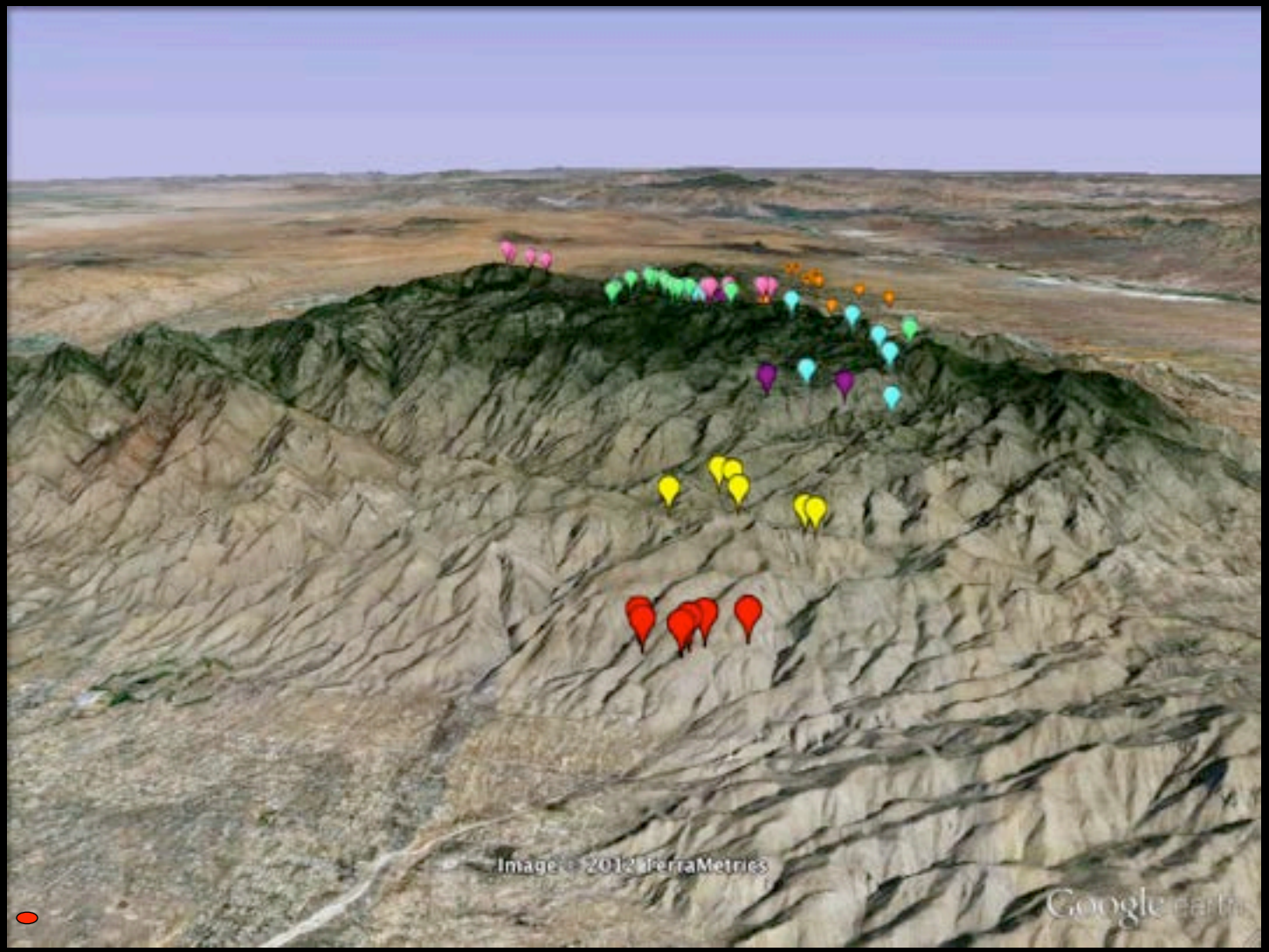





2013 to present


Mixed Conifer Forest
Pine Forest
Pine-Oak Woodland
Oak Woodland
Chaparral
Oak-Grassland
Desert Grassland
Desertscrub
South-facing Slopes
North-facing Slopes

Santa Catalina Mountains



- Desertscrub
- Oak-Grassland
- Chaparral
- Pine-Oak Woodland
- Pine Forest
- Mixed Conifer Forest
- Oak Woodland
- Desert Grassland
- Desert Grassland *Grazing Disturbed*

10 pitfall traps were arranged 10 m apart
along each 100 m transect line


Arizona
Catalina
5-19 May 2011
grassland, pitfall trap
code: CAT-GL-N-03

Undergraduate Research

ASAP Coleoptera Collection

Alaudes n. sp. ?

ASAP Coleoptera Collection

Gene Hall Univ. of Arizona
Carl Olson Univ. of Arizona
Jason Schaller Univ. of Arizona
James Robertson Univ. of Arizona
Nico Franz Arizona State University
Aaron Smith Arizona State University

Kim Franklin, Arizona-Sonora Desert Museum


Paul Marek, Virginia Tech



Carl Olson, UA Insect Collection

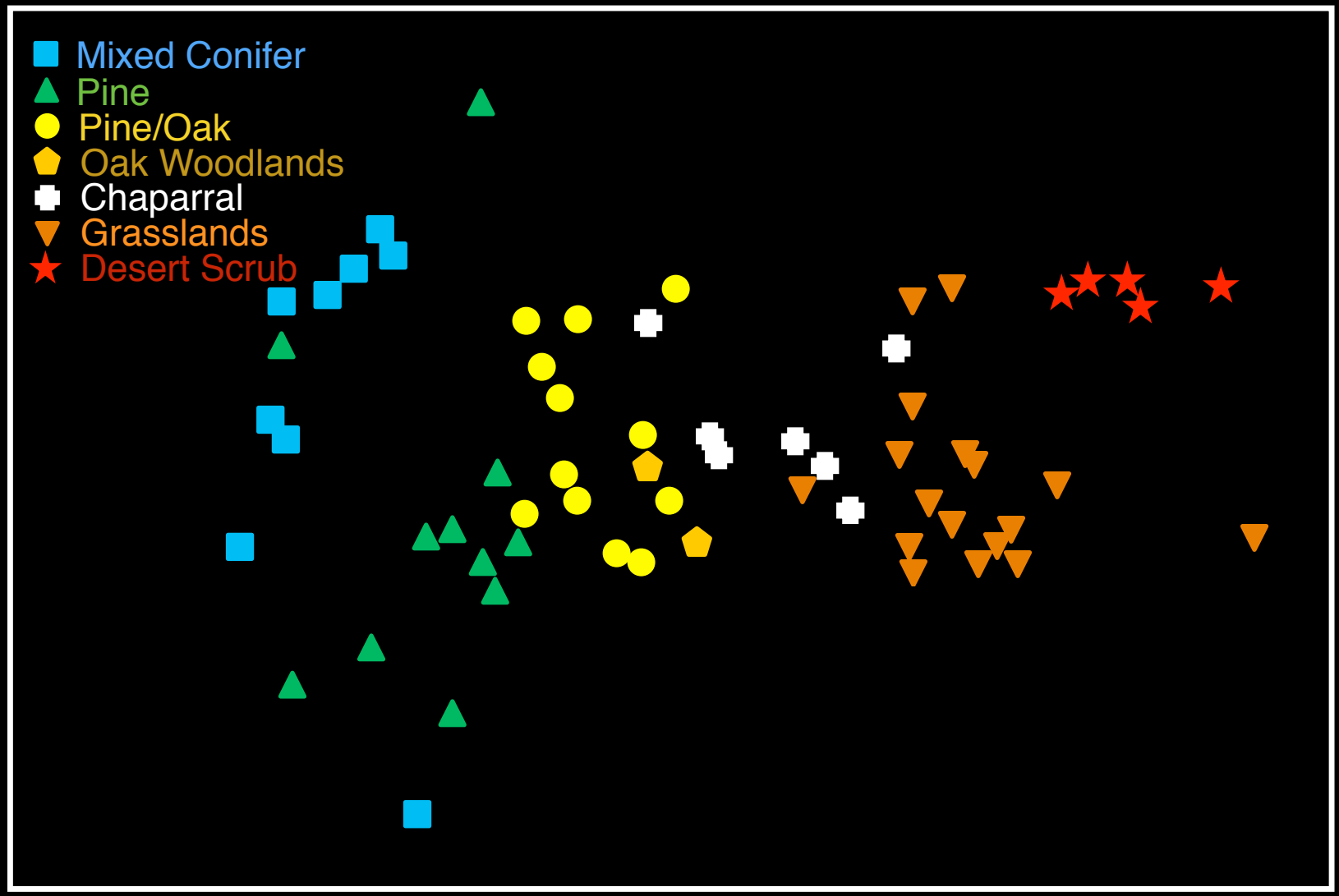

Garrett Hughes, University of Arizona



Sandy Brantley, University of New Mexico


Warren Savary, Tucson, Arizona


Soil Dwelling Arthropod Communities in the Santa Catalina Mountains



ANOSIM Results:

Mixed Conifer ≠ Pine ≠ Pine/Oak ≠ Chaparral ≠ Grassland ≠ Desert Scrub

Meyer et al 2015 PLoSOne

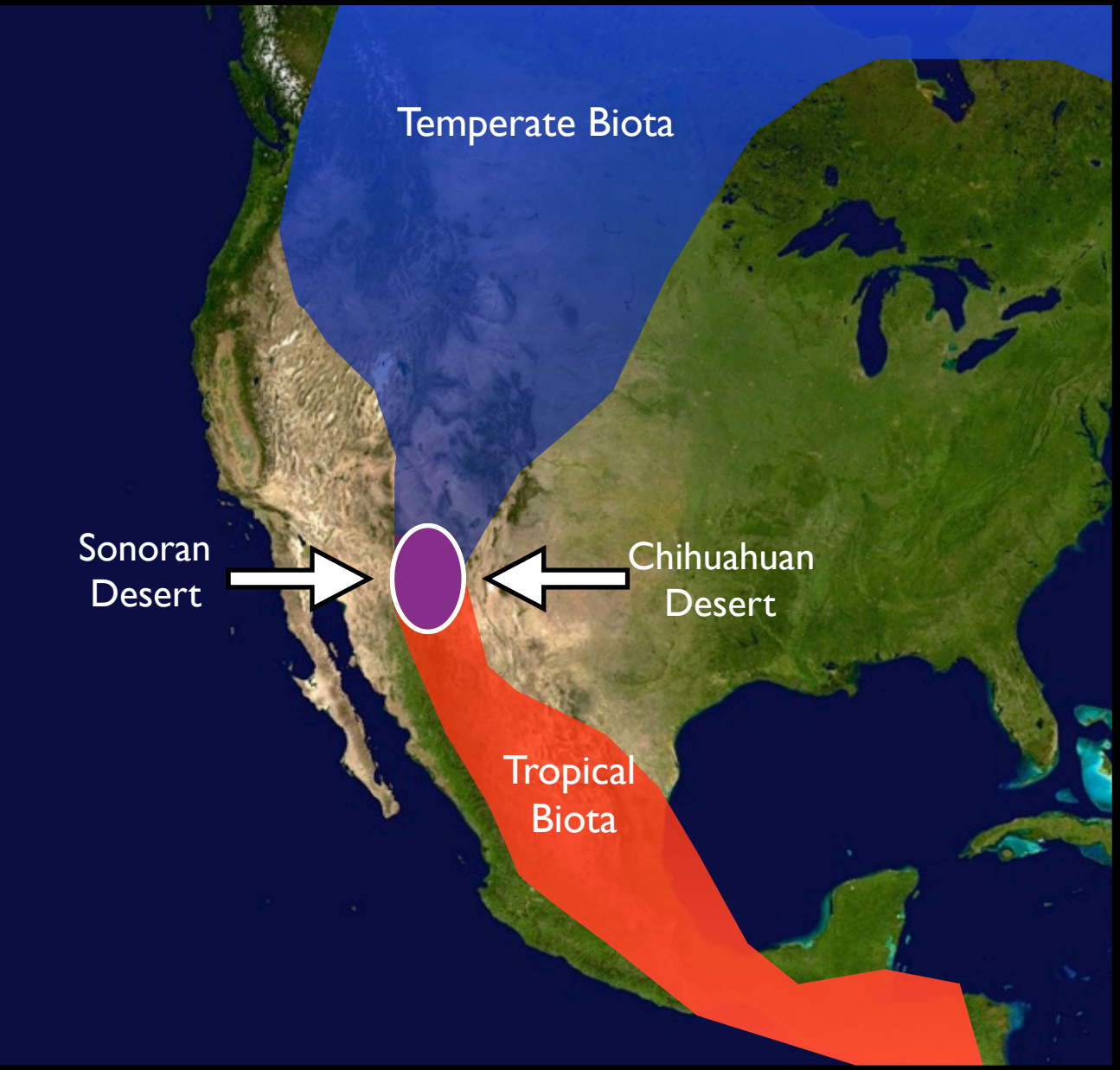
Arizona Sky Island Arthropods

Research Questions

Systematics, biogeography, and ecology of ground-dwelling arthropods

1. What arthropods inhabit Arizona's Sky Islands?
   How are these species distributed within the region?
   What are the biogeographic affiliations?

2. Have arthropods diversified or radiated *within* the Sky Island Region?
   If so, are there repeated phylogeographic patterns?



Madrean Sky Island Region

65 mountain ranges

Formed during the Miocene, 15-6 MYA as part of the Basin-and-Range Extensional Provence.

Biodiversity hotspot: one of the most biologically rich regions in the United States

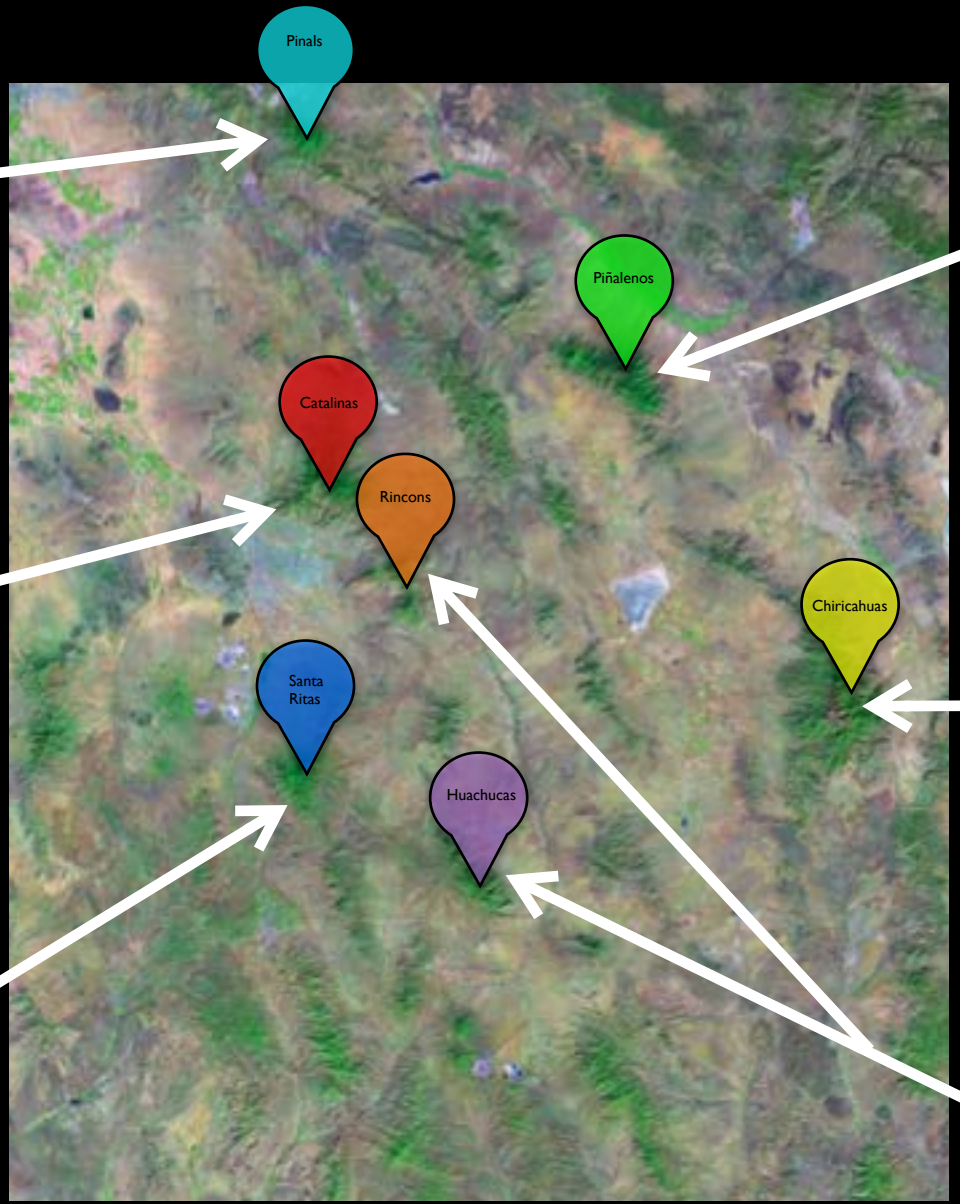
Scaphinotus petersi

6 subspecies of *Scaphinotus petersi*

Scaphinotus petersi petersi

Scaphinotus petersi catalinae

Scaphinotus petersi kathleenae



Ball 1966

Scaphinotus petersi grahami

Scaphinotus petersi corvus

Scaphinotus petersi biedermani

Have other arthropods diversified within this region?

"Symbiota Collections of Arthropods Network (SCAN): A model for collections digitization to promote taxonomic and ecological research"

Advancing Digitization of Biological Research Collections

Neil Cobb (Northern Arizona University), Boris C Kondratieff (Colorado State University), Charles S. Bundy (Regents of New Mexico State University), Frank Krell (Denver Museum of Nature and Science), James C. Cokendolper (Texas Tech University), John D. Oswald (Texas AgriLife Research), M. Deane Bowers (University of Colorado), Nico Franz (Arizona State University), Wendy Moore (University of Arizona)

2013 - present

"Symbiota Collections of Arthropods Network (SCAN): A model for collections digitization to promote taxonomic and ecological research"

Gene Hall, UAIC Collections Manager

Digitized to date:

- Carabidae
- Tenebrionidae
- Scarabaeidae
- Scolytinae
- Platypodinae
- Formicidae
- Orthoptera
- Isoptera
- research voucher specimens

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2013 - present

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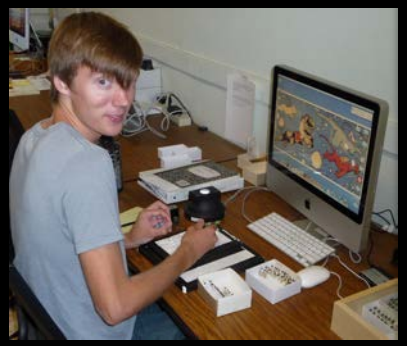


- 95,777 specimen records
- 81,355 (85%) georeferenced
- 87,153 (91%) imaged
- 68,896 (72%) identified to species
- 84 families

Advancing Digitization of Biological Research Collections

Neil Cobb (Northern Arizona University), Boris C Kondratieff (Colorado State University), Charles S. Bundy (Regents of New Mexico State University), Frank Krell (Denver Museum of Nature and Science), James C. Cokendolper (Texas Tech University), John D. Oswald (Texas AgriLife Research), M. Deane Bowers (University of Colorado), Nico Franz (Arizona State University), Wendy Moore (University of Arizona)

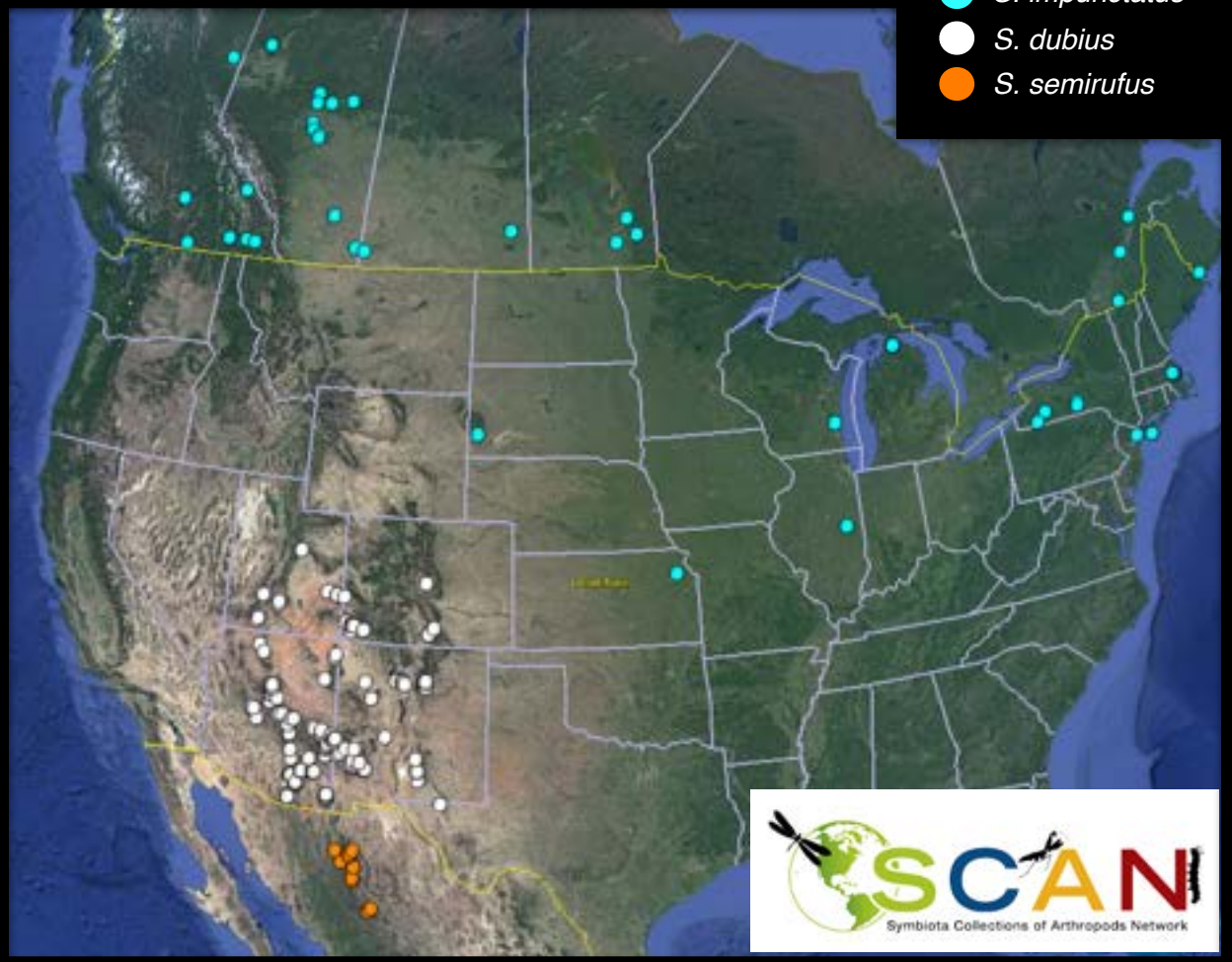
2013 - present

Alan Yanahan

PhD Student

Synuchus

- *S. impunctatus*
- *S. dubius*
- *S. semirufus*

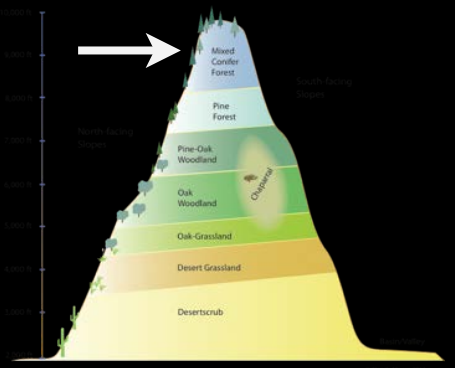


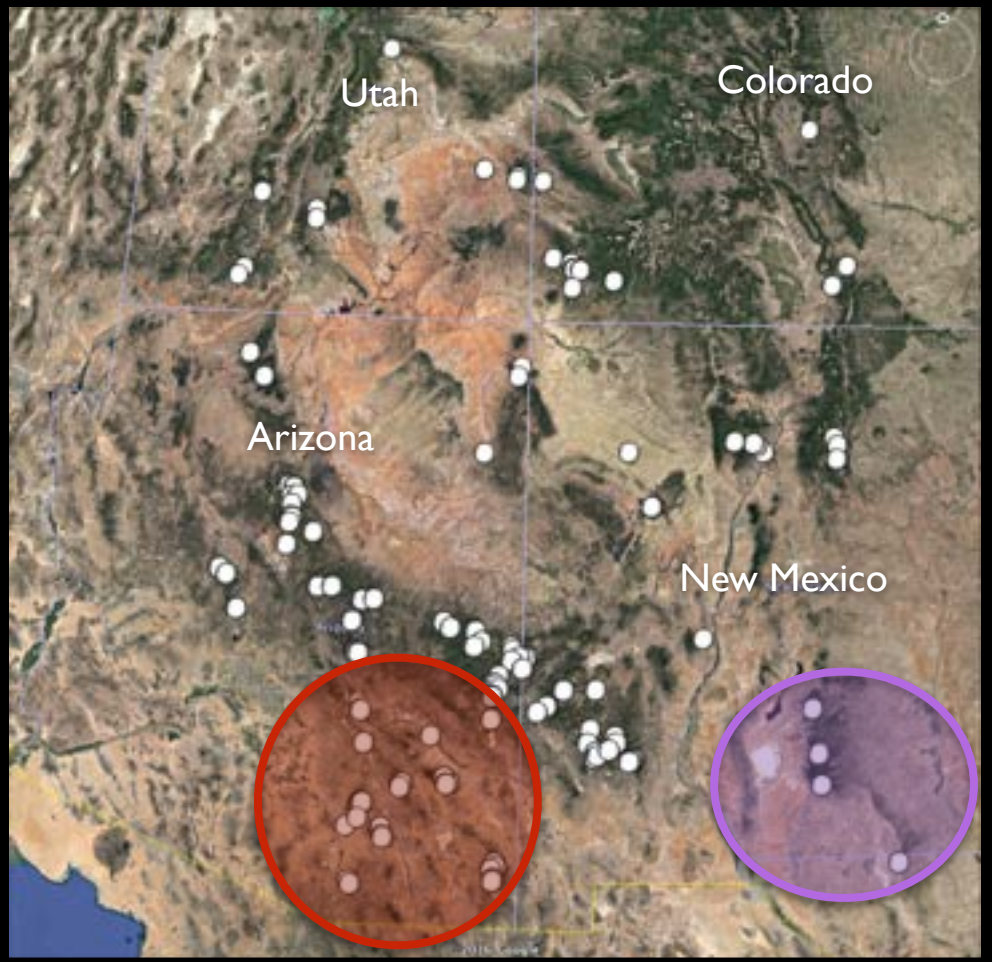
Synuchus dubius

Unlike *Scaphinotus petersi*, *Synuchus dubius* is not endemic to the Madrean Sky Island region.

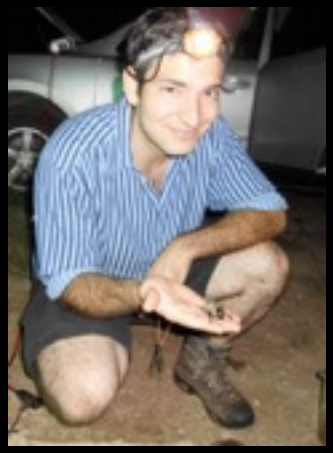
Gene: COI
Maximum Likelihood Tree
RAxML

Synuchus dubius





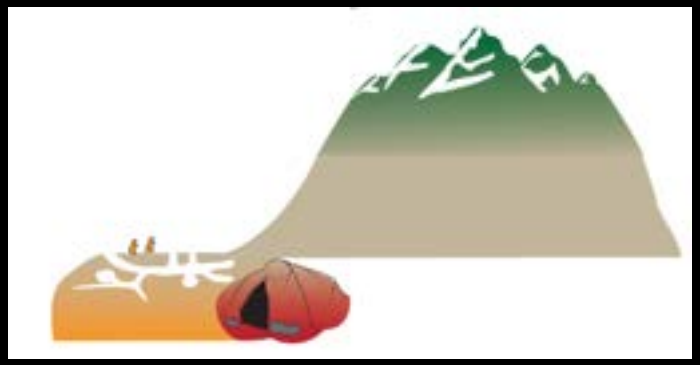
Gene: COI
Maximum Likelihood Tree
RAxML



Antonio Gomez

Master's Student

Rhadine approximately 30 species



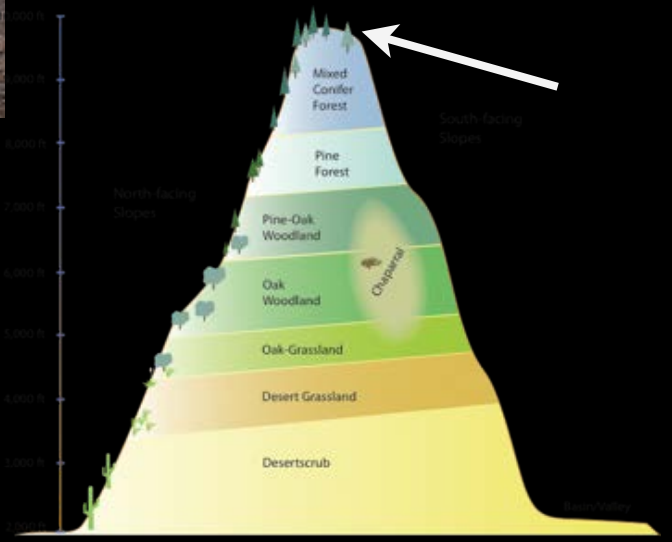
SCAN

Symbiota Collections of Arthropods Network

Genes: COI, 28S, CAD
Maximum Likelihood Tree
RAxML

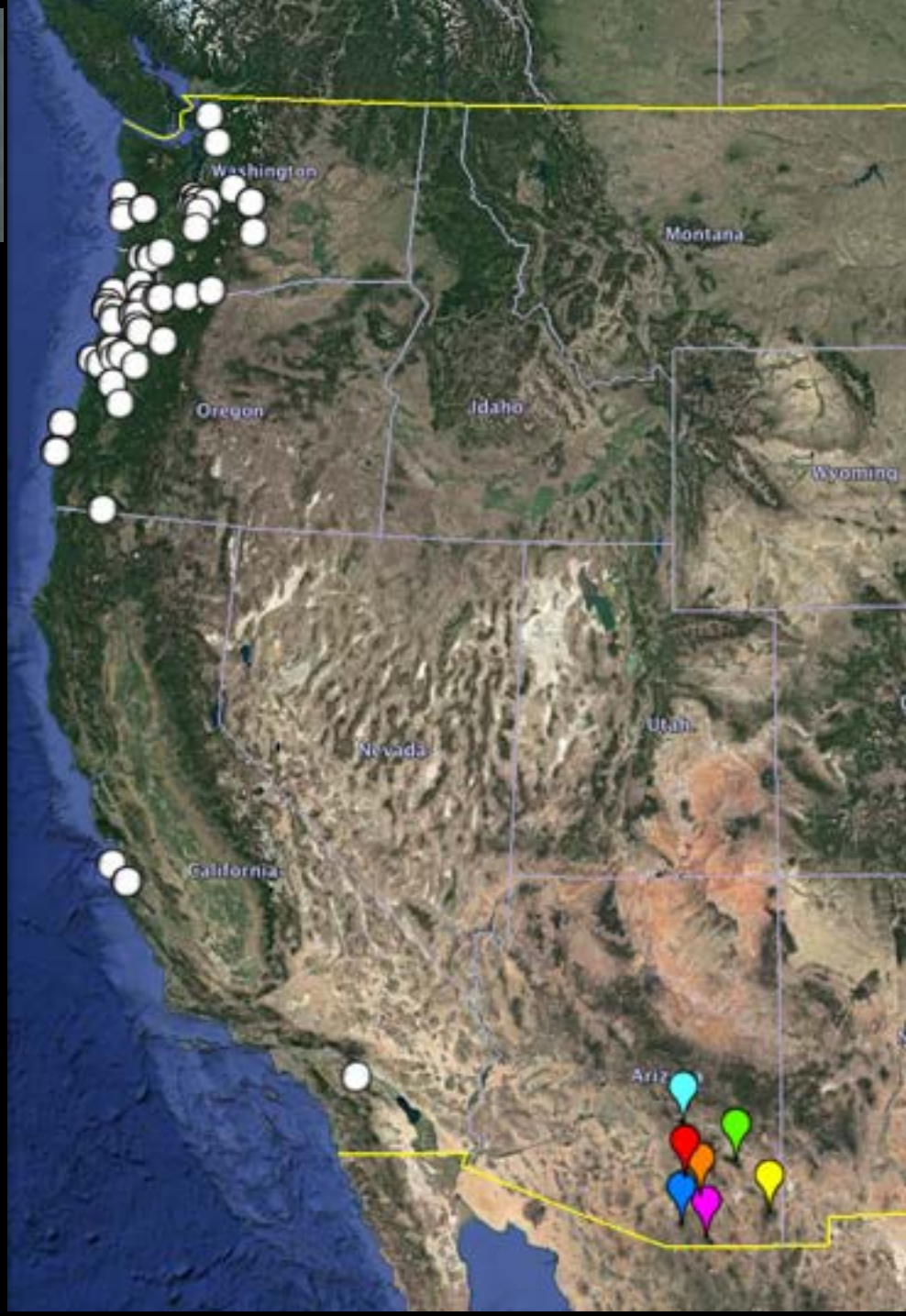
Garrett Hughes

PhD Candidate



flightless (non-phoretic) pseudoscorpions

100



Genes: COI and 28S
Maximum Likelihood Tree
RAxML

John Palting
PhD student

Lichen moths

Crambidia spp. (Lepidoptera: Erebidae: Arctiinae: Lithosiini)

Arizona Sky Island Arthropods

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Systematics, biogeography, and ecology of ground-dwelling arthropods

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VISITING SYSTEMATIST PROGRAM

- Supported by an endowment from the **Schlinger Foundation**
- Award is intended to help offset expenses for visiting systematists to work in the UAIC on their specialty group
- Enhance knowledge of their group in the Sonoran Desert Region and enhance the curatorial state of the specimens and associated digital data.
- **Amount**: Annual awards up to $25,000.

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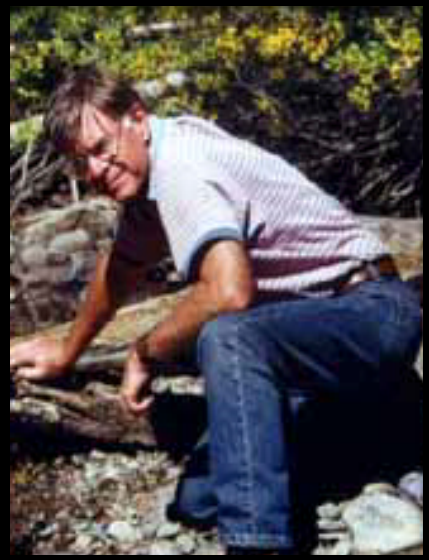
University of Arizona Insect Collection

VISITING SYSTEMATIST PROGRAM

Dr. Michael Sharkey
University of Kentucky
Braconid Wasps
2013-2014



Dr. Terry Erwin
Smithsonian
Ground Beetles
2014-2015

Dr. Tom Atkinson
University of Texas
Ambrosia Beetles
2015-2016

Dr. Robert Anderson
Canadian Museum of Nature
Weevils
Coming soon!

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DEPARTMENT OF ENTOMOLOGY
University of Arizona Insect Collection

ANCIENT DNA LAB

Coming soon!

Next Generation sequencing technology

Acknowledgements

Collaborators:
- Gene Hall
- Kim Franklin
- John Wiens
- Rick Brusca
- Sandy Brantley
- Aaron Smith
- Warren Savary
- Carl Olson

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- Reilly McManus
- Emmanuel Bernal
- Emily Hall
- Ryan McInroy
- Jeff Henkel
- Chelsea Powers
- Carol Tepper
- Chris McGinnis
- Shawna Rogers
- Eryn Wuori
- Heeya Ju
- Kayla Jones
- Rebecca Compoy
- Gabe Oropeza

Postdoctoral Fellows:
- James Robertson
- Marty Meyer
- Jeff Eble

Graduate Students:
- Reilly McManus
- Garrett Hughes
- Jason Schaller
- Antonio Gomez
- John Palting
- Alan Yanahan

Permitting:
Don Swan- Saguaro National Park
US Forest Service Special Use Permit # SAN0287

College of Agriculture & Life Sciences

NSF

NATIONAL GEOGRAPHIC