Assessing Insect Diversity

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Arizona: the insect capitol of the US

- We may have as many as 30,000 insect species here in the southwest
- We have many insects that are found nowhere else in the US
- We have at least 350 ant species, including army ants, leafcutters, and honeypot ants
- The best time to find insects is during the monsoon through November
- In addition to insects we have lots of other arthropods

Why is it important to study arthropod diversity?

Arthropods are very abundant, and play a variety of important ecological roles.

- Herbivores
- Predators
- Detritivores
- Disease vectors
- Pollinators
- Mutualists (mutual benefits to both partners)
- Soil processing, nutrients and aeration
- Food source for many other animals

Arthropods can be used as indicator species, or to study community response to perturbation

- Diversity may be reduced in areas with invasive species

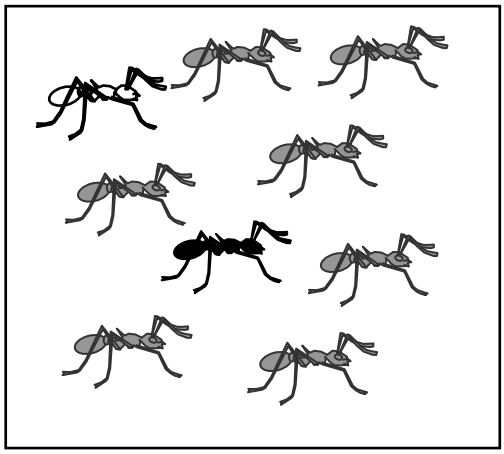
Invasive insects can have huge impacts on ecosystems

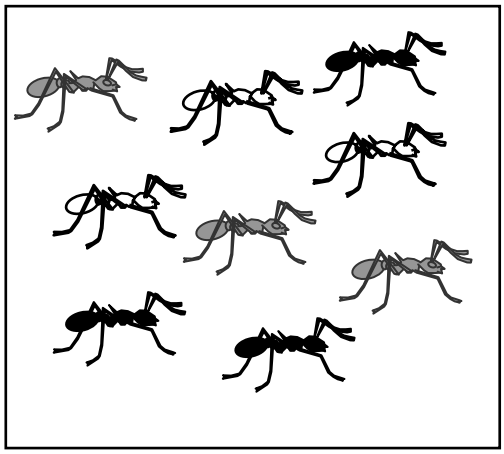
- the invasive argentine ant caused the number of ant species in some parts of California to go from about 50 to 2

How do we assess arthropod diversity?

Definition of diversity: species number, or species number plus evenness?

Which group of ants is more diverse?





Diversity Indices: ways to quantify diversity

The Shannon Index (H')

$$H' = -\sum_{i=1}^{S} p_i \ln p_i$$

S = the total number of species
p_i = the relative abundance of each species

The Simpson's Index (D)

D = the probability that two individuals drawn from the population are the same

$$D = \frac{\sum_{i=1}^{S} n_i(n_i - 1)}{N(N-1)}$$

S = the total number of species
N = the total number of individuals
n = the number of individuals in each species

There are many diversity indices out there. Many have neat online calculators!

One example of a Shannon calculator: http://math.hws.edu/javamath/ryan/DiversityTest.html

How to sample a habitat to estimate total insect diversity

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- repeated measures are critical
  - keep everything the same
  -
- remember, the "habitat" you are sampling depends on your method. Pitfall traps mostly catch ground-dwelling insects, for example.

Processing your data

Record the species found in each sample

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Species 1					
Species 2					
Species 3					
Species 4					
Species 5					
Species 6					

Create a species-area curve by plotting the total number of species found as a function of the area searched (or sampling effort expended)

Number of species found

Area searched

This relationship can be described by the power function $S = cA^z$

- **S = the number of species found**
- **A = the area searched**
- **c, z = constants**

The curve will look like a straight line on a log-log plot

$$\text{Log } (S) = z + c \log(A)$$

How do you know if you've sampled enough?

Rarefaction: a method for comparing samples of different sizes

- **Plot the number of species as a function of the number of individuals sampled**
- **Differently-sized samples can be compared at the same number of individuals**
- **There are computer programs that will do this quickly, including some available online**

Avoiding bug overload

- **sort your insects as "morphospecies" rather than trying to identify them all.**
- **Pick one group to focus on, such as ants, beetles, or butterflies.**
- **Use keys, books, and online resources to identify them**
- **Come to the University of Arizona collection for help**
- **expect that your species-area curve is going to be steep, and just do what you can**

Sampling methods

Sampling methods for repeated measures

Sweep netting: catches insects on vegetation and low fliers
Beat sheets: catches insects on vegetation
Pitfall traps: catch ground-dwelling insects
Malaise traps: catch flying insects

Other sampling methods

Blacklighting: catches a variety of insects
Hand-collecting: catches whatever you can find!

Resources

Resources for ants:

Ants of North America: A Guide to the Genera, by Brian Fisher and Stefan Cover

This is a brilliant illustrated guide that you can use to key ants to genera, even without previous experience. It has been perfected through years of the Ant Course, so it is easy to use. There is some complicated terminology, but it is defined in the back.

Antweb: http://www.antweb.org/

This website has incredibly detailed photos of ants from around the world, including almost every known species for the southwest and Arizona. It is well organized, allowing users to search in a variety of ways, and the location where specimens were found can even be plotted in Google Earth.

Resources for arthropods

Carl Olson (a. k. a. The Bug Man)

Associate Curator of the Entomology Collection
University of Arizona
bugman@ag.arizona.edu
(520) 621-5925

Carl can help you identify tricky insects and will be happy to answer any insect questions you come up with. He also has specimens for educational purposes and is known for his entertaining presentations and goofy jokes.

Sonoran Arthropod Studies Institute (SASI)

http://www.sasionline.org/

This organization hosts community days and an education program, including a mobile arthropod zoo that can be brought to classrooms.

Introduction to the Study of Insects, by Borror and Delong (7th edition!)

This is a very helpful book that you can use to identify insects to the family level. It has good pictures, decent keys, and nice descriptions.

Bugguide: http://bugguide.net

This helpful website is getting better all the time, with more insects and more information. Edited by both professionals and hobbyists, it is fairly accurate…

American Beetles Volume I and II, by Arnett, Thomas, Skelley, and Frank

You will need these massive tomes if you get serious about identifying beetles, especially beetle larvae.