Invertebrate Biodiversity

Background information

- Insects and other invertebrates are essential for any healthy ecosystem. Invertebrates aerate the soil, eat plant pests, pollinate flowers, and provide food for other organisms such as birds and small mammals.
- Ecosystems with high invertebrate diversity may be more stable over time and able to support a greater diversity of plants and animals. High diversity in an ecosystem can also affect ecosystem services. Ecosystem services are resources and processes generated by ecosystems that benefit humans. For example, food, water, energy, air quality, water purification, disease control, nutrient cycling, seed dispersal, and recreation are all ecosystem services.
- **Core data sampling methods**:
  - Sticky traps: Detailed sampling for flying insects is performed with sticky traps. One sticky trap is placed into each plot for one week prior to collecting.
  - Pitfall traps: Detailed sampling for ground-dwelling insects and other invertebrates is performed with pitfall traps. One pitfall trap is placed into each plot for one week prior to collecting.
- **Optional sampling methods**:
  - Scouting: The general occurrence and abundance of invertebrates within each plot is assessed with scouting. Scouting consists of detailed inspection of soil and individual plants for insects within a 0.25 x 0.25m area of the plot.
  - Sweep netting: Sweep netting can also provide data on general occurrence and abundance of invertebrates that fly and/or perch on plants.

- In addition to the provided Invertebrate Guide, you may find the following websites useful:
  - *bugguide.net* [Click on insect drawings on left to get details and photographs]
  - Dichotomous keys for winged (keyA) and wingless (keyB) insects:

  www.amnh.org/learn/biodiversity_counts/ident_help/Text_Keys/arthropod_keyA.htm
  www.amnh.org/learn/biodiversity_counts/ident_help/Text_Keys/arthropod_keyB.htm

Timeline/Frequency

Sticky traps and pitfall traps are used to collect insects and other invertebrates during the fall between September and October.

Optional sampling methods can be used at any time, but your sampling will be most successful in late spring and early fall.

STICKY TRAP PROCEDURE (Required for core data)

Materials

- Invertebrate Guide
- Sticky Traps
- Petri dishes for sorting invertebrates
- 1-meter high stakes
- Plastic wrap
- Camera to photograph unknown invertebrates

Instructions

1. Place a 1-meter high stake into random location in plot. (See 'Randomization Procedure' protocol.)
2. Attach the sticky trap to the stake.
3. Leave sticky trap for 1 week.
4. After 1 week, collect sticky trap, wrapping it in plastic wrap or covering with a plastic Ziploc bag.
5. Identify each invertebrate to order using the Invertebrate Guide**.**
6. Count and record the number of individuals of each order. Record your results on the Invertebrate Biodiversity Data Sheet (attached).
7. Photograph and describe any invertebrate you cannot identify. Identify this invertebrate later. List as Unknown Invert 1, Unknown Invert 2, etc.
8. Repeat for each plot.

Modified from Insect Abundance KBS023 LTER Protocol, 1995, http://lter.kbs.msu.edu/protocols/

PITFALL TRAP PROCEDURE (Required for core data)

Materials

- Invertebrate Guide
- Small plastic cup
- Trowel or soil auger
- Magnifying glasses
- Tweezers
- Camera to photograph unknown invertebrates

Instructions

1. Randomly select a location in the plot (See 'Randomization Procedure' protocol.)
2. At the sampling location, dig a hole just large enough for the cup to fit inside.
3. Fill the cup 3/4 full with soapy water.
4. Leave the cup for 1 week.
5. After 1 week, collect the invertebrates in the cup (pour contents of cup into a Ziploc bag).
6. Identify each invertebrate to order using the Invertebrate Guide.
7. Count and record the number of individuals of each order. Record your results on the Invertebrate Biodiversity Data Sheet (attached).
8. Photograph and describe any invertebrate you cannot identify. Identify this invertebrate later. List as Unknown Invert 1, Unknown Invert 2, etc.
9. Repeat for each plot.

Modified from Insect Abundance KBS023 LTER Protocol, 1995, http://lter.kbs.msu.edu/protocols/

SCOUTING PROCEDURE (Optional)

Materials

- Invertebrate Guide
- 0.25m x 0.25m frame
- Camera to photograph unknown invertebrates

Instructions

1. Place frame at random location in the plot using the 'Randomization Procedure' protocol.
    a. Sides of the frame should be parallel to the plot borders.
    b. Place the center of the frame on the location identified from the 'Randomization Procedure' protocol.

Note: If disturbance (walking path, animal burrow, previous harvest, etc.) is present in the area, repeat the 'Randomization Procedure' to select a new sampling location.

    c. Work the frame through the standing plants to the ground surface such that:
        - No plant stems rooted outside of the frame are lying inside the frame.
        - No plant stems rooted inside the frame are lying outside the frame.
2. Search the ground and plants inside the frame and use the Invertebrate Guide to identify organisms by order.
3. Count and record the number of individuals of each order. Record your results on the Invertebrate Biodiversity Data Sheet (attached).
4. Photograph and describe any invertebrate you cannot identify. Identify this invertebrate later. List as Unknown Invert 1, Unknown Invert 2, etc.
5. Repeat for each plot.

Modified from KBS063: Above Ground Primary Productivity (ANPP)-GLBRC Extensive sites http://lter.kbs.msu.edu/protocols/115, Carol Baker

SWEEP NETTING PROCEDURE (Optional)

Note: Sweep netting is most successful when plants are at least 6 inches tall.

Materials

- Invertebrate Guide
- Sweep nets
- White paper or trays
- Camera to photograph unknown invertebrates

Instructions

1. For each sweep, swing net through tops of plants in one direction (from right to left or from left to right). Angle opening of net slightly down so top of net opening hits plants before bottom of net opening.
2. Take 3 sweeps of each plot.
3. After the 3 sweeps, quickly move the net through the air to move all of the invertebrates to the bottom of the net bag. Grasp the net bag about halfway down to close the invertebrates in the net.
4. Empty invertebrates onto white paper or tray.
5. Identify each invertebrate to order using the Invertebrate Guide.
6. Count and record the number of individuals of each order. Record your results on the Invertebrate Biodiversity Data Sheet (attached).
7. Photograph and describe any invertebrate you cannot identify. Identify this invertebrate later. List as Unknown Invert 1, Unknown Invert 2, etc. for each invertebrate you cannot identify.
8. Repeat for each plot.

Modified from UC IMP Alfalfa Sampling with a Sweep Net

http://www.ipm.ucdavis.edu/PMG/r1900311.html

Switchgrass = S	Fertilized = F	Harvested = H
Prairie = P	Unfertilized = UnF	Unharvested = UnH

Invertebrate Biodiversity Data Sheet

Names:_____

School District:_____ Instructor/Fellow:_____

Date:_____ Time:_____ Weather:_____

School / Location Name: _____

Block Code:_____ Plot Treatment Description (Ex: P F UnH):_____

Collection method (Sticky Trap, Pitfall Trap, Scouting, Sweep Net)_____

All insect orders are listed in the table below. Use the empty rows near the bottom of the table to write in any unknown invertebrates.

Insect Order Common Name (*Scientific Name)*	# Individuals
Ants, Bees, Wasps (*Hymenoptera*) 	
Beetles & Weevils (*Coleoptera*) 	
Bugs, Cicadas, Aphids (*Hemiptera*) 	
Butterflies and Moths (*Lepidoptera*) 	
Cockroaches (*Blattodea*) 	
Dragonflies and Damselflies (*Odonata*) 	
Earwigs (*Dermaptera*) 	
Flies and Mosquitos (*Diptera*) 	
Grasshoppers, Katydids, Crickets (*Orthoptera*) 	
Lacewings (*Neuroptera*) 	
Praying mantids (*Mentodea*) 	
Termites (*Isoptera*) 	
Walking Sticks (*Phasmida*) 	
Springtails (*Collembola*) 	

Mayflies (*Ephemeroptera*) 	
Scorpionflies (*Mecoptera*) 	
Caddisflies (*Thrichoptera*) 	

Other Invertebrate Order Common Name (*Scientific name)*	**# Individuals**
Spiders, Daddy long legs, Ticks (*Arachnida*) 	
Centipedes (*Chilopoda*) 	
Millipedes (*Diplopoda*) 	
Earthworms (*Clitellata*) 	
Snails and Slugs (*Gastropoda*) 	
Pillbugs (*Malacostraca*) 	
Unknown Invertebrates & Description	**# Individuals**