

## Soil Microarthropod Lab BIOL 370L

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Soil microarthropods are abundant small invertebrates that live in the soil and litter layer. Typical microarthropods include mites, springtails, pseudoscorpions, and insect larvae. These microarthropods can be important in controlling the rate of litter decomposition and altering nutrient cycling. In this laboratory we'll examine some local microarthropods and determine whether the type and amount of litter they inhabit influences their abundance, richness, and composition. Specifically, we'll compare two habitats: pine needles and deciduous leaf litter. These litter types differ in their chemical composition and decomposition rate. Pine litter is usually more acidic and decays slower than deciduous tree leaves. After comparing litter types we'll examine whether there is a relationship between litter mass and species richness. More litter mass may provide more food and habitat for soil microarthropods.

Collecting invertebrates like microarthropods from samples containing organic matter and sediments is very difficult. Picking all of these small microarthropods from the samples requires using microscopes and is very time consuming. Instead, soil ecologists often use passive collection methods like Berlese funnels. Berlese funnels take advantage of the fact that soil microarthropods like moist, cool habitats. Light and heat from an incandescent light bulb force the microarthropods in the funnels to move away from the light, where they eventually drop into a collection cup containing a preservative.

### **Procedures:**

We will work over 2 wk to complete this lab. In the first week we'll set up the experiment and start writing the lab report. In the second week we'll identify and count the microarthropods collected in our samples, analyze the data, and finish writing up the report.

### Week 1

Each group will set up two Berlese funnels: one with pine needles, the other with deciduous leaf litter.

Setting up a Berlese funnel:

- Put about 30 ml of denatured ethanol in a specimen cup and place the cup in a beaker. **\*\*Don't forget to label your cups with your group name and type of leaf litter.\*\***
- Place a funnel in the beaker so that insects will easily fall from the funnel into the cup.
- Lay a small wire mesh circle inside the funnel, to keep the leaf litter from falling directly into the cup.
- Before going to the next step, we'll need to go out and collect a large handful of each litter type: conifer needles and deciduous leaves. Place the samples in a bag and bring them back to the lab.
- Place one litter type on top of the wire mesh inside one of the funnels. Repeat for the second funnel.
- Set your Berlese funnels under the designated lights to dry out over the week.

After both funnels are set up, your group can begin working on the lab report. The **Introduction** and **Methods** should be easy to complete in this session. You should also decide on which statistical tests and graphics you plan to use to analyze your data next week (see detailed instructions below).

### Week 2

Each group is responsible for identifying and counting the microarthropods found in each of their specimen cups and weighing the leaf litter from each funnel using a top-loading balance. You'll use dissecting microscopes to identify and count the microarthropods. You can identify them using a combination of a dichotomous key and pictures (found at the end of this handout). Record the leaf litter



Keys to soil animals [larger mesofauna (1 - 10 mm) and macrofauna (> 10 mm)]  
By **Patrick Foley** (2003)

### **A. Key to common soil invertebrate phyla**

- 1a. Segmented body with legs and chitinous exoskeleton: Phylum Arthropoda
- 1b. Worms, snails or slugs without legs
  
- 2a. Snails or slugs with foot, antennae, often a shell: Phylum Mollusca (Class Gastropoda)
- 2b. Worms
  
- 3a. Segmented worms: Phylum Annelida (Class Oligochaeta)
- 3b. Unsegmented worms
  
- 4a. Flatworms (flat in cross section): Phylum Platyhelminthes (Class Turbellaria)
- 4b. Roundworms: Phylum Nematoda

### **B. Key to soil Arthropod classes**

- 1a. No antennae, 4 pairs of legs, 2 (or apparently 1) body regions: Class Arachnida (mites, spiders)
- 1b. Not as above
  
- 2a. 3 pairs of legs on thorax, 3 body regions (head, thorax, abdomen): Class Insecta
- 2b. More than 8 legs, numerous similar sections (also check immature insect key)
  
- 3a. Flattened oval body: Class Crustacea (sowbugs)
- 3b. Elongate body
  
- 4a. Apparently two pairs of legs/segment: Class Diplopoda (millipedes)
- 4b. Apparently one pair of legs/segment
  
- 5a. Long-legs, flat body, large mandibles: Class Chilopoda (centipedes)
- 5b. Short legs, cylindrical body
  
- 6a. Antennae branched, 9 pairs of legs: Class Pauropoda
- 6b. Antennae not branched, 10-12 pairs legs: Class Symphyla

### **C. Key to soil Arachnid orders**

- 1a. Legs on same body region as abdomen, no distinct cephalothorax: Order Acarina (mites, ticks)
- 1b. Legs on cephalothorax, distinct from abdomen
  
- 2a. Large pincer-like pedipalps: Order Pseudoscorpionida
- 2b. Smaller pedipalps
  
- 3a. Segmented abdomen joined broadly to cephalothorax: Order Opiliones (harvestmen)
- 3b. Unsegmented abdomen joined narrowly to cephalothorax: Order Araneae (spiders)

### **D. Key to soil Insect orders** (using adults and nymphs, i.e., immatures with incomplete metamorphosis)

- 1a. Not winged (also see key to some immature insects)

- 2a. No antennae or eyes, about 1-mm long: Order Protura
- 2b. Antennae and eyes present
- 3a. With conspicuous abdominal extensions
  - 4a. 2 or 3 abdominal cerci (usually long bristletails): Order Thysanura (silverfish)
  - 4b. Usually with furcula (bent forked abdominal spring): Order Collembola (springtails)
- 3b. Without conspicuous abdominal extensions
  - 5a. Sucking mouthparts, short body (2 times as long as wide or less): Order Homoptera (aphids)
  - 5b. Chewing mouthparts, elongated body (> 2X as long as wide)
  - 6a. Head, thorax, abdomen narrowly joined, bent antenna: Order Hymenoptera (ants)
  - 6b. Head, thorax and abdomen fused broadly
  - 7a. Less than 5 mm, antennae, much longer than head: Order Psocoptera (booklice)
  - 7b. Antennae about size of head: Order Isoptera (termites)
- 1b. Winged
  - 8a. Pincer-like abdominal extensions: Order Dermaptera (earwigs)
  - 8b. Without “pincers” at end of abdomen
  - 9a. Wings covered with scales: Order Lepidoptera (moths, butterflies)
  - 9b. Wings not covered with scales
  - 10a. Tiny slim bodies (0.5-2 mm long), wings fringed with long hairs: Order Thysanoptera (thrips)
  - 10b. Wings not fringed with long hairs
  - 11a. One pair of wings: Order Diptera (flies)
  - 11b. Two pairs of wings
  - 12a. All wings similarly membranous, transparent
  - 13a. Wasp-waisted: Order Hymenoptera (wasps, ants, bees)
  - 13b. Thick-waisted, sucking mouthparts rear of head: Order Homoptera (aphids)
  - 12b. Front wings thicker than hind wings
  - 14a. Chewing mouthparts
    - 15a. Front wings form line straight down back: Order Coleoptera (beetles)
    - 15b. Front wings veined, antennae >11 segments, cerci: Order Orthoptera (crickets, roaches)
  - 14b. Sucking mouthparts
    - 16a. Front wings form X, mouth at front of head: Order Hemiptera (true bugs)
    - 16b. Front wings uniformly thick, mouth at rear: Order Homoptera (aphids)

**E. Simplified key to common soil insect larvae** (immatures before complete metamorphosis)

- 1a. Insect is a nymph, i.e., looks like a small adult but without mature wings, see adult insect key above
- 1b. Insect looks like a caterpillar or maggot
  - 2a. Spinneret on labium, thoracic legs and abdominal prolegs usually present, usually with crochets (curved hooks) on prolegs, antennae in 3 segments: Order Lepidoptera (moths)
  - 2b. Not as above
    - 3a. Head is a sclerotized (hard) capsule, legs usually present: Order Coleoptera (beetles)
    - 3b. Head not very sclerotized, legs usually absent
      - 4a. Mouthparts reduced to hooks, body cylindrical: Order Diptera (flies)
      - 4b. Well sclerotized mouthparts or body U or C shaped: Order Hymenoptera (ants, wasps)

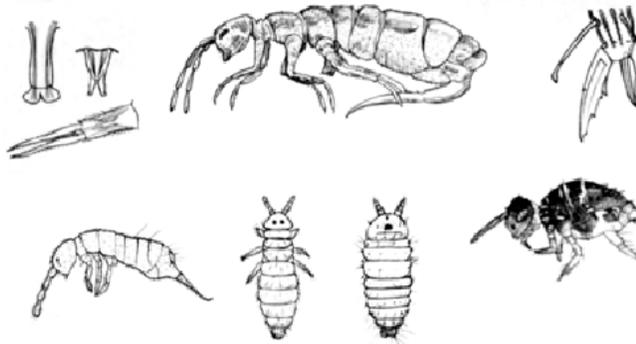
**References consulted:**

- Arnett, R. H. 2000. American insects: a handbook of the insects of America north of Mexico. CRC Press Boca Raton, FL.
- Borror, D. J., C. A. Triplehorn, and N. F. Johnson. 1989. An introduction to the study of insects. Saunders, Philadelphia.
- Borror, D. H., and R. E. White. 1970. A field guide to insects of America north of Mexico. Houghton Mifflin Company, Boston.
- Brusca, R. C. and G. J. Brusca. 1990. Invertebrates. Sinauer, Sunderland, Massachusetts.
- Chu, H. F. 1949. How to know the immature insects. Wm. C. Brown Company, Dubuque, Iowa.
- Coleman, D. C., and D. A. Crossley. 1996. Fundamentals of soil ecology. Academic Press, New York.
- Dindal, D. L. (ed.). 1990. Soil biology guide. John Wiley & Sons, New York.
- Essig, E. O. 1926. Insects of western North America. Macmillan, New York.
- Moldenke, A. 199?
- Peterson, A. 1960. Larvae of insects, part 2. Self-published, Columbus, Ohio.
- Peterson, A. 1962. Larvae of insects, part 1. Self-published, Columbus, Ohio.
- Powell, J. A., and C. L. Hogue. 1979. California insects. University of California Press, Berkeley.
- Stehr, F. W. 1987. Immature Insects. Kendall Hunt, Dubuque, Iowa.

Pictures of some common soil microarthropods



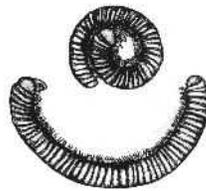
Centipede



Collembola



Isopoda



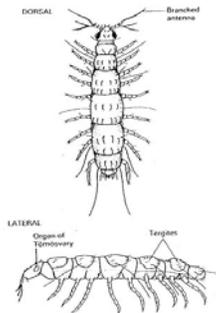
Millipede



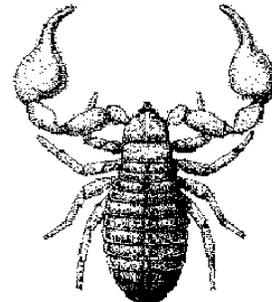
Opiliones



Oribatid mite



Pauropoda



Pseudoscorpion



Tick



Aranae



Symphyla