Exploring Patterns of Soil Organic Matter Decomposition with Students and the Public through the Global Decomposition Project (GDP)

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Background

- Soil organic matter (SOM) is important to local ecosystems because it affects soil structure, regulates soil moisture and temperature, and provides energy and nutrients to soil organisms.
- SOM is important globally because it stores a large amount of carbon, and when microbes decompose SOM they release greenhouse gasses (CO_2 and CH_4).
- Factors that control SOM decomposition can be examined using a common substrate (cellulose) decomposition experiment.

Objective

The objectives of **the Global Decomposition Project (GDP)** are to explore local and global patterns of decomposition, to educate students and the public about SOM and decomposition, and address these questions:

1. How do environmental conditions control decomposition of organic matter in soil?

2. Why do some areas accumulate organic matter and others do not?

Middle school students in California and Alaska work with researchers to compare decomposition rates.

Aerobic decomposition (i.e., decomposition that requires oxygen) is the same chemical process as respiration, in which organisms break down sugars to obtain energy:

$$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2 + \text{energy}$$

Protocol overview

Cellulose decomposition bags are made of cellulose paper enclosed in a screen mesh. The bags are placed in the ground for a set period of time, then removed and weighed to determine mass loss.

Supplies needed:

Deployment
1. Serrated knife
2. Trowel
3. Flagging
4. Decomp. bags

Processing
1. Oven
2. Paint brushes
3. Tweezers
4. Scale

Figure 1. Installing decomposition bags.

Field deployment

- Insert bag by cutting 10 cm deep and 10 cm wide slit in ground (Fig. 1a)
- Open the slit (Fig. 1b) and insert bag (Fig. 1c)
- Close the opening in the soil with your hands (Fig. 1d)
- After 1-12 weeks (see protocol for times for your region) remove bag

Processing the Bags

- Wash bags in water to remove soil attached to the outside the screen
- Dry the bags (with filter paper still inside) at 60^0 C for 48 hours, or at room temperature in a dry location until the bags are no longer losing water
- Open each bag, remove the filter, and use a paintbrush and tweezers to clean soil from the filters before weighing them (Fig. 2).

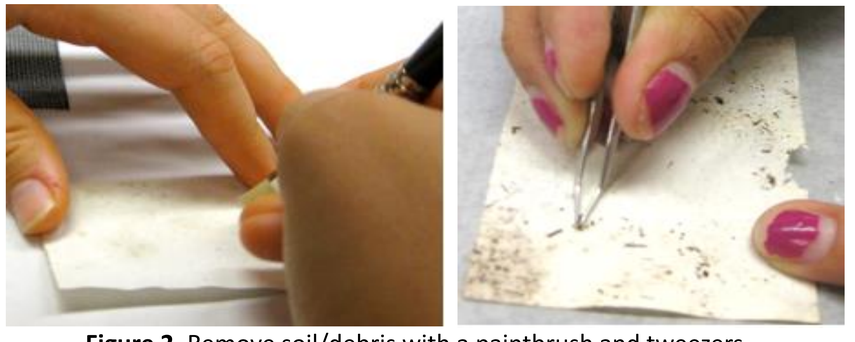

Figure 2. Remove soil/debris with a paintbrush and tweezers.

Weigh the cellulose paper, and calculate percent mass loss:

% mass loss = [(initial paper weight – final paper weight)/initial paper weight] * 100

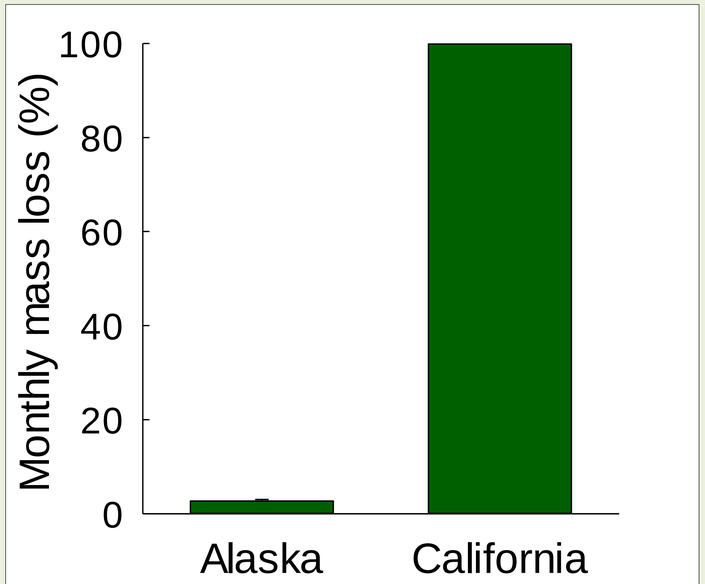

Figure 3. Decomposition rates vary strongly across regions as exemplified by decomposition experiments conducted in Alaska and California.

Future directions

- Conduct decomposition experiments in locations across the globe
- Share and display data using an interactive online map and data visualization tools
- Create a forum for ideas, lesson plans, and extensions of the base protocol to address questions of local interest such as:
  1. How do different materials vary in their decomposition rates?
  2. How does experimental soil warming, drying, wetting, fertilization affect decomposition?
  3. How do decomposition rates vary across local ecosystem types or soil conditions?

Send data and address questions to snatali@whrc.org. Data will be archived and once a critical mass is obtained will be posted as a database and an interactive map. Cleaned filter papers and soil samples (only U.S. samples) can be mailed to: **Global Decomposition Project, c/o Sue Natali, Woods Hole Research Center, 149 Woods Hole Road, Falmouth, MA 02540**