ANNUAL DECAY RATES

AIM

To monitor the annual decay rate in soil using protocols developed by the Pacific Forestry Centre, Canadian Forestry Service.

RATIONALE

Measuring decay rate allows tracking changes in soil health and basic soil processes such as respiration and productivity. Climate change can have considerable impacts on soil processes as rates of decomposition are influenced by changes to temperature and moisture regimes. Increases in temperature through global warming can increase the rate of decay in soils, releasing more carbon dioxide, which then contributes to global warming. Tracking decomposition in soils will provide information on the impacts of climate change to soil health and productivity in Canadian forests.

BACKGROUND

For forest vegetation, the intake of carbon and nutrients is essential to survival. Once a plant dies it then undergoes decomposition, which is the process of breaking down organic matter and the subsequent release of gases and nutrients. The nutrients held within a plant become available for uptake by living vegetation. Decomposition also releases carbon dioxide into the environment. Rates of decay can be influenced by many factors including climate, temperature, moisture, substrate type, nutrient concentrations and availability, litter type and size, and soil organisms.

Changes in decay rates are associated with climate change effects. Increases in atmospheric carbon dioxide are thought to contribute to global warming and climate change. The vegetation, soils, wetlands and organic litter in temperate forests can house large amounts of carbon. An increase in temperature could increase the rate of decomposition, which would then cause an accelerated release of carbon into the atmosphere, thereby contributing to global warming and climate change. This positive correlation is a concern in predicting changes to forest systems and poses many problems for the management of forested areas. Many researchers have stated that there is a lack of specific information on rates of decay in Canadian ecosystems. There has also been elevated concern with regards to the impact of climate change on northern forests. Improving our knowledge of decomposition in Canadian ecosystems can allow for a better understanding of the impacts of climate change and better management practices for our forests.

CHECKLIST OF MONITORING ACTIVITIES

- Complete site description datasheet and mark exact location;
- Deposit wooden chopsticks;
- Retrieve wooden chopsticks one year later;
- Record data and manage data sets;
- Send copy of data to EMAN office for regional, provincial and national comparisons.

EQUIPMENT

Site establishment data sheet
Drying oven and Desiccator
8 pairs of aspen chopsticks
drill
20 Aluminium tags
Pen
Flagging tape
Trowel/small shovel
Rate of decay data sheet
Scale (accurate to 3 decimal places)
4x 50 cm Metal "Pigtails" (poles)
compass or Stakes
Plastic sheet / Garbage bag

LOCATION

Sites need to be easily accessible and free of hazards. In all cases once a site is chosen, *site description datasheets should be filled out*. Sampling stations within each site should be plotted on a site map. Photographs of the site may also be useful in describing the sample area. Decay rate protocols can be carried out in urban areas, natural areas or as part of a Forest Biodiversity Plot.

Natural areas

Select and clearly define a suitable location for monitoring within a site that will continue to be accessible in future years.

Determine the exact latitude and longitude of the monitoring station using a central reference point. If available, use a GPS system with approximately 1m accuracy. Alternatively, one or more topographic maps such as the 1:50,000 NTS (National Topographic System) covering the site(s) can be used to determine precise coordinates (latitude and longitude). Another option is to use the following search tool provided by Natural Resources Canada (http://geonames.nrcan.gc.ca/).

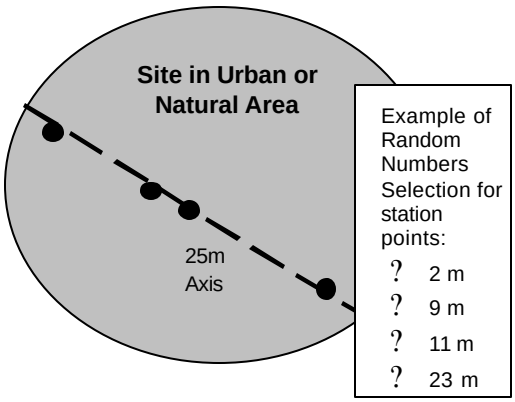

Figure 1. Random point selection for decay rate stations

When you receive the search results, click on the place name to view additional data including, latitude and longitude.

Within the station select 4 random points, avoiding visible rocks and logs. Random sites can be selected through random sampling along an axis (see figure 1). None of the points should be located closer than 50 cm to a tree. Fill in the point location and description information on the Decay Rate data sheet.

Forest Biodiversity Plots

When associating decay rate with Forest Biodiversity Plots, sampling stations should be located outside the plot according to the forest monitoring station design in Figure 2. Locating decay rate inside the plot would result in increased traffic in the area under study . Avoid visible rocks and logs when plotting decay rate points and none of the points should be located closer than 50 cm to a tree. Make sure to fill in the point location and description information on the Decay Rate data sheet.

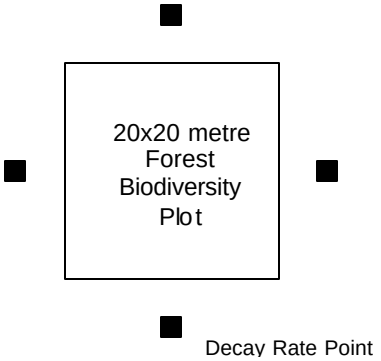

Figure 2. Forest Biodiversity Plot station design with decay rate points.

SAMPLING METHODS

Timing

The placement of the aspen chopsticks should be done during the autumnal litter fall, no later than the 1st of November or the first snowfall. Remove the chopsticks exactly one year from the placement date. After removal, insert new aspen chopsticks for removal the following year.

Aspen Chopstick Placement

- Prepare 8 pairs of Japanese style aspen chopsticks (20.4 cm long, tapering from 1.2 cm to 0.7x0.4 cm). These chopsticks are joined at one end, designed to be split. Contact EMAN CO (eman@ec.gc.ca) for information on where to order chopsticks.
- Oven dry the chopsticks at 70°C (158°F) overnight, place in a desiccator, and allow to stand at room temperature for 24 hours.
- Split each pair of chopsticks and drill 2mm holes at the end of each chopstick.
- Weigh each chopstick on a 3 decimal place balance (0.001g) and record the weights on the Decay Rate data sheet.
- Attach an aluminium tag to each chopstick through the predrilled holes using wire or strong fishing line. Chopsticks will then be labelled in 4 groups of 4; each tag should

display the station number and the unique chopstick number (for example: "1A, 1B, 1C, 1D; 2A, 2B etc).

- At each station move aside the surface litter from an area approximately 25 x 25 cm. Within this area dig a small trench the width of your hand, 3 to 5 cm deep and long enough to hold the chopsticks.
- Lay chopsticks 1B and 1C in the bottom of the trench. Lay chopstick 1A and 1D directly on the soil surface on each side of the trench (see Figure 1). Be sure to separate chopsticks that were pairs. Standing grass or thick layers of lichens and/or low vegetation should be displaced or cut so that the chopstick can be placed directly on organic or moss layers.

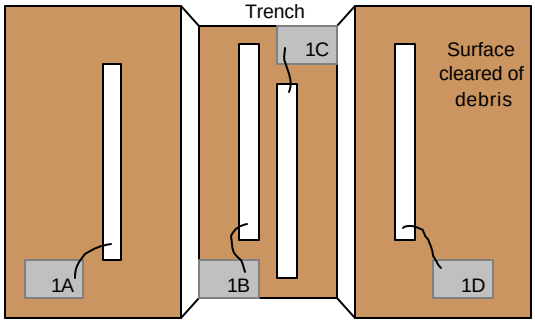

Figure 1. Placement of chopsticks in soil.

- Replace the surface litter ensuring that the tags are hidden as they may be attractive to rodents, birds and children. Fill in the trench with the excavated soil. Do this for each of the four stations.

In order to ensure that you can find the chopsticks the following year, label and flag a metal pigtail and insert it 10 cm to the north of the chopsticks. Or you can place a large metal or wooden stake directly north of the trench and mark the stake with flagging tape and a tag.

Record the date of placement and location of all stations.

Data Collection

When digging up the chopsticks in the trench, careful attention is required to ensure that all pieces that may have broken off are collected. Carefully place all dug materials on a plastic sheet or garbage bag. Go through the materials and remove the chopstick or chopstick pieces.

Put each individual chopstick with its aluminium tag into a small plastic bag and record the date of collection and repeat Aspen Chopstick Placement procedures with new aspen chopsticks for next year's collection.

Immediately after collection gently brush the chopsticks with a soft paintbrush to remove any adhering material. If necessary do this with the chopstick in a pan of distilled water. After materials are removed, place the collected chopsticks with the tags attached onto a cookie sheet and oven dry the chopsticks at 70°C (158°F) overnight to stabilize the samples and prevent further microbial growth.

Place in dessicator and allow to stand at room temperature for 24 hours. Remove the aluminium tags and weigh each chopstick, recording its weight to 0.001 grams.

DATA ANALYSIS

Compare the decayed rate of aspen chopsticks to their original weigh and express results as % mass remaining or % mass loss. Use station values as replicates for the plot to calculate the mean and standard error in % mass loss for the stands. The results can be charted over time in order to detect trends in soil decay rate.

DATA MANAGEMENT AND SHARING

Hard copies of the data should be kept in an appropriate area for future use. Submit hard copies of the data sheets or electronic copies (preferred) to the Environmental Monitoring and Assessment Network (EMAN) in order to allow for regional, provincial and national comparison of decay rates and soil health.

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EMAN Coordinating Office
Canada Centre for Inland Waters • 867 Lakeshore Road • Burlington • Ontario • L7R 4A9
Phone: 905 336 4414 • Fax: 905 336 4499 • Email: eman@ec.gc.ca

REFERENCES

Elliott, W.M., N.B. Elliott, and R.L. Wyman. 1993. Relative effect of litter and forest type on rate of decomposition. Am. Midl. Nat. 129(1):87-95.

Trofymow, J.A., G.L. Porter, B.A. Blackwell, R. Arksey, V. Marshall, and D. Pollard. 1997. Chronosequences for research into the effects of converting coastal British Columbia old-growth forests to managed forests: an establishment report. Nat. Resour. Can., Can. For. Serv., Pac. For. Cent., Victoria, B.C. Inf. Rep. BC-X-374. http://www.pfc.forestry.ca

Trofymow, J.A., CIDET Working Group. 1998. The Canadian Intersite Decomposition Experiment (CIDET): Project and site establishment report. Nat. Resour. Can., Can. For. Serv., Pac. For. Cent., Victoria, B.C. Inf. Rep. BC-X-378. http: //www.pfc.cfs.nrcan.gc.ca/climate/cidet

Environment Canada Environnement Canada

Canadian Forest Service Service canadien des forêts

ANNUAL DECAY RATES DATA SHEET

SITE INFORMATION

SITE NAME:	NEAREST NAMED PLACE:	
OBSERVATION AREA DESCRIPTION (FOREST/WETLAND):		
LATITUDE/LONGITUDE:	COUNTY /TOWNSHIP:	PROVINCE:
OBSERVER NAME(S):	OBSERVER ADDRESS: TELEPHONE: EMAIL:	

PLOT:

CHOPSTICK NUMBER	ORIGINAL WEIGHT (3 DECIMAL PLACES)	LOCATION (ALONG AXIS OR IN PLOT)	DATE LAID	DATE COLLECTED	WEIGHT AFTER COLLECTION (3 DECIMAL PLACES)