The Effect of Mesh Size on Litter Decomposition Rates in Northern Hardwood Forests

Brianne Innusa, Rick Biche, Alexander Young, Ruth Yanai

How do nitrogen, phosphorus, stand age, soil fauna, and litter species composition affect rates of litter decomposition?

An experiment conducted from 2012 to 2014

by Rick Biche
and two cohorts of students from
A. Crosby Kennett Middle School

Experimental Variables

- **Variables:** Litter species composition, stand age, fertilizer treatments, mesh bags
- **Litter Composition**: Fresh leaf litter from these 4 stands was collected from suspended hammocks to create litter composition mixes representative of these stands.

	2 Young Stands (Harvested 1985-1990)	2 Old Stands (Harvested (1883-1890)
Species	American beech (*Fagus americana* Ehrh.) white birch (*Betula papyrifera* Marsh.) pin cherry (*Prunus pensylvanica* L.) red maple (*B. alleghaniensis* Britt.)	American beech sugar maple (*Acer saccharum* Marsh.) yellow birch

Experimental Variables

- **Fertilizer Treatments**
  - Control (untreated)
  - Nitrogen (30 kg N/ha/yr as NH_4NO_3),
  - Phosphorus (10 kg P/ha/yr as NaH_2PO_4)
  - Nitrogen + Phosphorus (30 kg N/ha/yr + 10 kg P/ha/yr)
- **Litter Bag Assembly**
  - 10 cm x 10 cm
  - Small mesh: 63 µm nylon mesh top and bottom, microfauna
  - Large mesh: 2 mm mesh of rigid plastic on top, small nylon mesh on bottom, macrofauna, mesofauna, microfauna

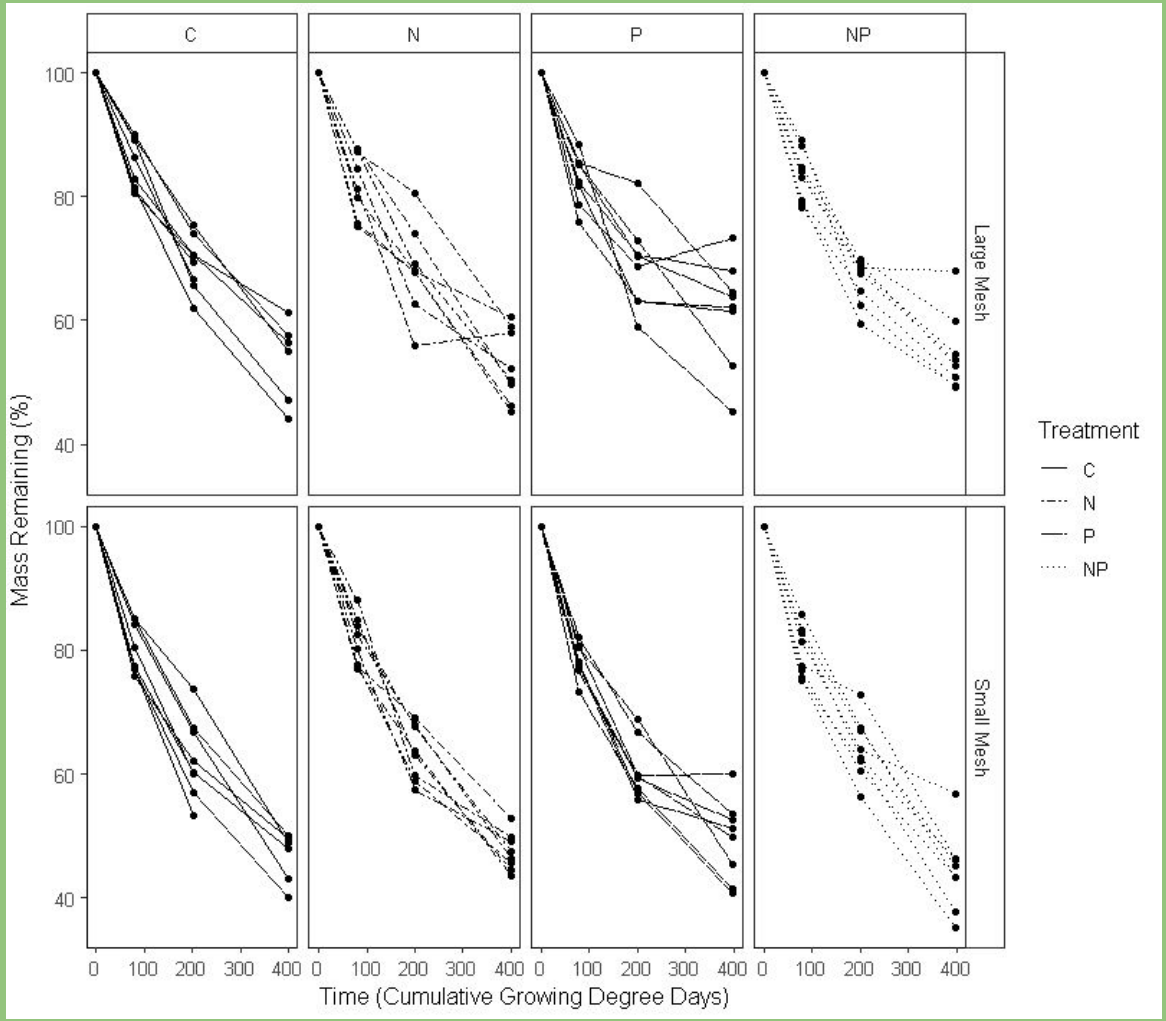
Methods

- **Litter Deployment:** Litter bags were randomly placed in treatment plots
    - Stapled to the ground with wildlife netting and placed on top of existing litter.
- **Litter Bag Removal:** June 2013, October 2013, and September-October 2014
    - litterbags were randomly chosen from each plot, cleaned of roots, and weighed.

Data Analysis Methods

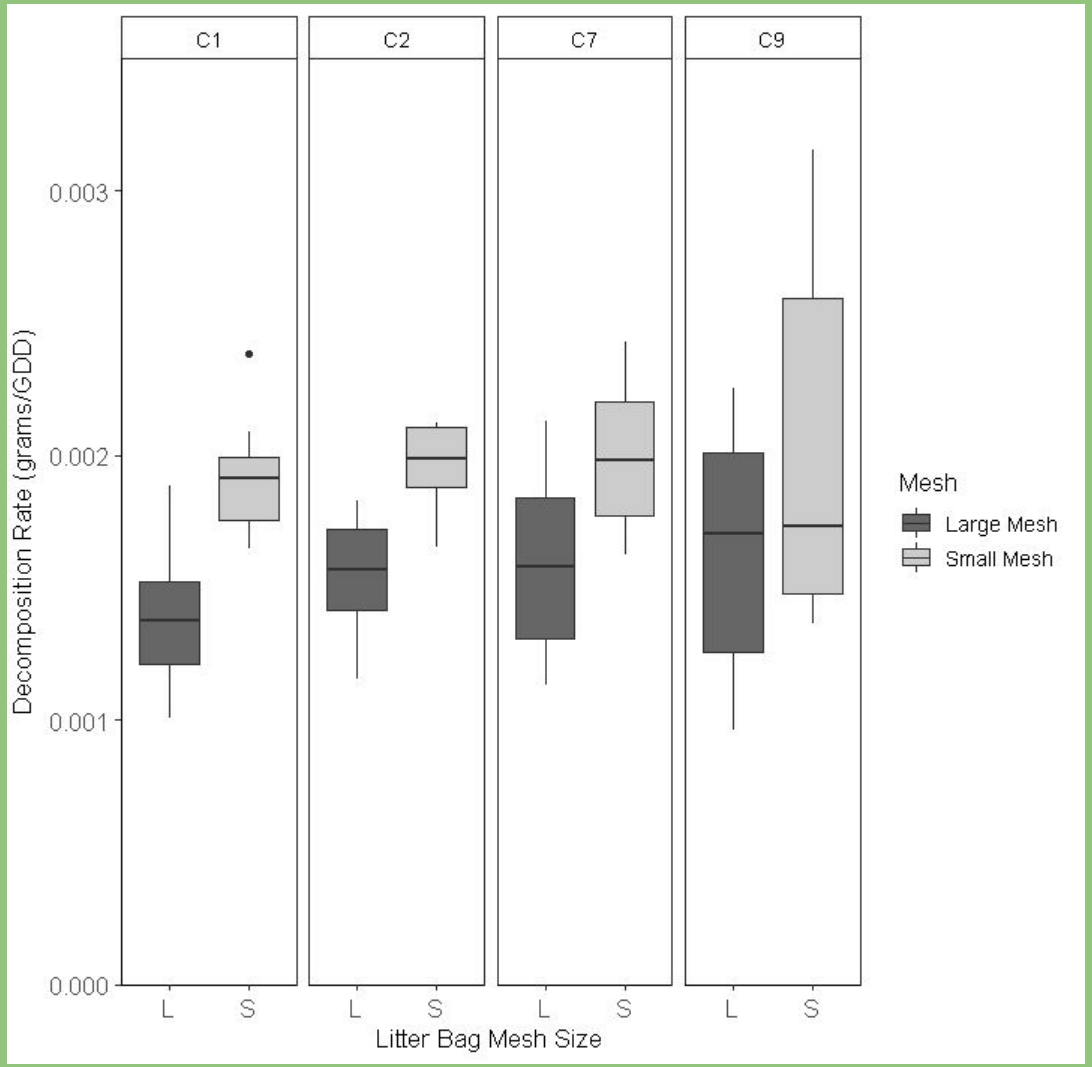
- Mass loss of leaf litter was determined at 79, 201, and 399 cumulative growing degree days (soil temperature ≥ 5℃).
- The rate of decay = log of percent mass remaining against cumulative growing degree days
- Stand age, nutrient additions, and litter composition did not improve the model (AIC, R-squared, Shapiro-wilk) and were insignificant (ANOVA)
- An ANOVA and Tukey’s post-hoc test was used to compare the means of each variable and determine the magnitude of change and significance

Results


C
N
P
NP
Large Mesh
Small Mesh
Mass Remaining (%)
100
80
60
40
0
100
200
300
400
Time (Cumulative Growing Degree Days)
Treatment
C
N
P
NP

Results

Experimental Variable	P-Value
Stand Age	0.47
Litter Composition	0.73
Nitrogen Treatment	0.70
Phosphorus Treatment	0.21
Nitrogen + Phosphorus	0.07
Mesh Size	<0.0001



Findings

- Microfauna may have decomposed leaf litter faster due to predator exclusion and their ability to break down lignin.
- **Fertilization**: The fertilization of N,P, and N+P is presumed to have no significant effect because of how early the nutrient loading was in the environment.
- **Method Flaw**: Jenna noted that upon litter bag removal, large mesh bags were less compressed than small mesh bags.
    - The rigid plastic of the large mesh bags prevented folding and foliage breakup while the nylon mesh of the small bags allowed the bags to crumple and break apart.
- **Future Study:** A continuation of this study should keep the mesh material consistent to confirm if microfauna affect litter decomposition

Acknowledgements

- The 100 students at A. Crosby Kennett Middle School
- NSF Grant Proposal # DEB 0949324
- Supplement by RET 2013 (1314909)
- Hubbard Brook Research Foundation RET 2012
- State University College of Environmental Science and Forestry
- Multiple Element Limitation in Northern Hardwood Forests lab (MELNHE)