Soil Nutrient and Organic Matter Responses to Fire, Harvesting, and Salvage logging in the Chisholm Fire

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Questions to be Addressed:

1. Which sites are more productive from a nutritional standpoint – harvested or burned?

2. What are factors responsible for differences in nutrient availability?
Objectives

1. To identify properties of forest floor, mineral soil, and foliar nutrition under different types of disturbances

2. To identify the role of saproxylic beetle and bryophyte communities in the turnover of nutrients
Four Studies

Forest floor, mineral soil, and foliage properties

Fine woody debris decomposition

Bryophytes and fine woody debris decomposition

Saproxylic beetles and coarse woody debris decomposition
Research plots established in 2001 and 2002

Two stand types
  Mixedwood
  Spruce

Four treatments
  Burned
  Salvage logged
  Harvested
  Control

Three replicates

Total of 24 sites
Forest Floor, Mineral Soil, Foliage Properties
Forest Floor and Mineral Soils

At each of the 24 sites

Grid established
Forest floor and soil sampled at each point
Physical and Chemical Analyses

Physical properties
- Depth, mass, bulk density

Chemical properties
- pH, total and extractable N (ammonium and nitrate), C, P, S, exchangeable cations (K, Ca, Mg, Na), cation exchange capacity
Statistical Analyses

Tested for normality and homogeneity

Analysis of variance

Separation of means using Tukey or Tukey Kramer’s test

Bonferroni correction
Forest Floor Properties

Control

Burned

Harvested site

Salvage logged
Forest Floor Properties

Physical properties of interest:
  Depth, mass, bulk density

Chemical properties of interest:
  Calcium, magnesium, carbon, pH, CEC

No consistent effects across disturbances
Mineral Soil Properties

Physical properties of interest:
  Bulk density

Chemical properties of interest:
  Calcium, magnesium, carbon, pH, CEC

No consistent effects across disturbances
Foliage

Regenerating aspen foliage from mixedwood stands

Leaves collected in 2003

Nutrient concentration variable

No consistent effects
Fine Woody Debris
Experimental design:

Same sites as the ones chosen for soils (24 sites)
Harvested and Salvage logged

Treatments

< 20m

20m

p11

p10

p13

p09

p14

p08

p16

p15

p07

p06

p01

p05

p02

p04

p03

50m buffer

50m buffer

fine woody debris

intact

fragmented

x 2
Chemical analyses
Similar to the ones shown previously but done on woody debris

Statistical analyses
Similar to the ones shown previously
Chemical properties of interest over years:

Intact woody debris
  Carbon and available phosphorus decreased
  Ammonium nitrogen increased

Fragmented woody debris
  Carbon decreased

Intact vs fragmented woody debris:
  Total nitrogen and exchangeable calcium lower in fragmented woody debris than in intact woody debris
  Ammonium nitrogen greatest in small, fragmented woody debris compared to large class size and intact debris
Chemical properties of interest among treatments:

Ammonium nitrogen (P = 0.09)
Control was higher than the three disturbance treatments
Presence of mosses on control plots
Bryophyte and Fine Woody Debris
On one burned site:
High moss/debris
Low moss/debris
High moss/no debris
Low moss/no debris

Three replicates
Chemical analyses
Similar to the ones shown previously but done on soil and woody debris

Statistical analyses
Similar to the ones shown previously
Chemical properties of interest over one year:

Fine woody debris
   Carbon decreased
   Exchangeable calcium increased

Soil
   Exchangeable calcium increased

No moss effect as was speculated
Saproxylic Beetles and Woody Debris
Logs inoculated with 0, 2, 5, 8 or 10 beetle larvae in enclosures

Four replicates

Control enclosures
Chemical analyses
Similar to the ones shown previously but done on soil

Statistical analyses
Similar to the ones shown previously
Chemical properties of interest:

- Total nitrogen
- Available phosphorus
Summary

- Effects of disturbances on soil properties were not consistent across wildfire, salvage-logged and harvest treatments.
- Changes in chemical composition of woody debris reflected decomposition over time, and was somewhat faster in fragmented debris.
- Disturbance types did not have major effects on decomposition of fine woody debris.
- Mosses did not affect decomposition of woody debris in one year.
- Beetle larvae affected soil nitrogen and available phosphorus.
Conclusions

Unexplained variability
Further research required to identify other driving variables