Fuel treatment effects in ponderosa pine and dry mixed conifer forests: 17 Years after the Fire-Fire Surrogate Study

May 31, 2018

NORTHERN ROCKIES FIRE SCIENCE NETWORK
A JFSP Knowledge Exchange Consortium
JOINT FIRE SCIENCE PROGRAM
Rocky Mountain Research Station
W.A. FRANKE COLLEGE OF FORESTRY & CONSERVATION
UNIVERSITY OF MONTANA

Restoring Ponderosa Pine/Fir Forests – The Fire/Fire Surrogates (FFS) Study

Context
Objectives
Hypotheses
Design
Treatments
Outcomes


POST
OFFICE


COLDWELL BANKER
MCCARTY REALTY
520-537-4321

Objective

Develop low-hazard, sustainable conditions in ponderosa pine/Douglas-fir forests.

Objectives (specific)

- Achieve “80”/“80” rule
- Increase Crowning Index
- Increase average DBH (QMD)
- Increase ratio of pine to fir
- Create conditions to regenerate pine

Hypotheses Underlying Restoration Approaches

<u>Control</u>: Forest ecosystems are best conserved by "hands off" management, with no direct manipulation of forest structure or process.

<u>Burn-only</u>: Forest ecosystems are best conserved by restoring ecosystem processes (i.e., reintroducing fire).

<u>Thin-only</u>: Forest ecosystems are best conserved by restoring ecosystem structure (i.e., thinning/selection cutting).

<u>Thin-and-Burn</u>: Forest ecosystems are best conserved by restoring both structure and process (i.e., thinning and burning).

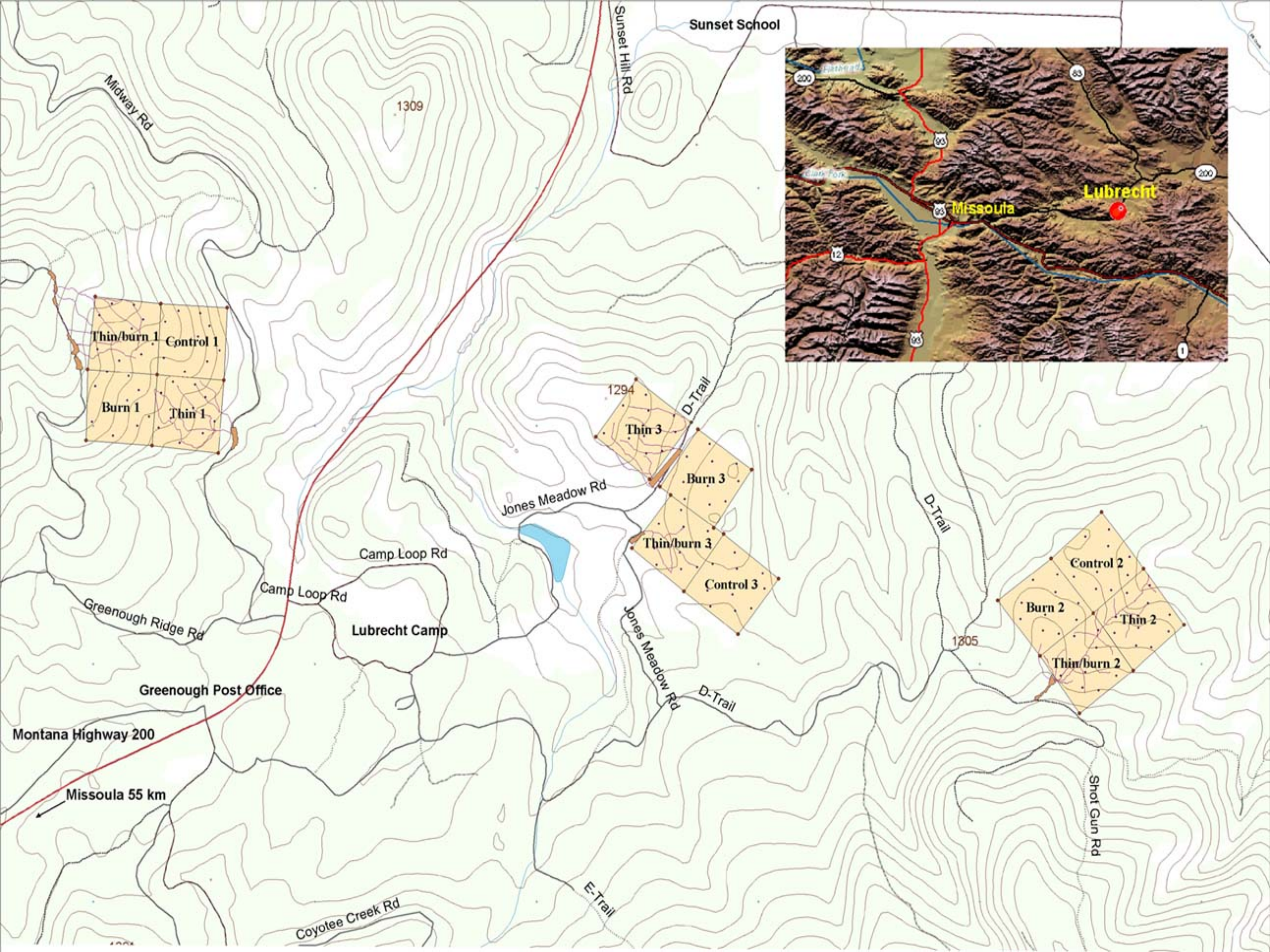
Treatments Evaluated

- **Control** (no treatment, ~ 23 m^2/ha; 105 ft^2/ac existing basal area at beginning of study)

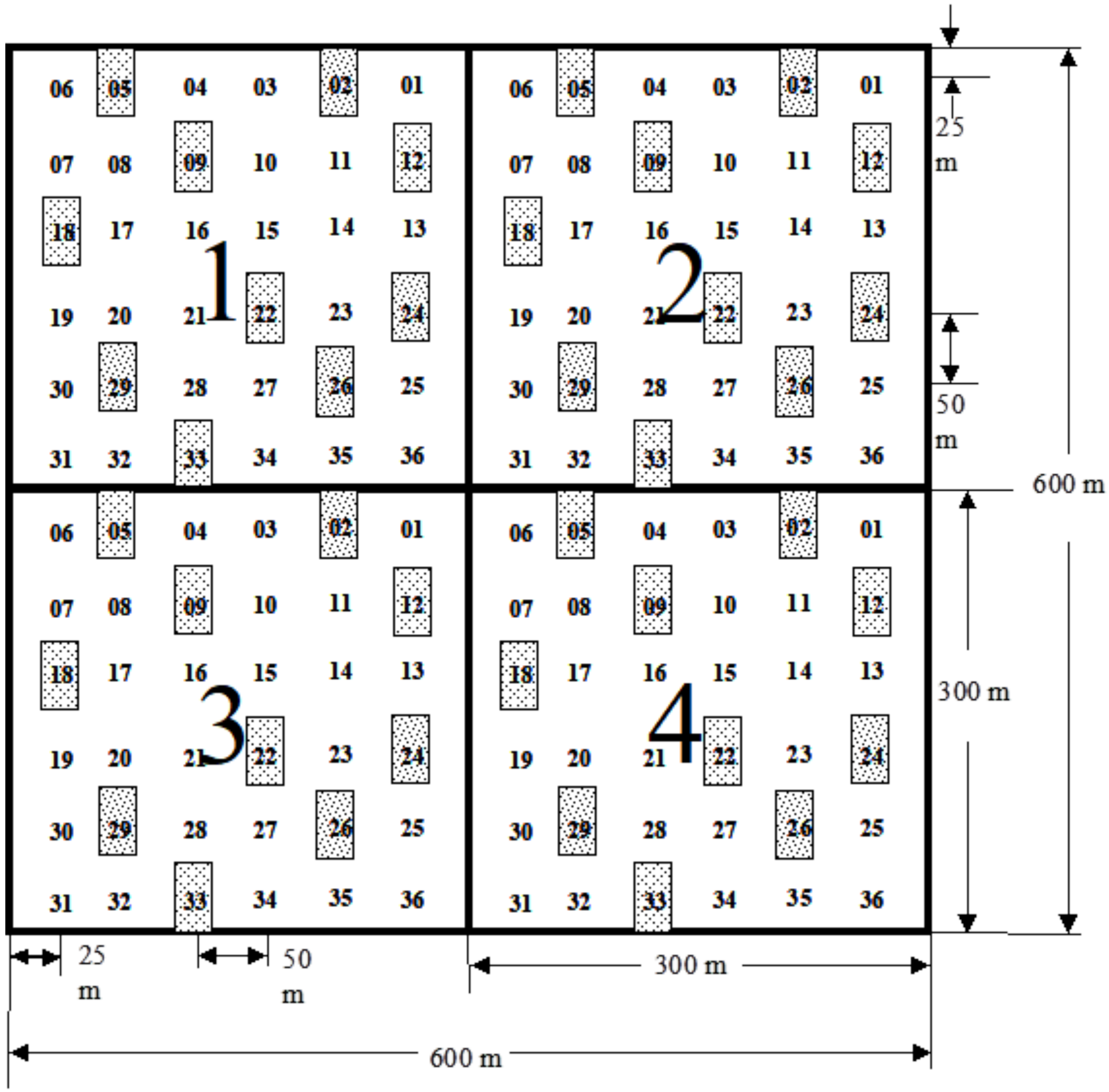
- **Burn-only** (spring burn, no reserve basal area target)

- **Thin-only** ("thin" to 11 m^2/ha; 48 ft^2/ac reserve basal area, PP>WL>LP>DF)

- **Thin-burn** ("thin" to 11 m^2/ha; 48 ft^2/ac reserve basal area, PP>WL>LP>DF, spring burn)



Sunset School
Sunset Hill Rd
Midway Rd
1309
Flathead
200
93
83
Clark Fork
Lubrecht
Missoula
12
1
Thin/burn 1
Control 1
Burn 1
Thin 1
1294
D-Trail
Thin 3
Burn 3
Jones Meadow Rd
Thin/burn 3
Control 3
Camp Loop Rd
Camp Loop Rd
Greenough Ridge Rd
Lubrecht Camp
Control 2
Burn 2
Thin 2
Thin/burn 2
1305
Greenough Post Office
Montana Highway 200
Jones Meadow Rd
D-Trail
Missoula 55 km
Shot Gun Rd
E-Trail
Coyotee Creek Rd


1
2
3
4
25 m
50 m
600 m
300 m
25 m
50 m
300 m
600 m

Northern Rockies Fire / Fire Surrogate Study

Fuels and Prescribed Fire Summary

Mick Harrington (Retired)
Missoula Fire Science Lab


Fire Treatment

Fuels and Fire Behavior Initial Results

1. Even though pretreatment fuel loads were quite modest, sufficient fuel quantity and quality existed to cause severe stand impacts from wildfire burning under average worst fire weather and fuel moisture conditions.

2. Slash from the cut-to-length harvesting system used at this site was highly concentrated, potentially resulting in greater fire impacts during prescribed burning than with more uniform slash distribution.

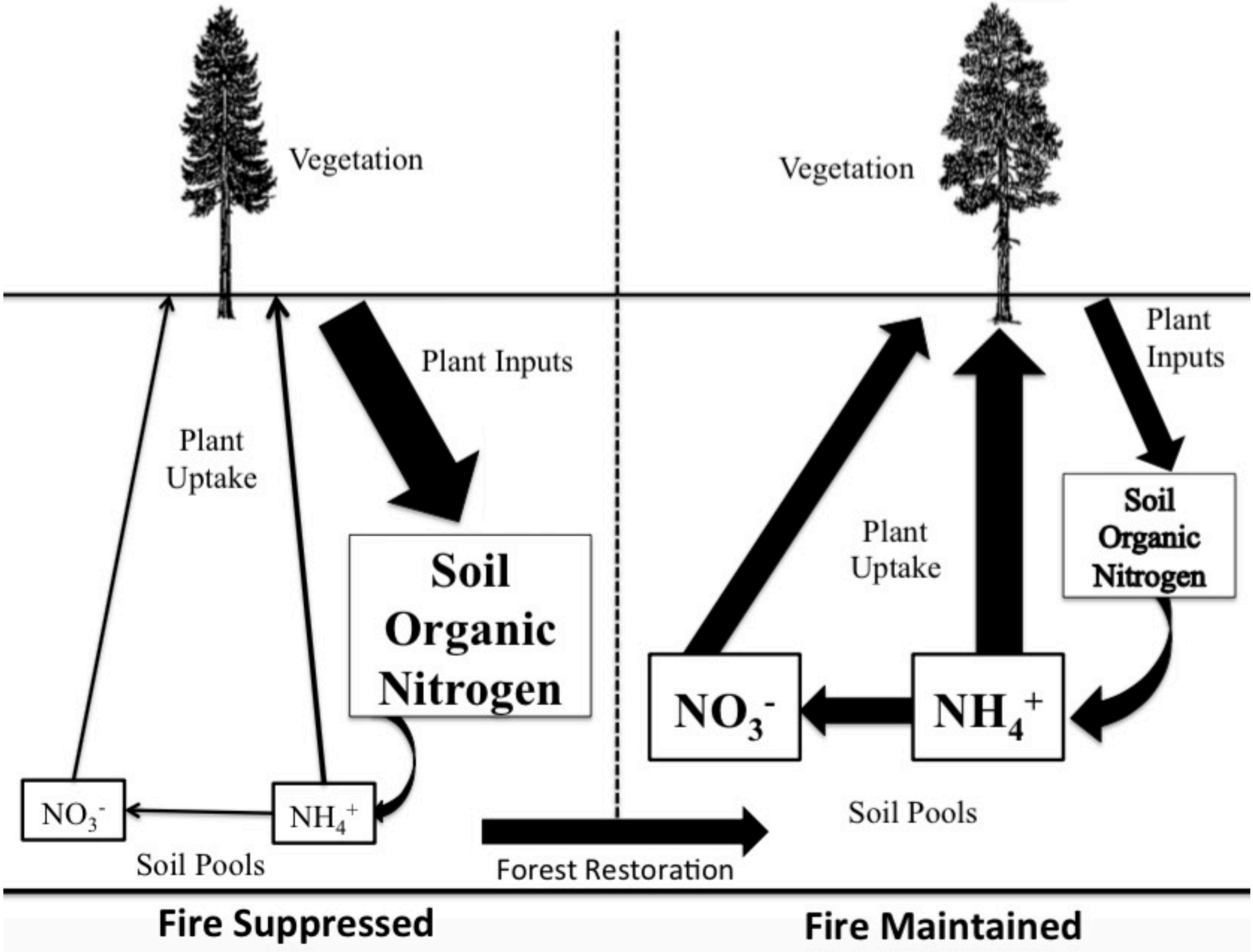
3. Prescribed burning in the burn-only treatments resulted in a significant decrease (50-75%) in surface fuel loading, but new fuels will accumulate rapidly from fire damaged trees.

Long- and short-term effects of FFS treatments on soils

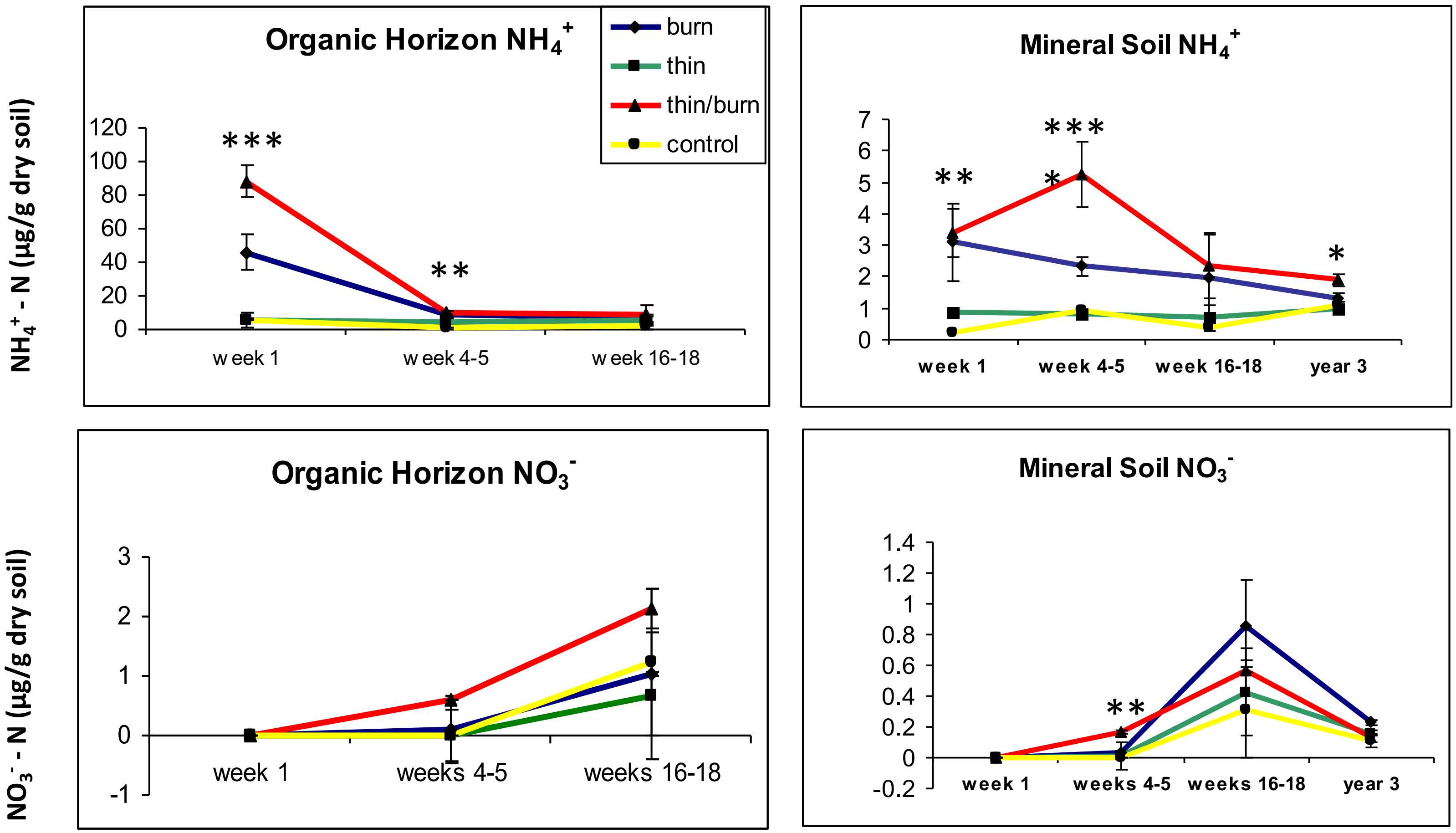
Tom DeLuca, short-term effects

Cory Cleveland, long-term effects

- Fires consume ~ 20% biomass
- N loss: 150 – 400 kg N ha^{-1}
  Forest floor, twigs, needles
- Mostly just N affected:
  - N volatilizes > 120^{o} C
  - S > 600^{o} C
  - P > 770^{o} C
  - K, Mg, Ca > 900^{o} C
  - Slight increase in pH


Vegetation
Plant Inputs
Plant Uptake
Soil Organic Nitrogen
NO_3^-
NH_4^+
Soil Pools
Forest Restoration
Vegetation
Plant Inputs
Plant Uptake
Soil Organic Nitrogen
NO_3^-
NH_4^+
Soil Pools
Fire Suppressed
Fire Maintained

FFS NH_4^+ and NO_3^- Response



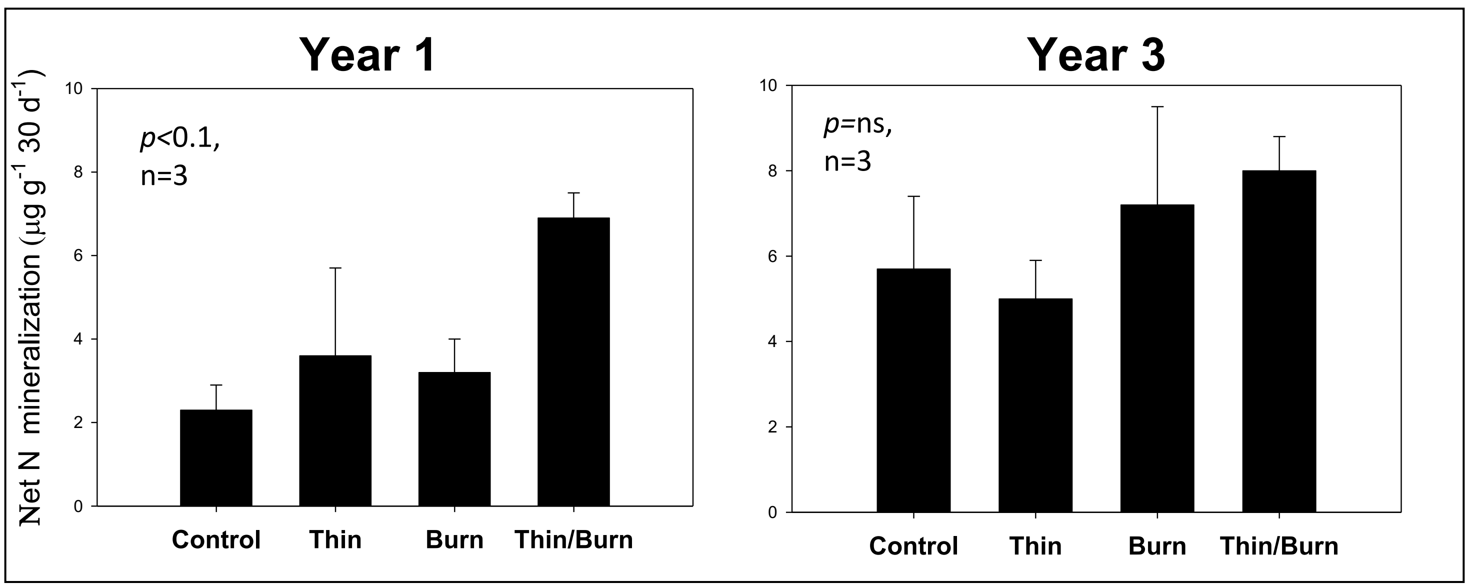
p-value: * < 0.1, ** < 0.05, *** < 0.01, **** < 0.001; One-way ANOVA (df=11,3) or Kruskal-Walis (df=3), n=3

Gundale et al. 2005

Net Mineralization

Net N mineralization

Organic N $\xrightarrow{\text{ammonification}}$ NH_4^+ $\xrightarrow{\text{nitrification}}$ NO_3^-

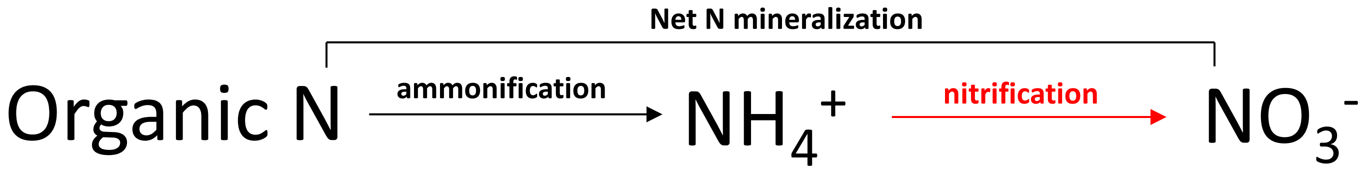


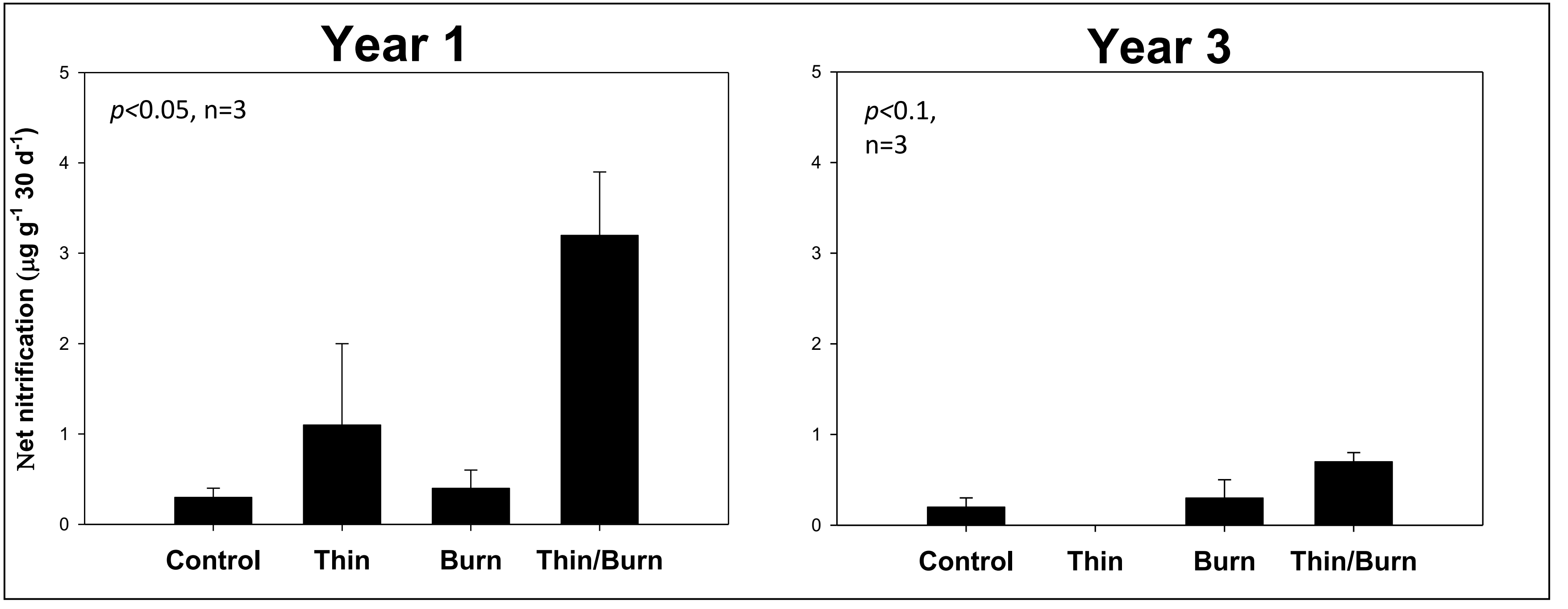
Year 1: Blocked ANOVA (df=11,2,3)

Year 3: One-way ANOVA (df=11,3)

Gundale et al. 2005

Net Nitrification





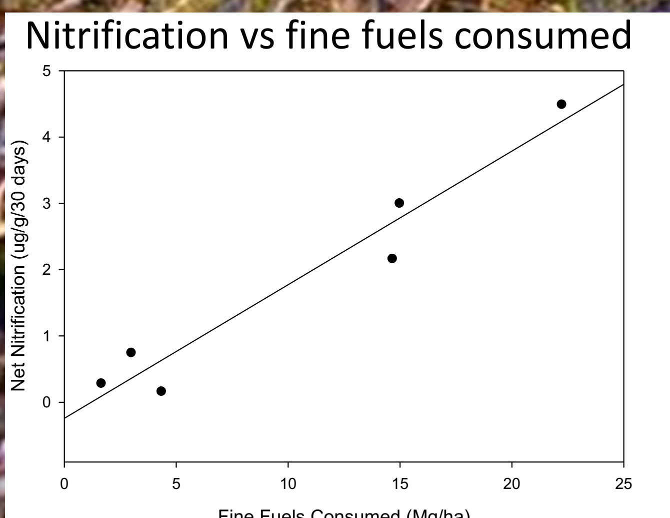
Year 1: One-way ANOVA (sqrt) (df=11,3)

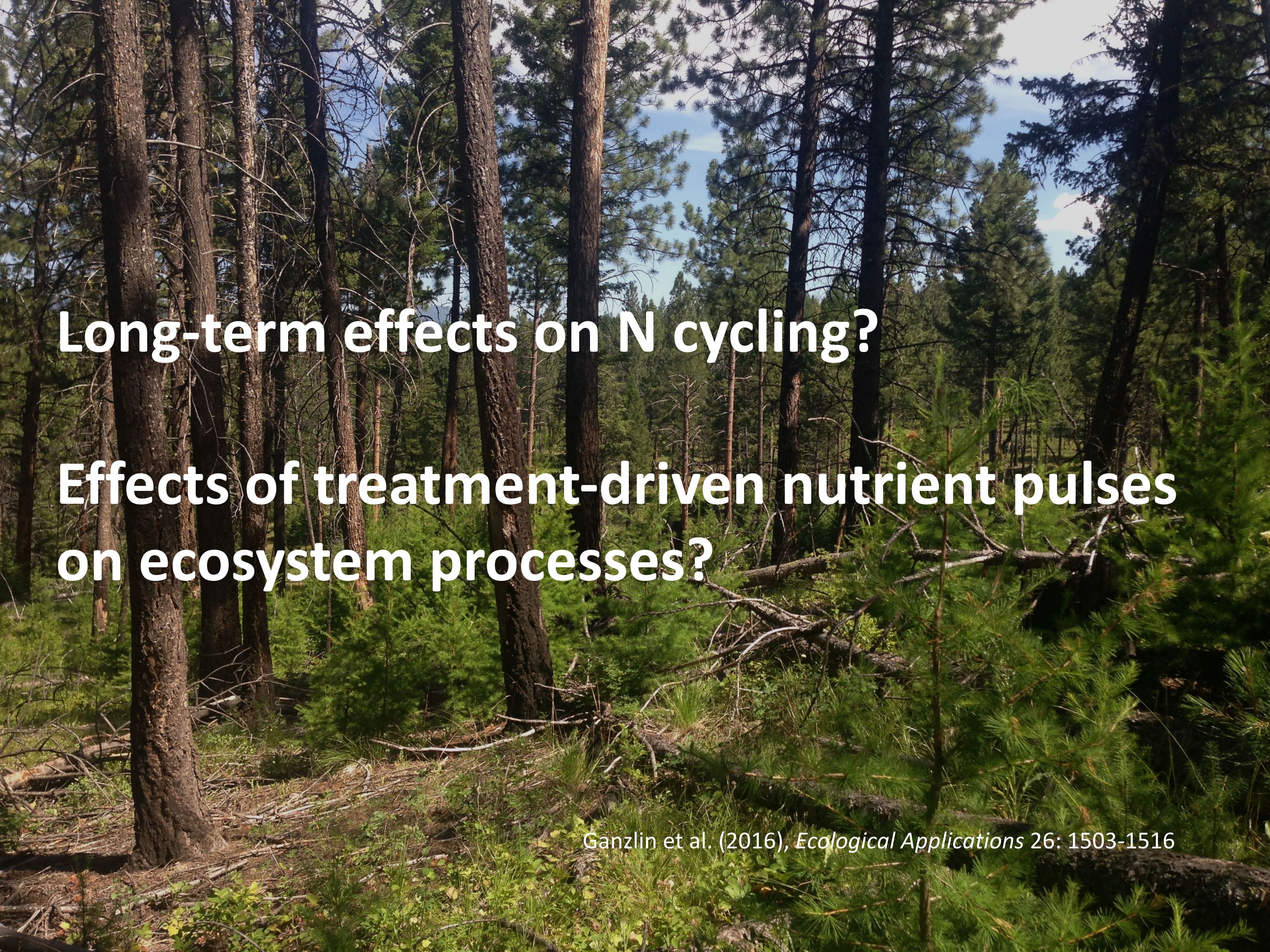
Year 3: One-way ANOVA (df=11,3)

Gundale et al. 2005

Short-term effect on N Cycling

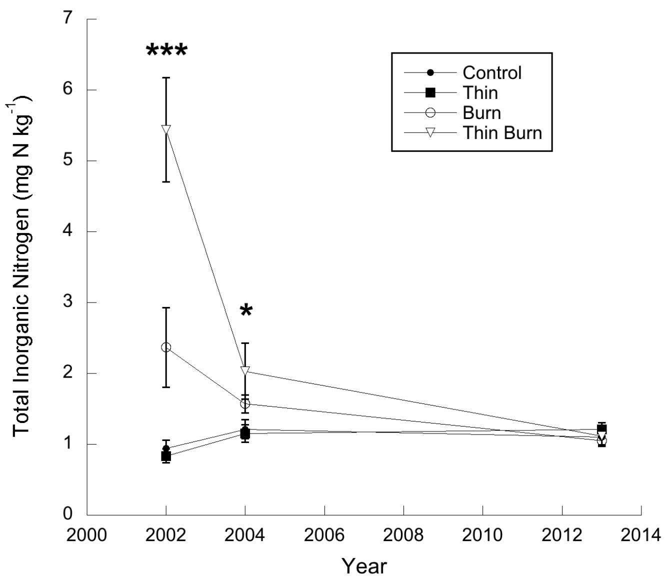
- Trt effect: Thin/Burn > Burn >> Thin and Control
- Fire stimulates N cycling
- Role for Charcoal?

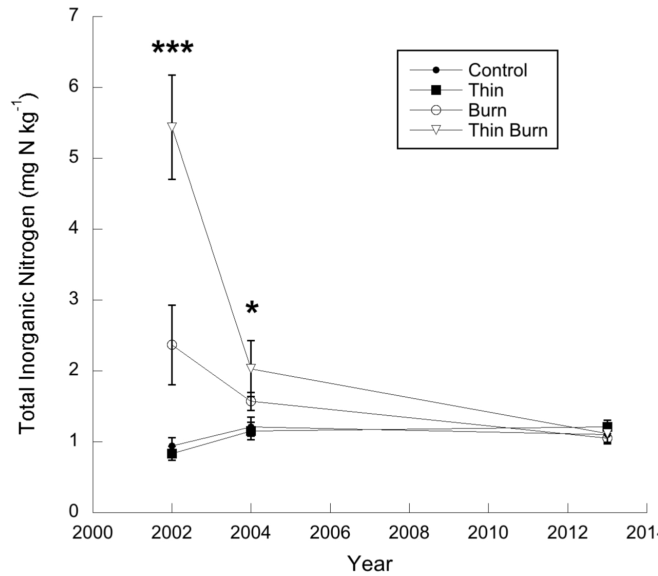


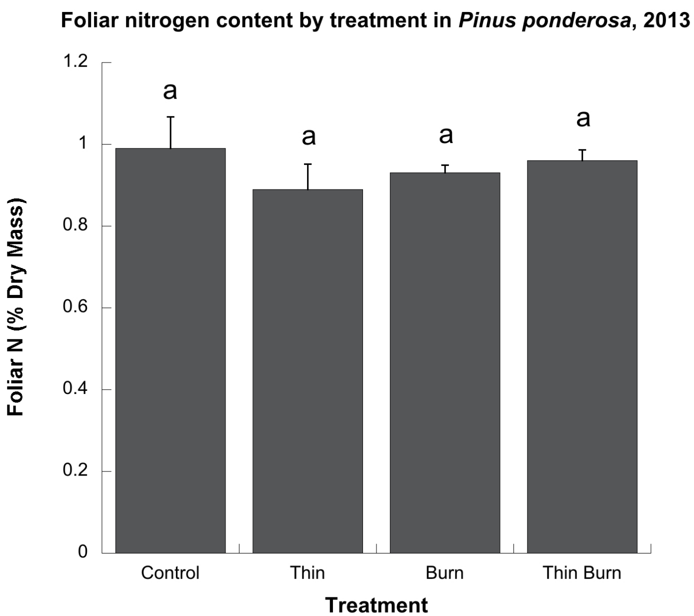

Long-term effects on N cycling?
Effects of treatment-driven nutrient pulses on ecosystem processes?
Ganzlin et al. (2016), *Ecological Applications* 26: 1503-1516

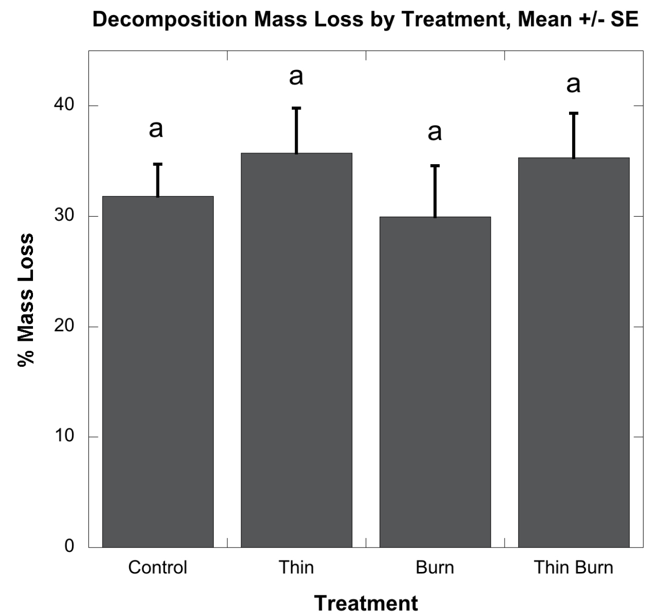

MONTANA
GRIZZLIES

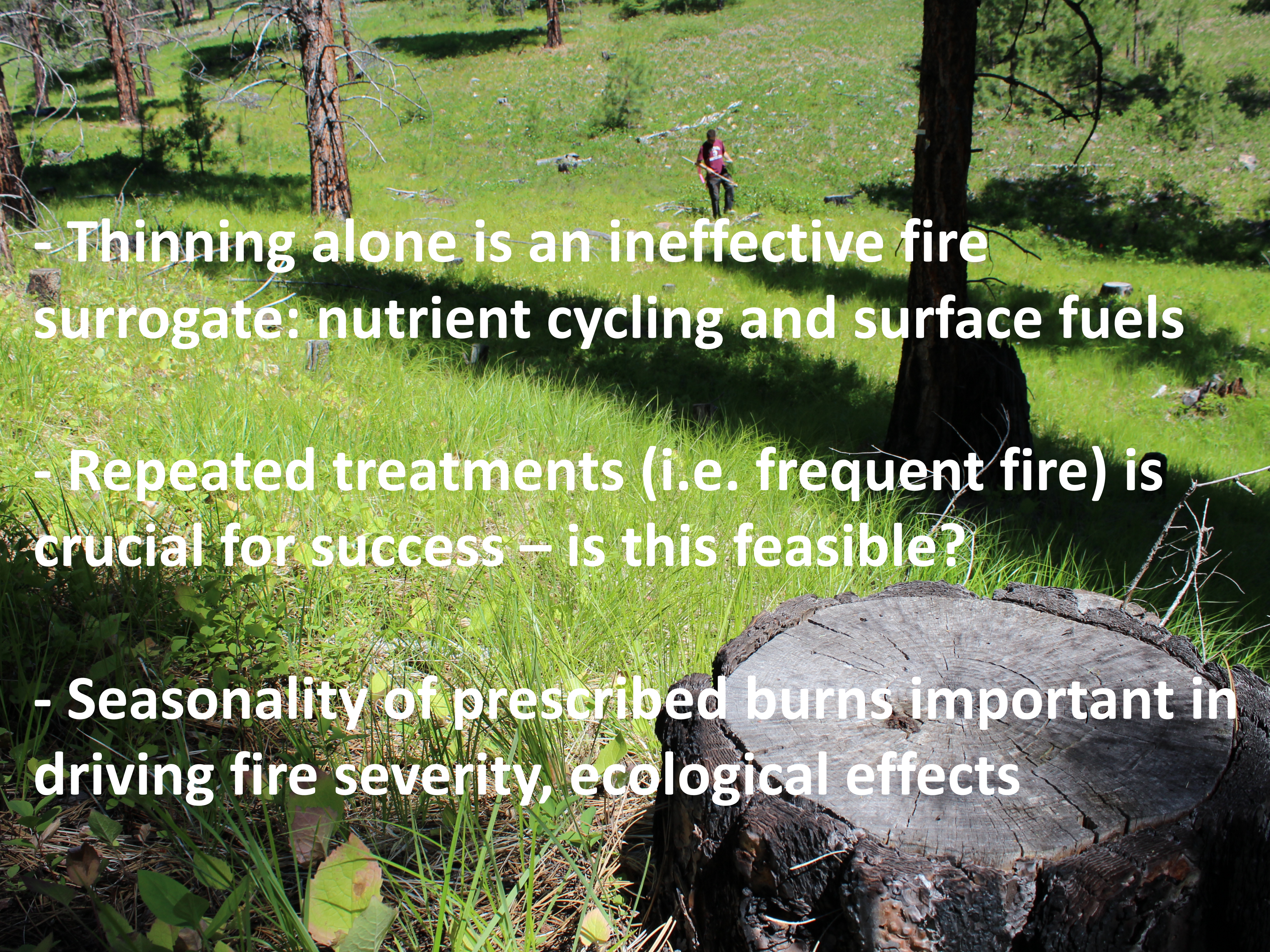
Effects on N Cycling and Ecosystem Processes, 10 Years on…









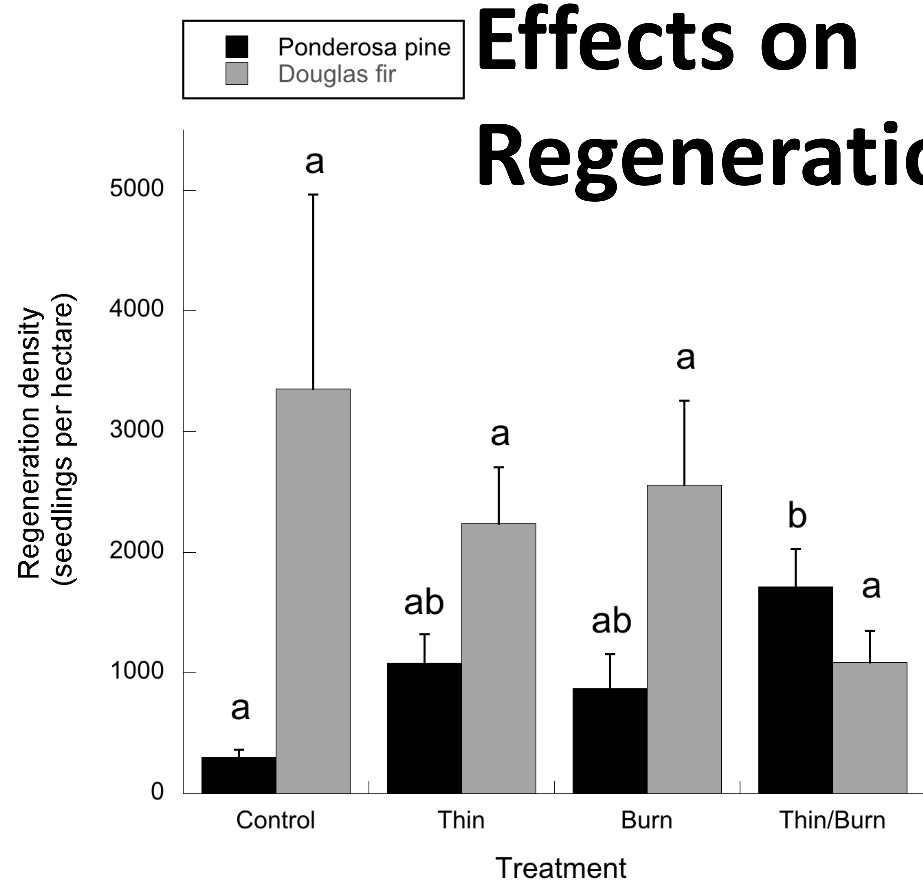


- Thinning alone is an ineffective fire surrogate: nutrient cycling and surface fuels

- Repeated treatments (i.e. frequent fire) is crucial for success – is this feasible?

- Seasonality of prescribed burns important in driving fire severity, ecological effects

Effects on Regeneration?



Thin + Burn is most effective in encouraging ponderosa pine regeneration

Frequent fire reducing seedling densities

Significant removal of Douglas fir basal area critical to restoration success