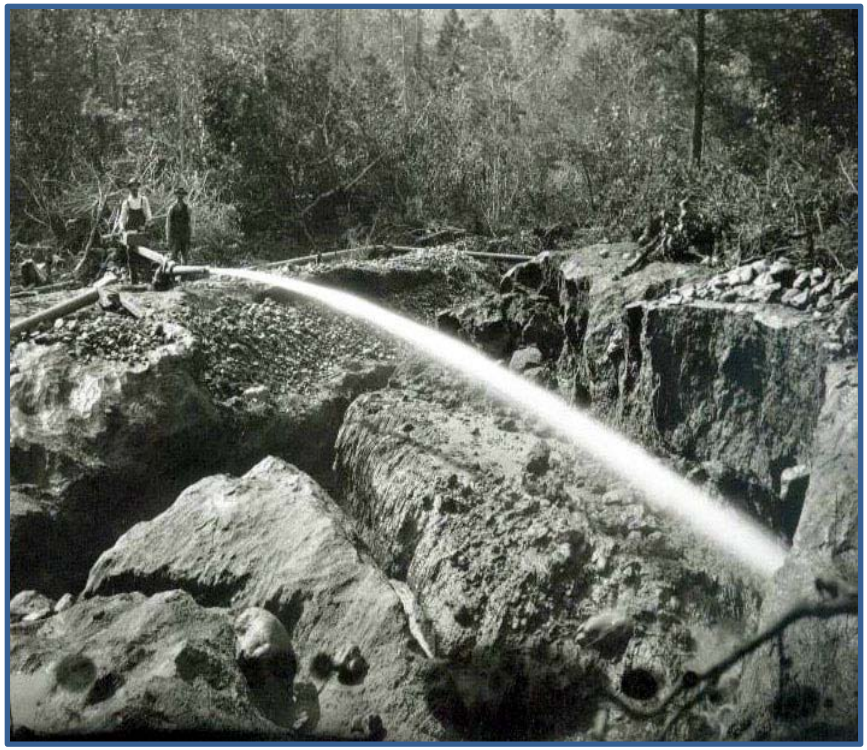
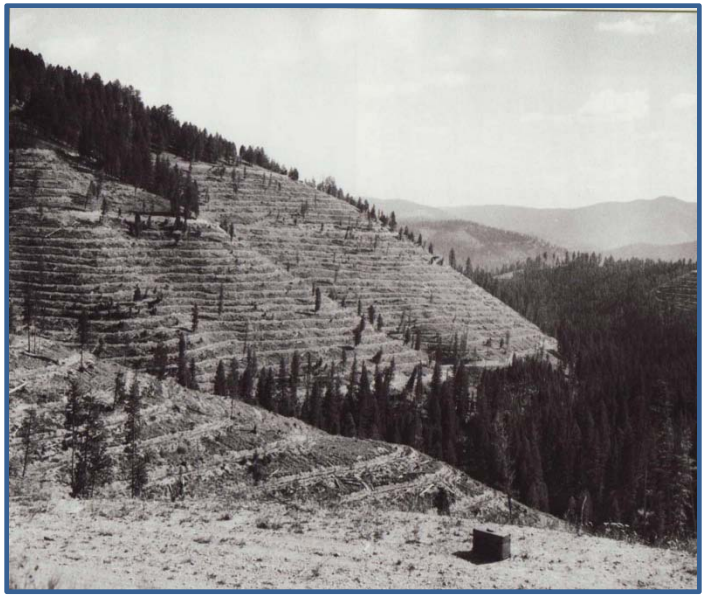
EFFECTS OF RESTORATION TREATMENTS ON SOIL

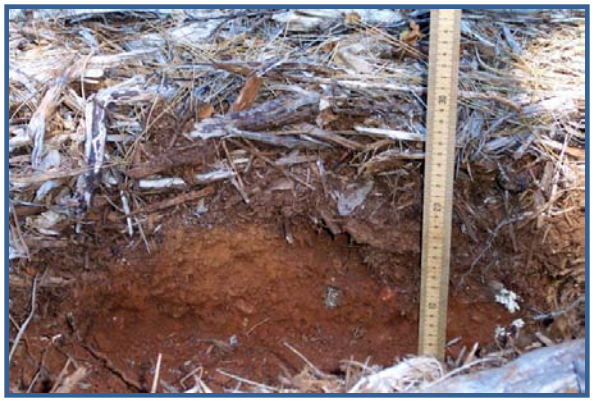
Matt Busse, Terry Craigg, Gregg Riegel

Black-and-white treatment of forest soil





SHADES OF GRAY:
RESTORATION TREATMENTS AND SOILS



- We argue that most soils are tolerant or resilient to single-entry BMPs
- What about multiple entries?
- Can forest restoration improve soil quality?

Forest Restoration Beyond Fuel Reduction: What is the Vision?

October 12-14, 2011 - Willie Hall,
Central Oregon Community College - Bend, Oregon

PHOTO COURTESY: STEPHEN FITZGERALD

Objectives

The objectives of this conference are to discuss and answer questions about:

1) Expressions of different visions of restored forests by various stakeholders;

2) How fuel reduction and fire can be integrated with forest restoration;

3) Discuss the economics, mechanics and tools used for forest restoration;

4) Explore the social aspects of forest restoration;

5) Establish and use reference conditions to formulate restoration goals; and

6) Effects of restoration treatments on various resources such as wildlife, soils, and water.

Forest Restoration:

What is the vision for soil?

- **Commitment to long-term soil stewardship**
- **Proactive - use our knowledge of soil and its inherent capacity to support life during the restoration planning process**
- **Reactive – acknowledge and account for repeated disturbance effects on soil properties**

Discussion topics

Fire

- repeated burning and soil N
- restoration planning and accounting
- pile burning is hot, but does it matter?

Mechanical harvesting

- is compaction as bad as they say?
- what about repeated mowing or masticating?
- does whole-tree biomass harvesting deplete ecosystem nutrient stocks?

Climate change

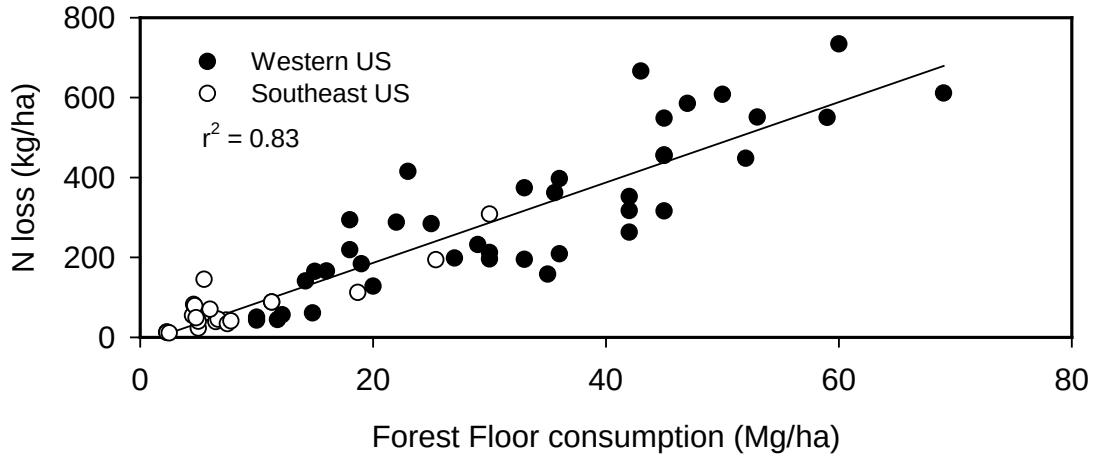
- Managing for soil carbon increases?

Repeated fire and soil N

- Periodic flush of plant-available N
- Cumulative loss of total N from litter + duff

Extent of N loss	N loss (kg/ha)	Study
Low to moderate	40-88	Bell and Binkley 1989
(0-200 kg/ha)	11-40	Richter et al. 1982
	55	Gundale et al. 2005
	55	Hubbard et al. 2004
	54	Kodama and Van Lear 1980
	150	Covington and Sackett 1984
	56-61	Caldwell et al. 2002
	94	Jurgensen et al. 1981
	119	Klemmedson et al. 1962
Moderate - Severe	200-600	Little and Ohmann 1988
200 – 800 kg/ha	225-571	Little and Klock 1985
	347-435	Shea 1994
	362	Caldwell et al. 2002
	353	Klemmedson et al. 1962
	551-807	Moghaddas et al. 2007

The amount of N lost is a direct function of forest floor consumption, which is controlled by duff moisture content



If conservation of soil N is desired

Select burn prescriptions that limit duff consumption

Bend LTSP study (Sugar Cast)

Burn year	Duff Consumption	N loss (kg/ha)	N gain (N fixation)	Net loss of ecosystem N
1991	55%	- 430	20	-17%
2002	45%	- 165	10	- 6%
Total (so far)		- 595	30	-23%

Bend LTSP study (Swede Ridge)

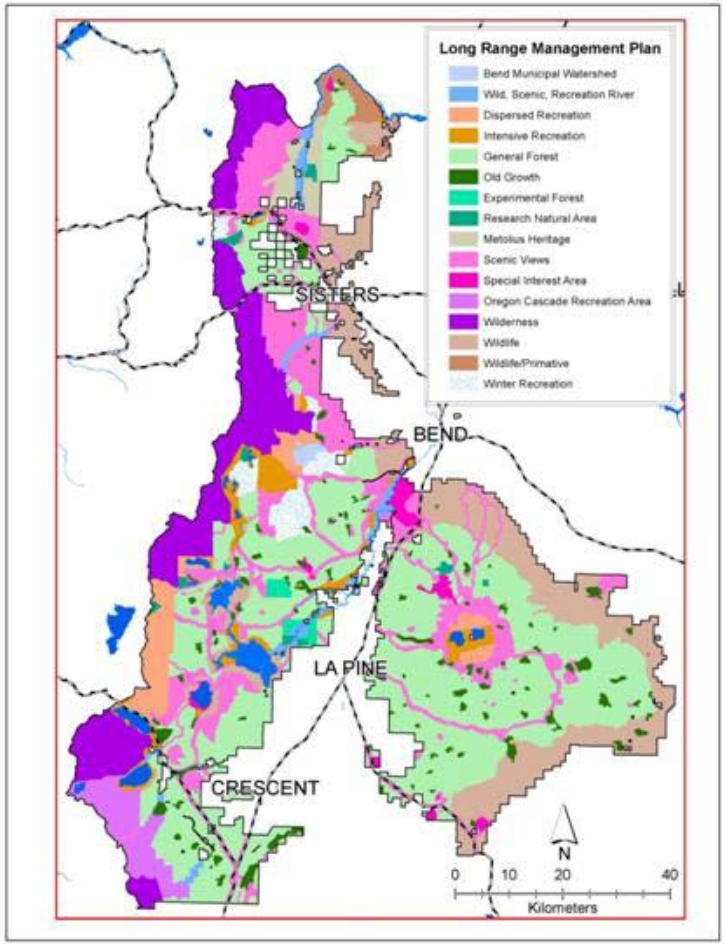
Burn year	Duff Consumption	N loss (kg/ha)	N gain (N fixation)	Net loss of ecosystem N
1991	42%	- 347	150	- 5%
2002	40%	- 155	80	- 2%
Total (so far)		- 502	230	- 7%

Restoration Planning for repeated fire

1. **Identify risk gradient for N loss**
   - **Soil fertility**
   - **Forest floor mass**
   - **Plant community**

2. **Develop burn prescriptions for duff consumption that match the potential risk**

   (e.g. burn when duff moisture is moderately high on the eastern flank of Deschutes NF)




5-Year Fire Return Interval
Metolius basin


EAST FORT ROCK

Accounting system

1. Estimate changes in soil N for each restoration entry

2. Link soils database to GIS activity layer

3. Data types can include
   - Soil N loss during burning,
   - Pile burn intensity and ground coverage
   - Skid trail coverage
   - Harvest removal of nutrients

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Climate change

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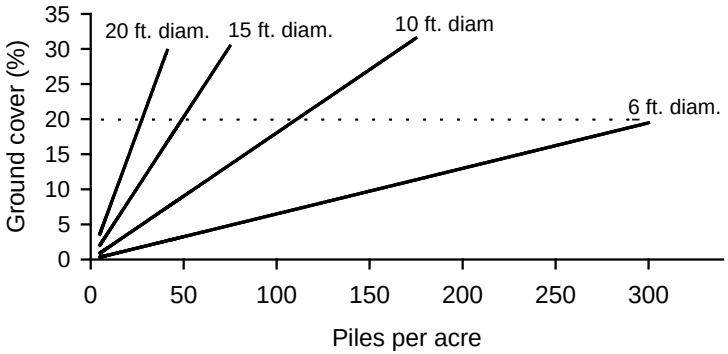
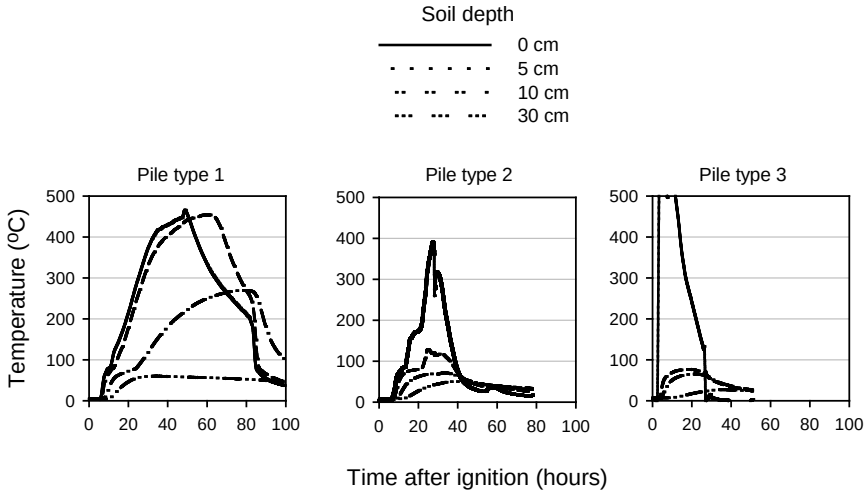
Pile burning can get hot
But does it matter?

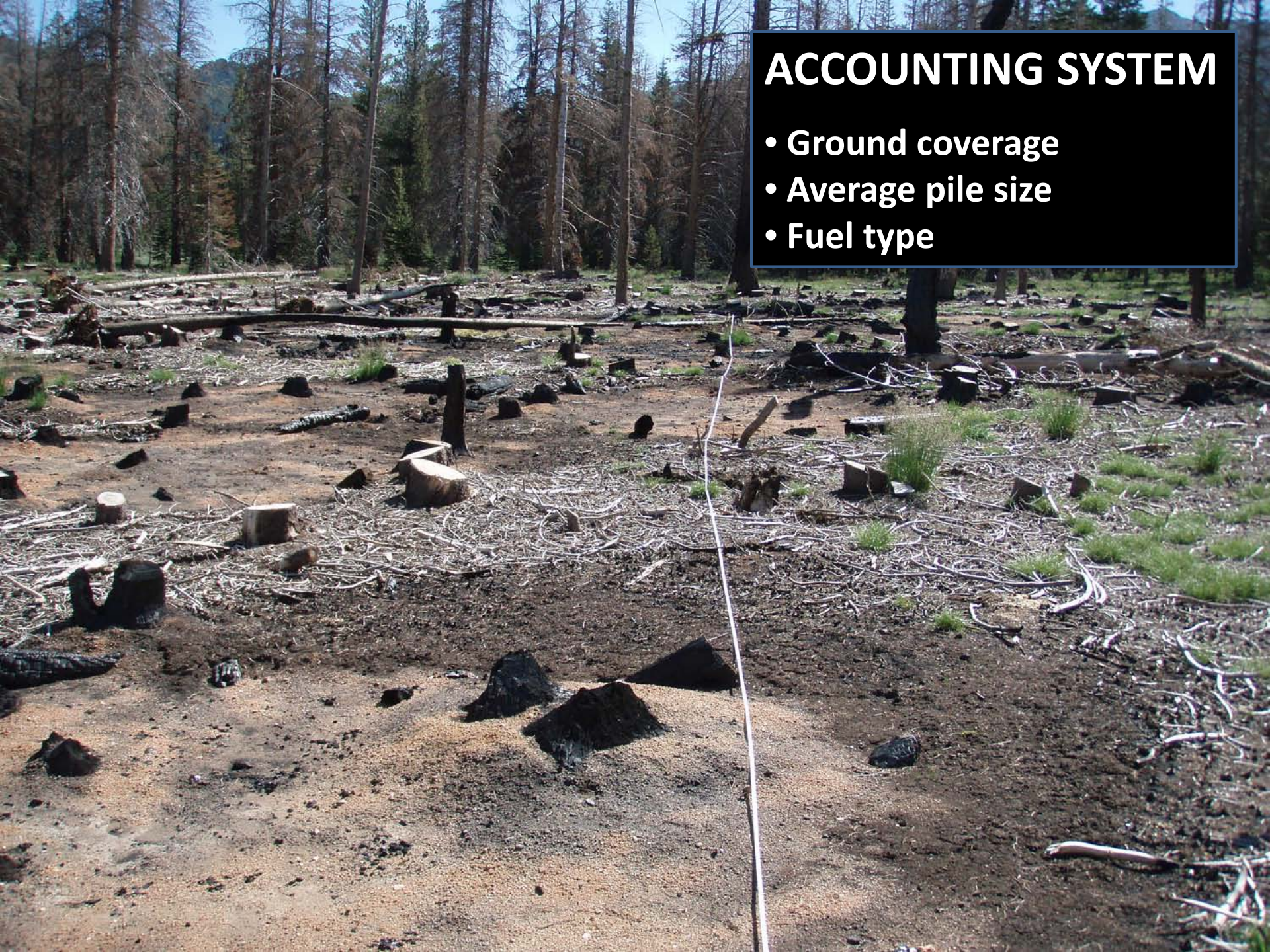
Soil effects are not that great unless:

- **Ground coverage is 20% or greater**



- **Piles are dominated by large wood**




ACCOUNTING SYSTEM
• Ground coverage
• Average pile size
• Fuel type

SOIL COMPACTION

THINNING AND SOIL COMPACTION

Rule #1 - DO NOT drive on wet ground

Rule #2 - DO NOT drive on semi-wet ground

Rule #3 - see rules #1 and #2

SOIL COMPACTION

We know how to compact a soil

- Harvest when soil is moist or wet
- Use equipment with high ground pressure
- Drive equipment on bare soil
- A few repeated passes

SOIL COMPACTION

Parker's standard thinning rules

1. Include contract specifications for acceptable levels of compaction that contain incentive and penalty clauses

2. Meet on site with all personnel before thinning to discuss goals, concerns and soil issues

3. Use dedicated skid trails

4. Establish a monitoring plan for contract inspectors (don't walk away)

SOIL COMPACTION

- **Predicting the severity and extent of compaction is complicated (one size does not fit all)**

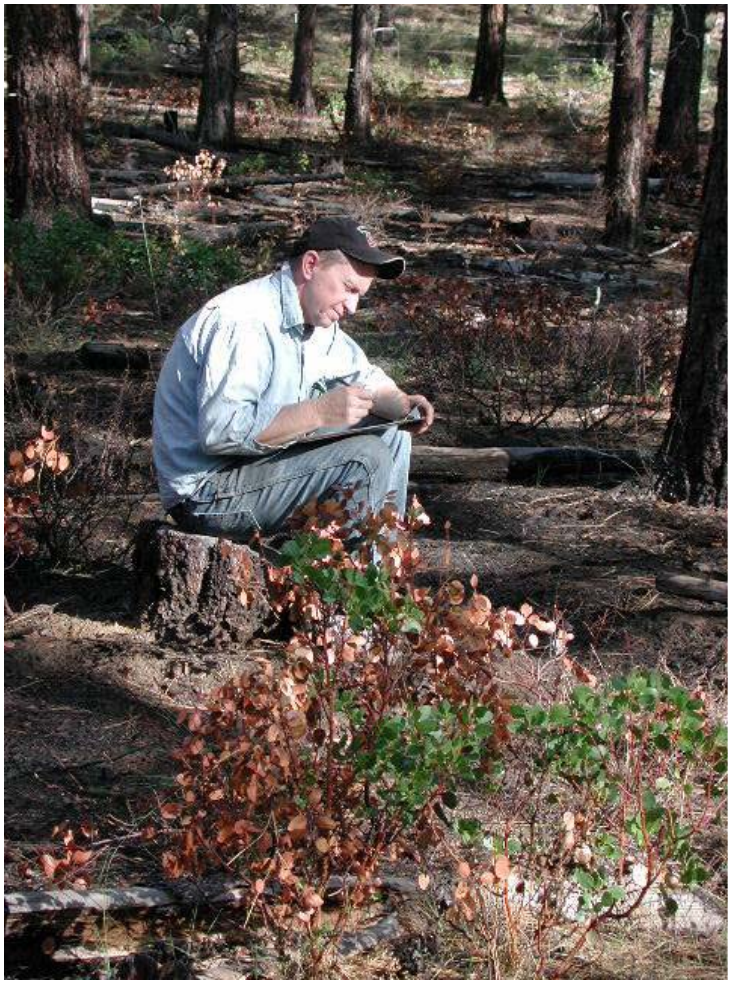
- **Predicting ecosystem effects is even more complicated**

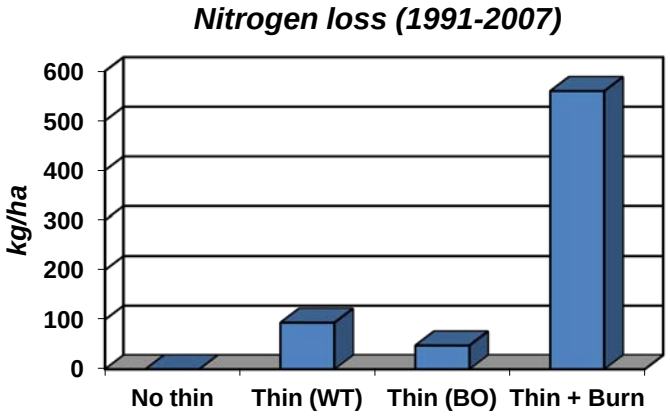
"PERHAPS THE MOST NOTABLE AND UNEXPECTED RESULTS TO DATE IS THE INCREASED CONIFER GROWTH RESPONSE TO COMPACTION"

Meta-analysis results from the North American Long-term Soil Productivity study (Ponder et al. 2012)

Is whole-tree biomass harvesting ok for soil?

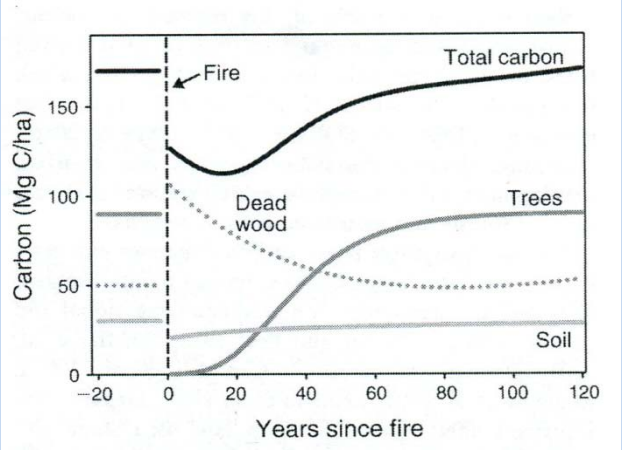
- **Thinning residues are not a major nutrient source (Janowiak and Webster 2010)**
- **Thinning residues may protect soil from compaction, rutting, mixing**
- **Avoid whole-tree harvesting on extremely infertile sites**





Can we use forest restoration practices to increase soil carbon storage

- We hope so, however…..
- Most forest studies show little change in soil C content due to an assortment of management practices
- Deforestation is the largest contributor to loss of soil carbon stock
- Afforestation is the largest contributor to gains in soil carbon stocks



From: ***A synthesis of current knowledge on forests and carbon storage in the United States***
McKinley et al. 2011, Ecological Applications

Summary

- **Soils are a piece of the restoration puzzle**
- **Awareness and understanding of cumulative effects are crucial**
- **The vision for soil involves proactive planning, reactive accounting, and long-term commitment**