

Long-term Trends in Soil Productivity:

WHO WILL SPEAK FOR THE SOIL?

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Gregg Riegel, Region 6 Ecology Program

Marty Jurgensen, Michigan Tech Univ.



Marty Jurgensen



Gregg Riegel

Marty Jurgensen

Gregg Riegel



“Soil is our most valuable resource”

Gregg Riegel, 2004

SOIL ATTRIBUTES

- **Basic natural resource**
- **Nonrenewable in our lifetime**
- **Susceptible to mismanagement**
- **Boring**



“the significance of soil seems
lost to modern society”

Powers et al., 1998

Presentation topics

- **Soil productivity: What does it mean and should you care?**
- **Are we losing productivity? 15-year effects of fire and thinning**
- **Can we regain productivity? Benefits of understory vegetation**

National forests shall provide “sustained yield of the several products and services without impairment of the productivity of the land”

Multiple-Use, Sustained-Yield Act of 1960:

SOIL PRODUCTIVITY: The capacity of a soil to produce a certain yield of crops or other plants with a specified system of management.



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SOIL QUALITY: The capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health

..... avoiding **SOIL DEGRADATION**

Soil degradation: adverse change in soil properties



Soil degradation: adverse change in soil properties



TYPES OF SOIL DEGRADATION

Physical

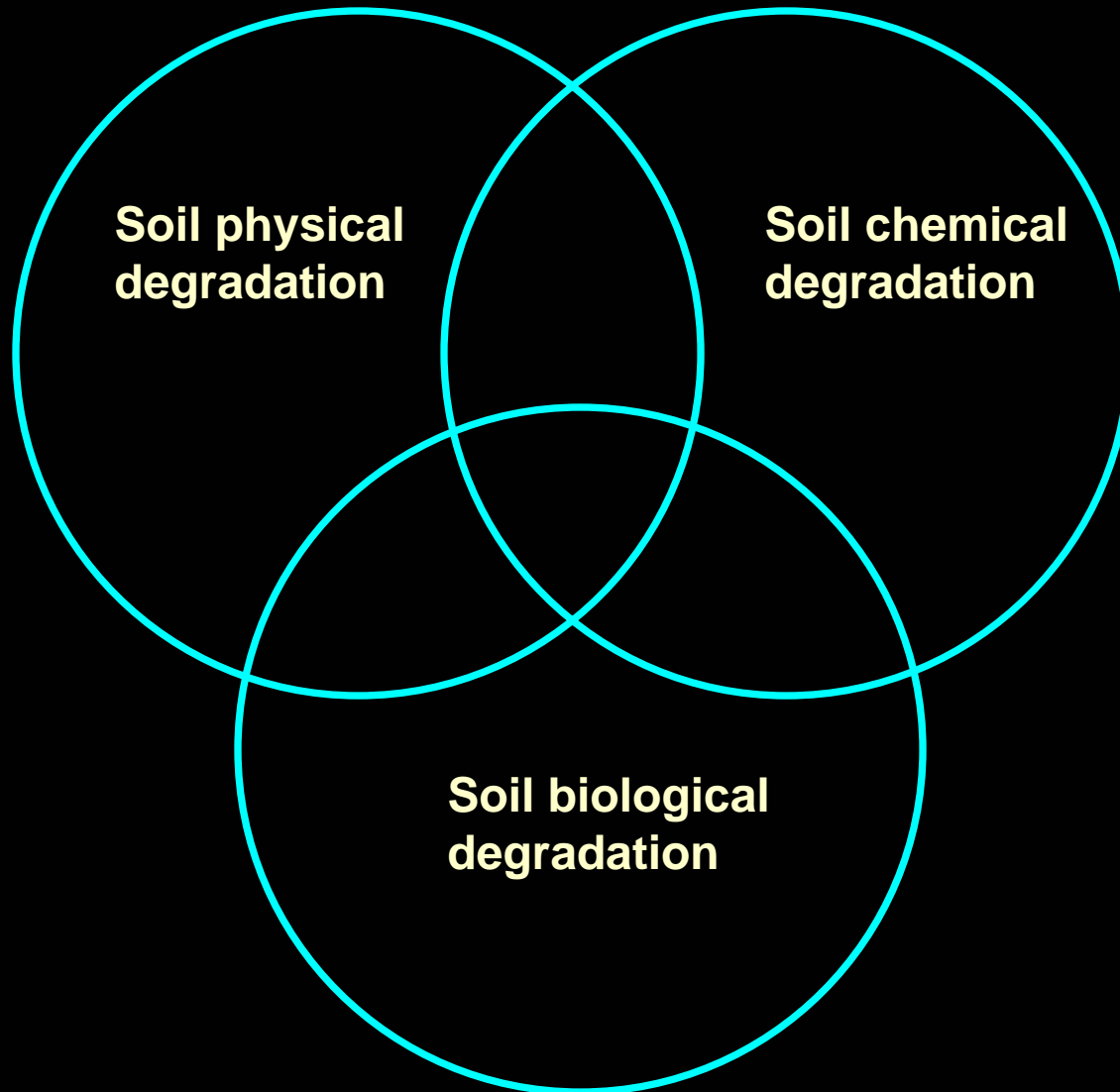
- Erosion (wind, water)
- Compaction
- Reduction in water infiltration rate
- Breakdown of soil structure
- Crusting
- Increased surface runoff
- Waterlogging

Chemical

- Nutrient depletion
- Acidification
- Leaching of bases
- Salinization, alkalinization
- Contamination

Biological

- Depletion of soil organic carbon
- Decline in soil biodiversity
- Increase in soil-borne pathogens



**Soil physical
degradation**

**Soil chemical
degradation**

**Soil biological
degradation**

from a global perspective.....

why worry about ponderosa pine forests?



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A photograph showing five firefighters in a forest. They are wearing helmets and gear, and are positioned in front of a controlled fire. The fire is burning on the ground, with smoke rising into the air. The firefighters are looking towards the fire. The forest has tall, thin trees and some low-lying vegetation. The scene is lit with a warm, orange glow from the fire.

THE DESCHUTES LONG-TERM SITE PRODUCTIVITY STUDY

Objective 1: Compare Methods to Enhance Ecosystem Health and Sustainability

No Thin



Thin



Fire



Thin + Fire



Bend Study Sites



Deschutes
National Forest

OREGON



**SOIL PROFILE:
typical of pine/bitterbrush community**

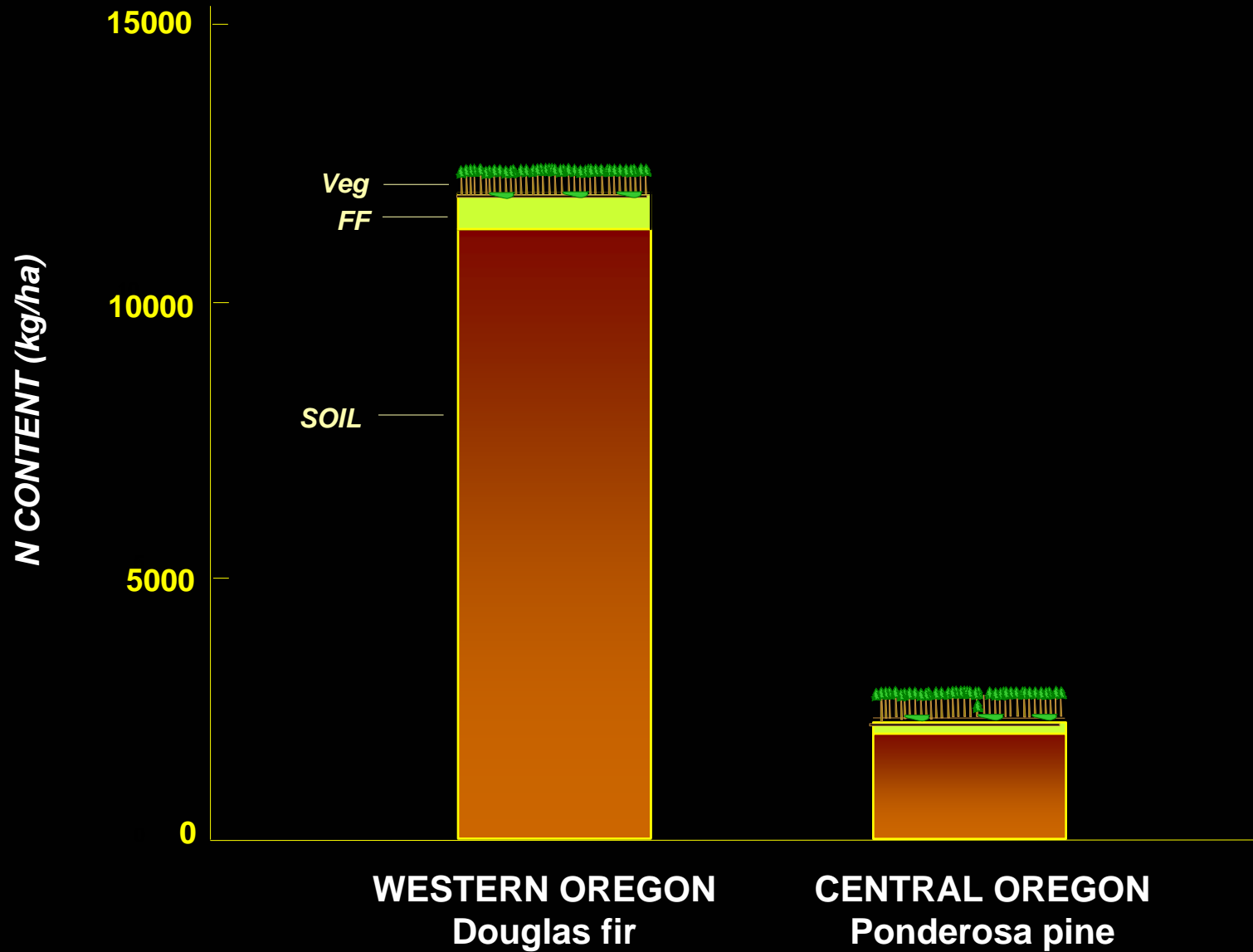
A

AC

C



ECOSYSTEM NITROGEN CONTENT (kg/ha)



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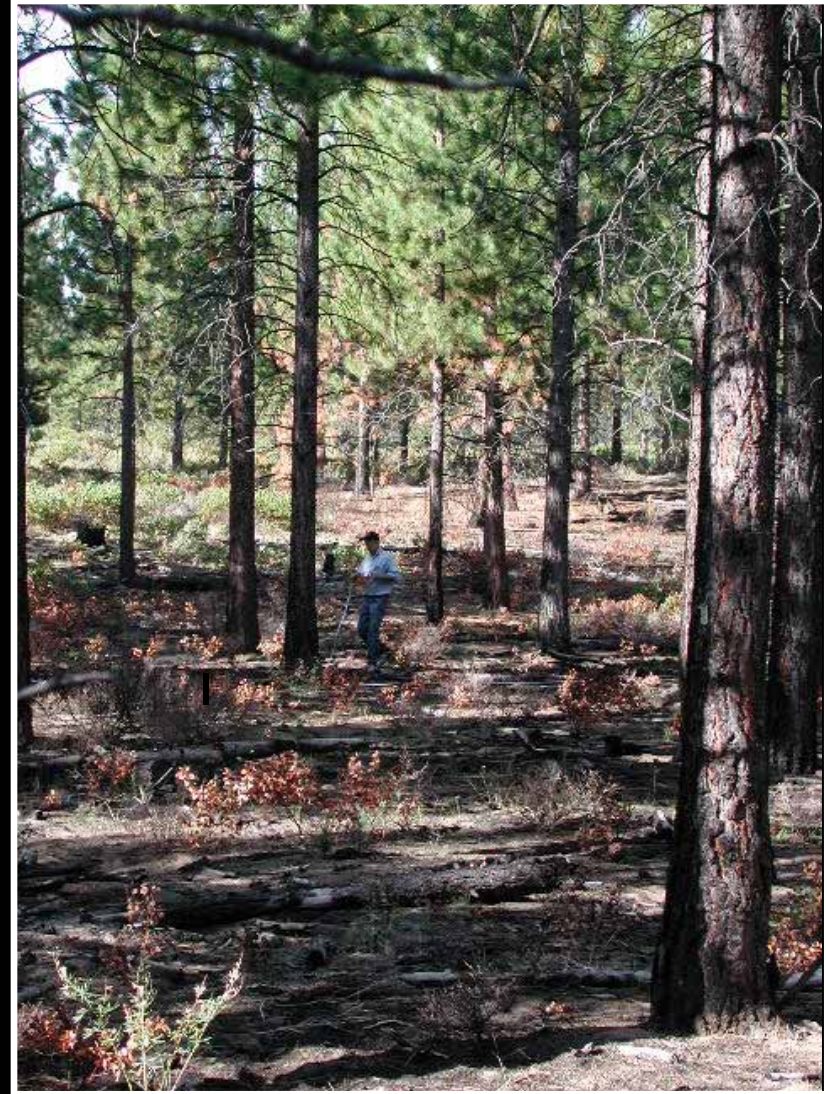
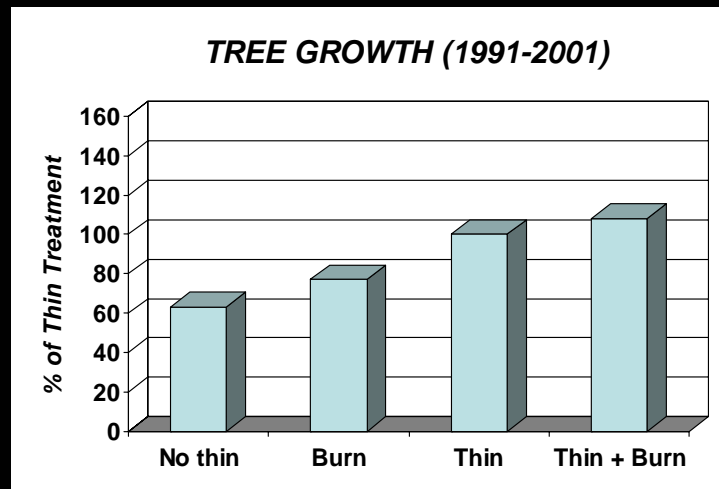
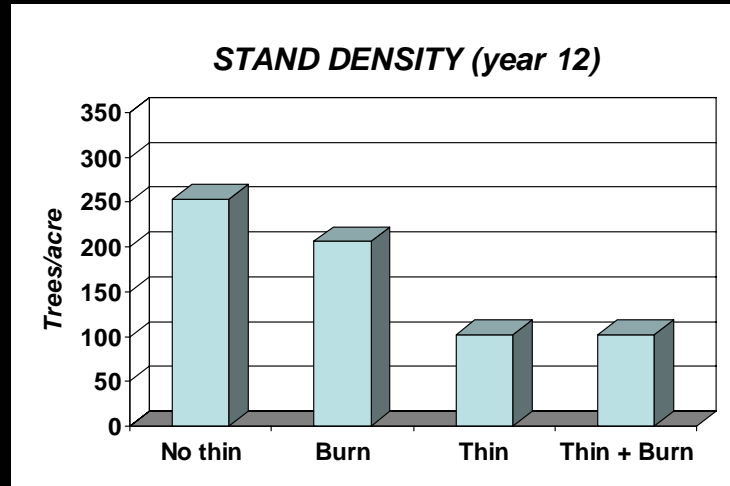
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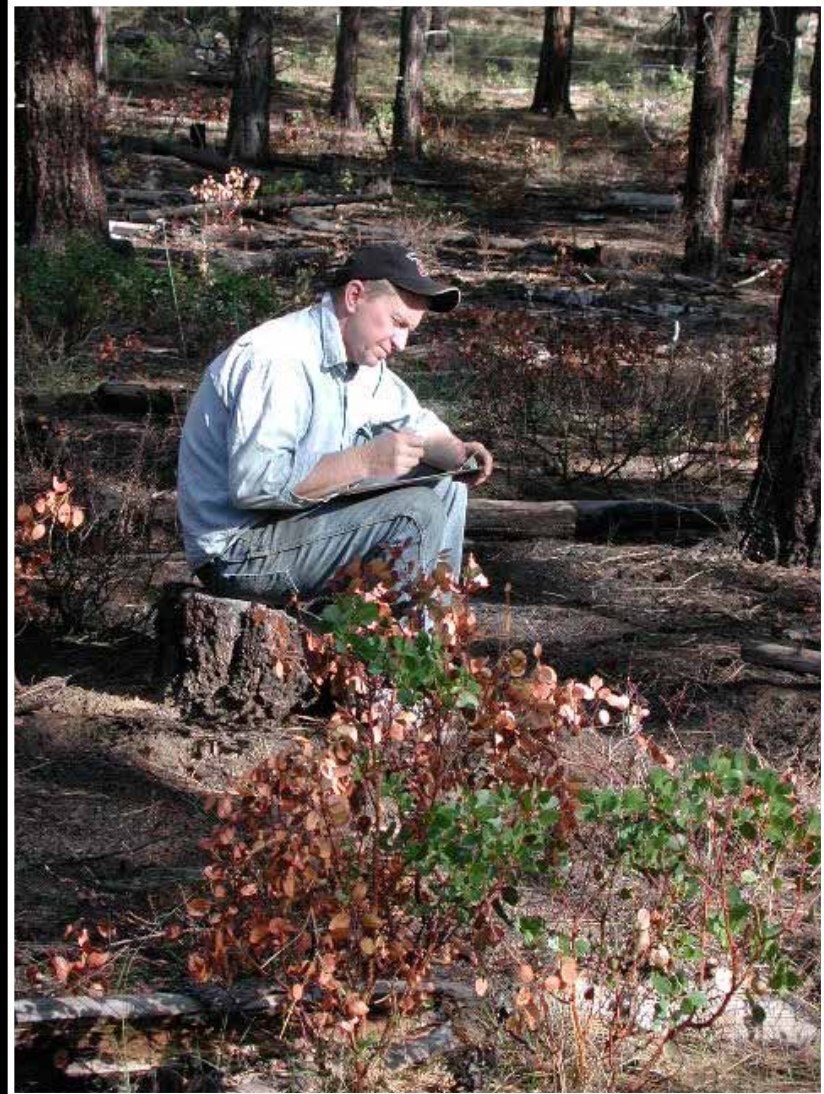
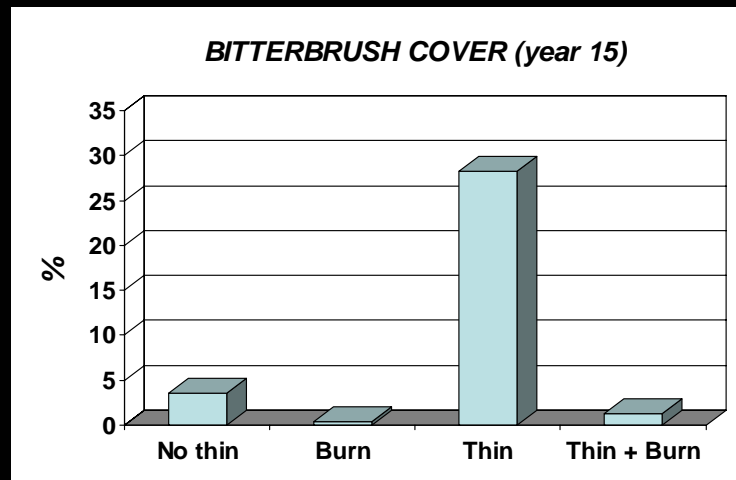
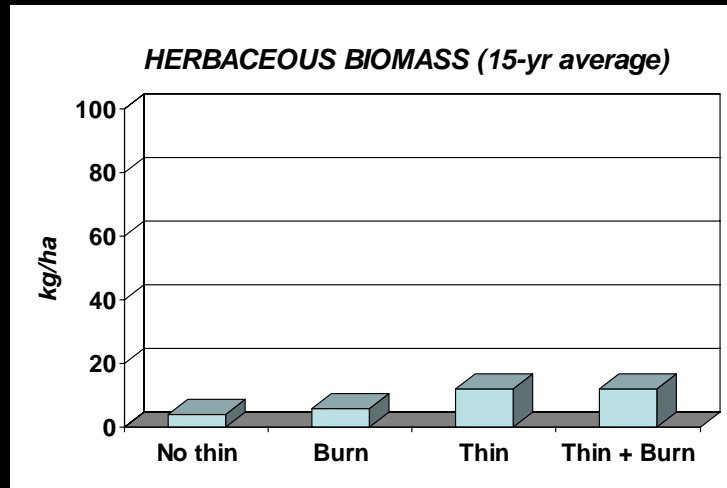
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- Decline in soil biodiversity
- Increase in soil-borne pathogens

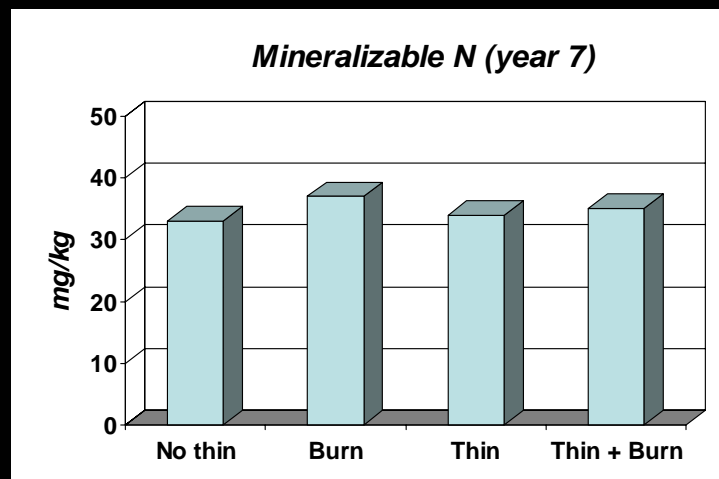
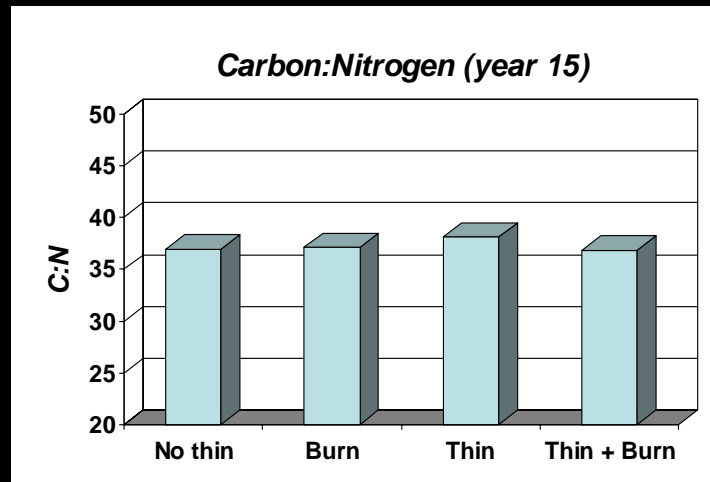
Overstory Condition



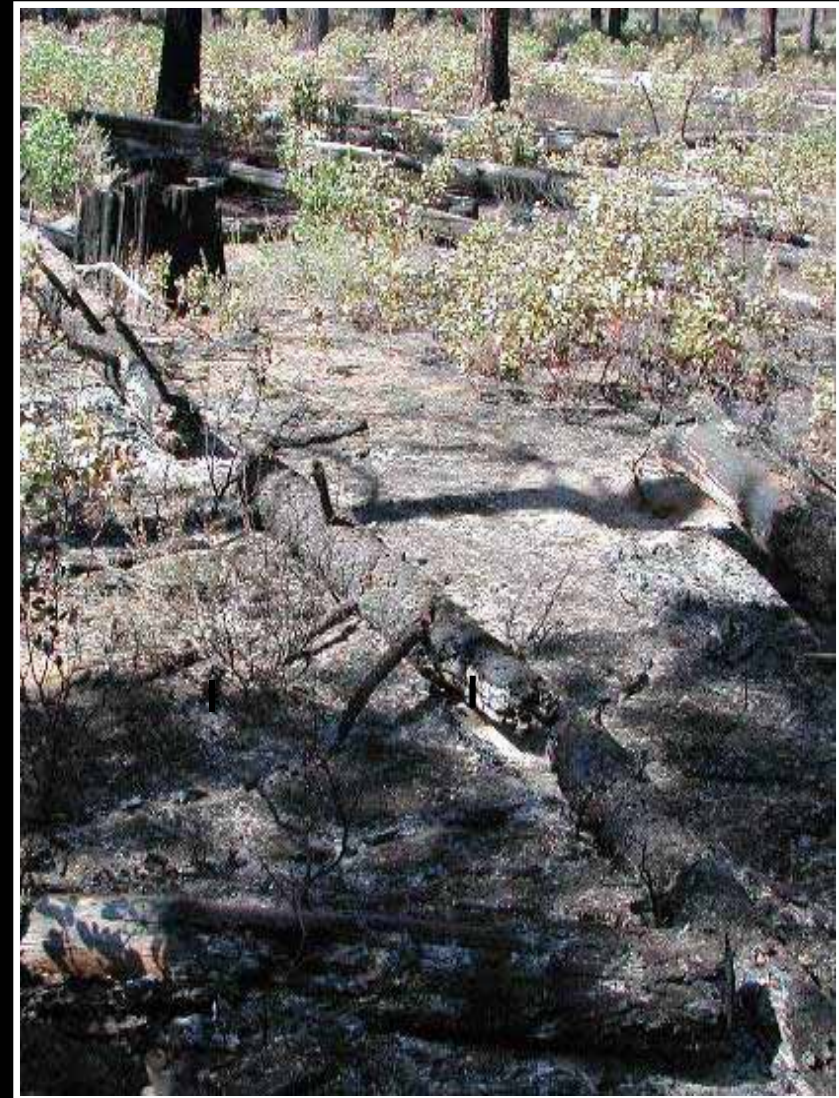
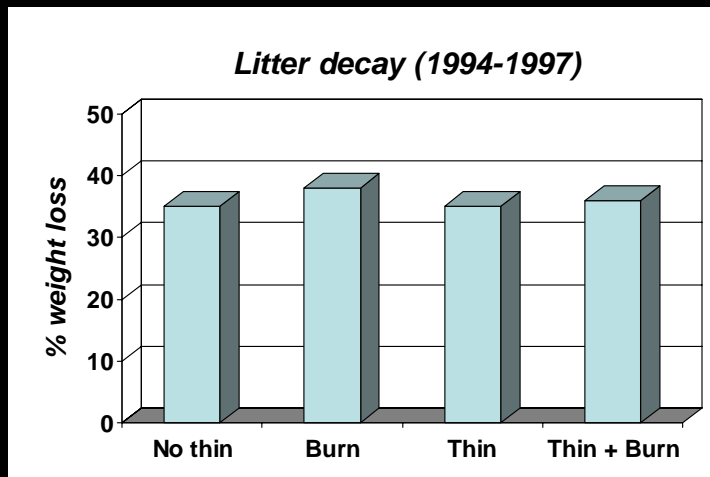
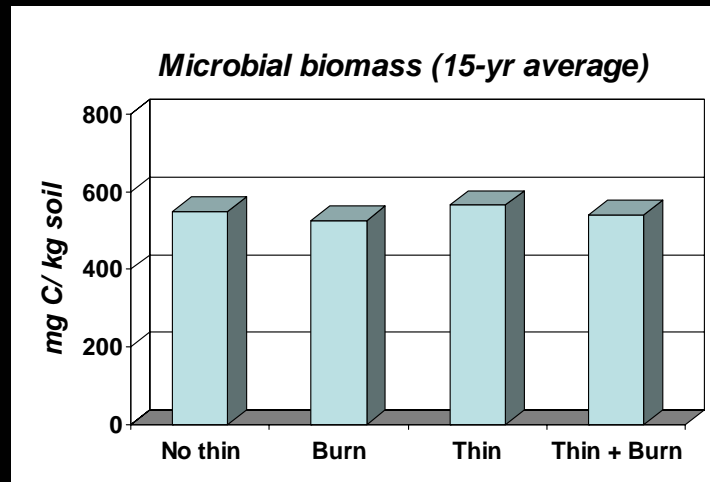
Understory Response



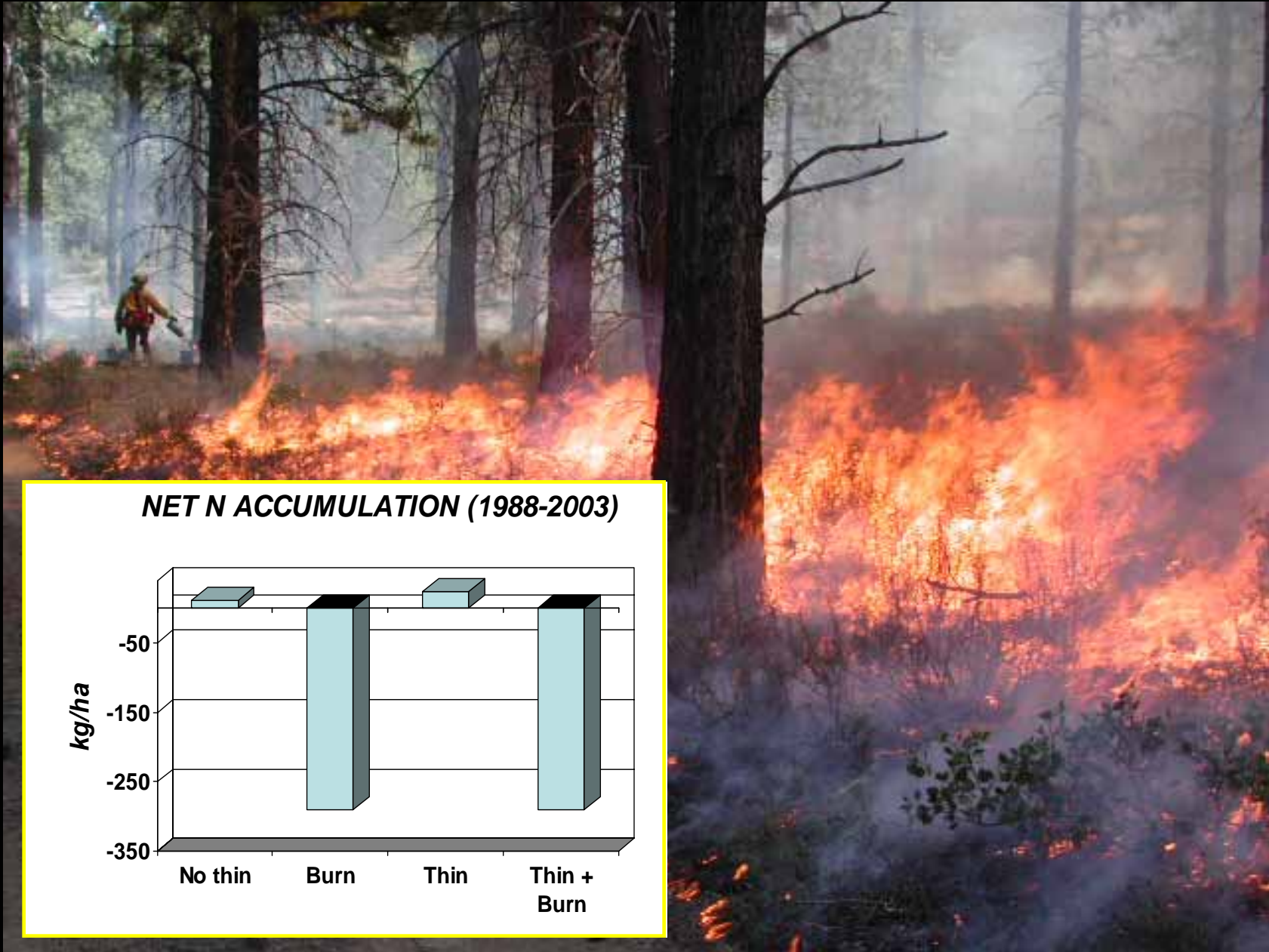
Soil degradation?



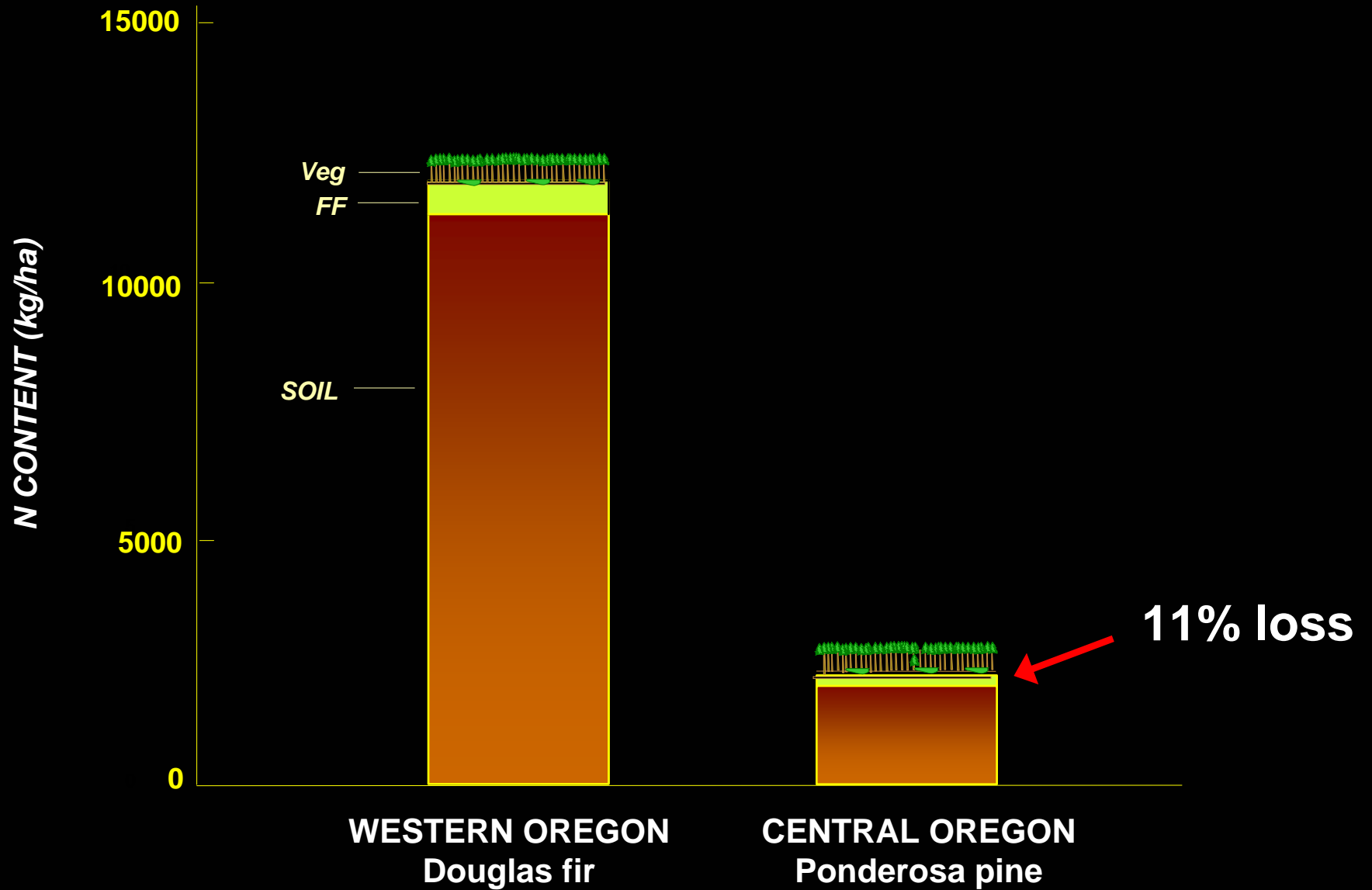
Soil degradation?



NUTRIENT DEPLETION



ECOSYSTEM NITROGEN CONTENT (kg/ha)



Single prescribed fire

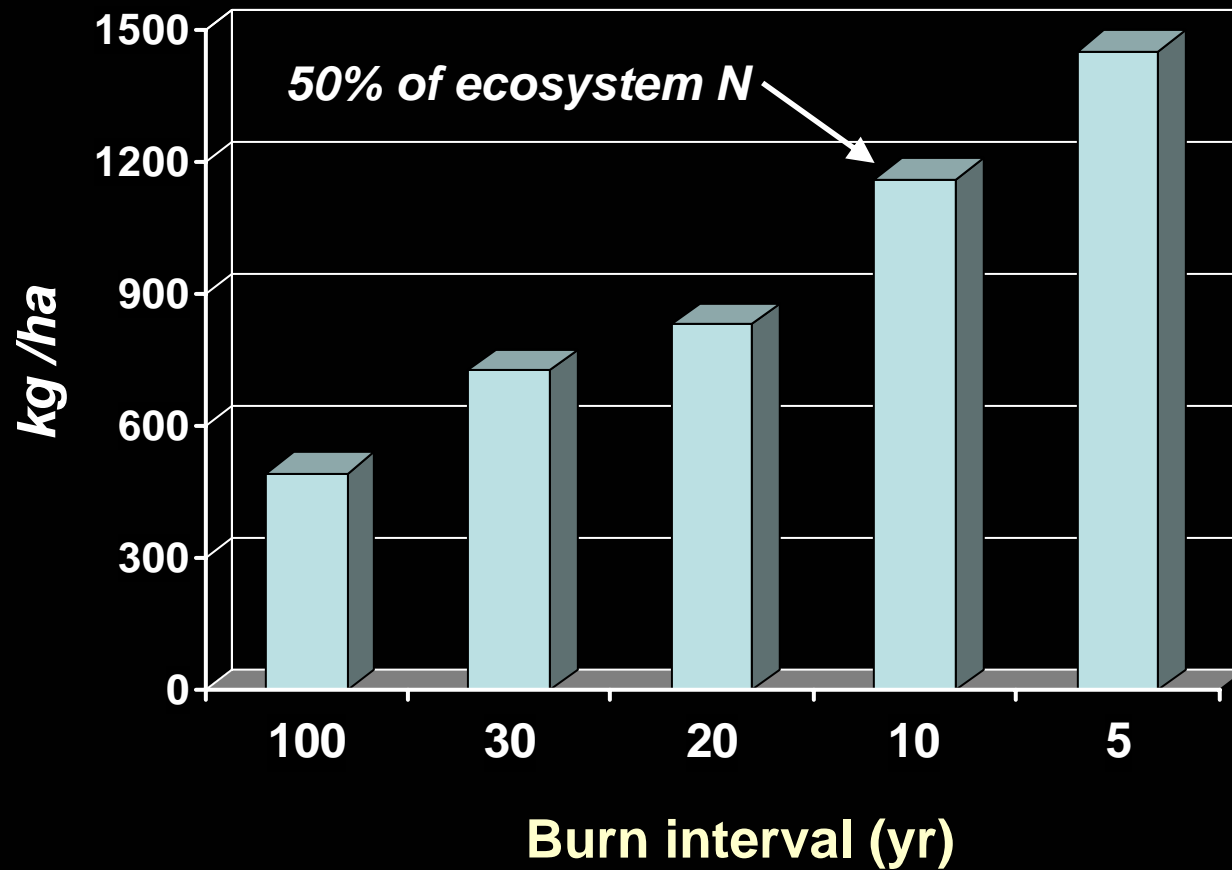


Nitrogen loss

✓ 50 – 200 kg/ha

✓ 2 - 9% of ecosystem N

**100-year cumulative N loss during repeated burning
in jeffrey pine forests (Johnson et al. 1998)**

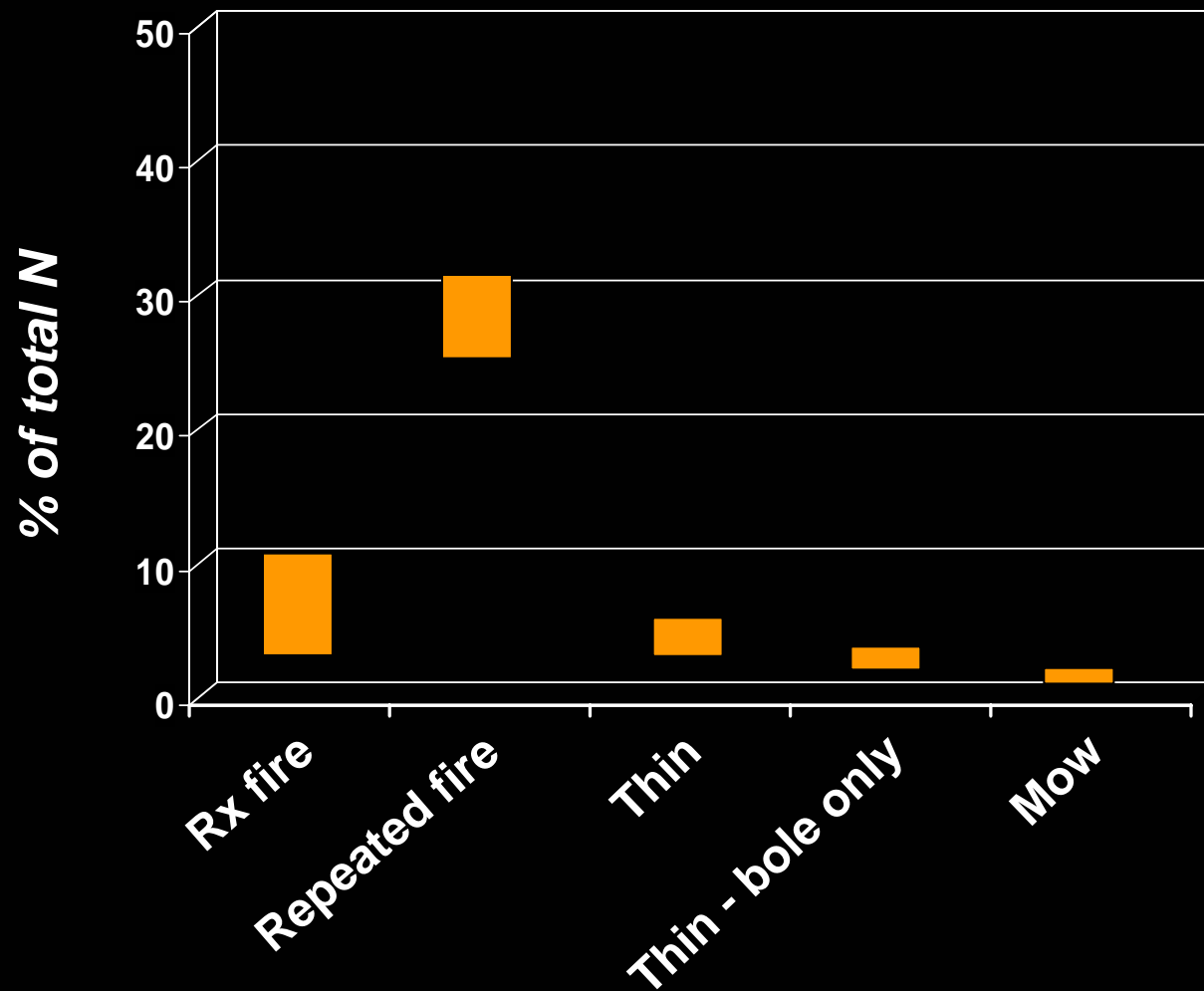


Repeated prescribed fire (20-yr cycle)

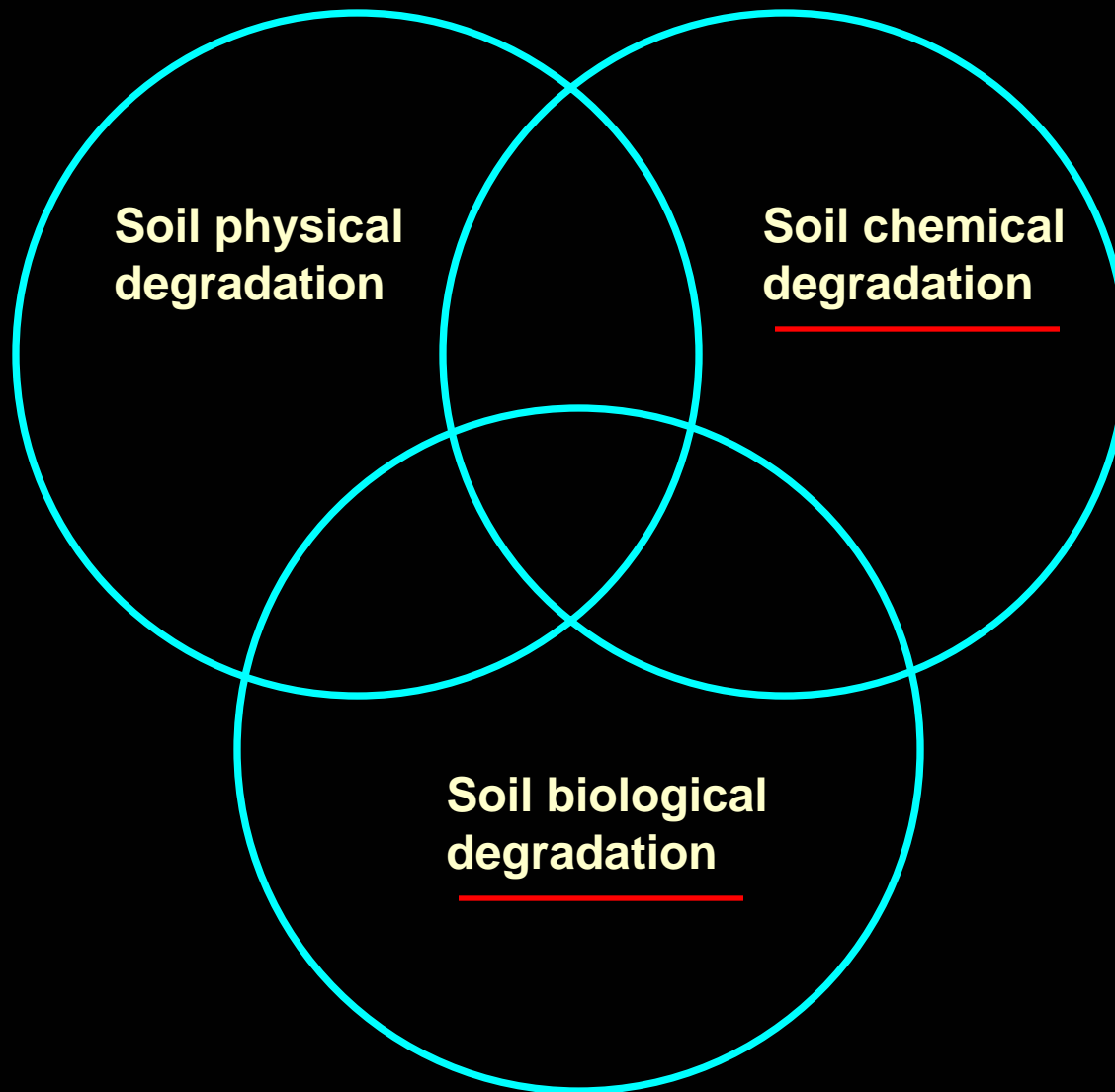


- Nitrogen loss***
- ✓ 580 – 700 kg/ha/100yr
 - ✓ 25 - 30% of ecosystem N

Potential ecosystem N losses in central Oregon pine forests



POTENTIAL LONG-TERM SOIL DEGRADATION?



EASY SOLUTIONS

- **Burn light, less frequent, mosaic patterns**
- **Incorporate mechanical treatments (mowing, thinning)**
- **Value N-fixing understory plants**
- **Look the other way**

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Potential N gains

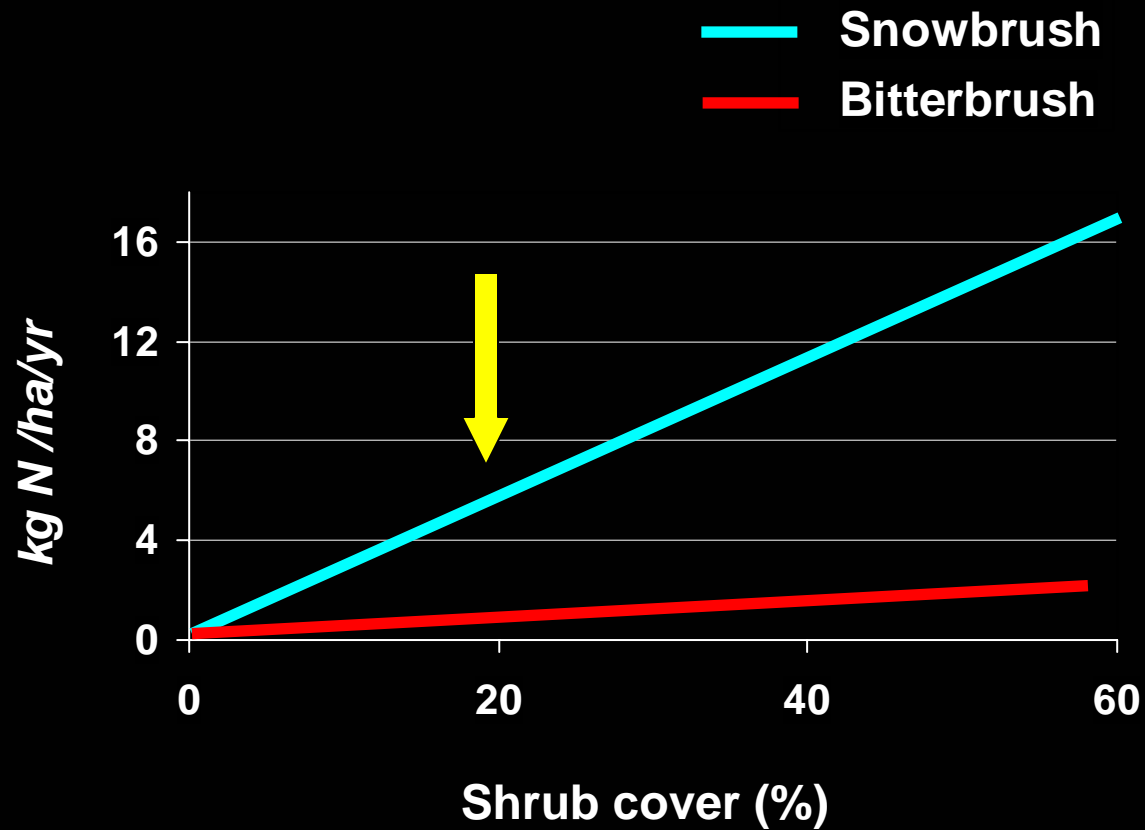


N fixation (kg/ha/yr)

Bitterbrush 0.5 – 3

Snowbrush 5 - 15

ANNUAL N FIXATION AS A FUNCTION OF SHRUB COVER



ECOSYSTEM N BALANCE SHEET : ***100 YEARS***

**Scenario 1: 20% snowbrush cover
20-year fire cycle**

<u>Source</u>	<u>Cum. N (kg/ha)</u>
Repeated fire	- 700
Snowbrush N fix	+ 600
Atmos. N fix	+ 100
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ECOSYSTEM N BALANCE SHEET : ***100 YEARS***

**Scenario 2: 20% bitterbrush cover
20-year fire cycle**

<u>Source</u>	<u>Cum. N (kg/ha)</u>
Repeated fire	- 700
Bitterbrush N fix	+ 100
Atmos. N fix	+ 100
	<hr/>
	- 500

THINK LONG TERM

(Soil degradation should not be a major issue)

- **Repeated fire can lead to substantial soil nutrient depletion**
- **Mechanical treatments can help reduce N losses**
- **N fixing plants provide partial to full N replacement**



SPEAK FOR THE SOIL