

# Hypothesis

- **Six years following catastrophic fire, soil nitrogen will be at low levels due to lack of litter and duff that sequester nitrogen.**
- **Nitrogen levels will be only slightly reduced following salvage logging due to lack of nitrogen in cellulose.**

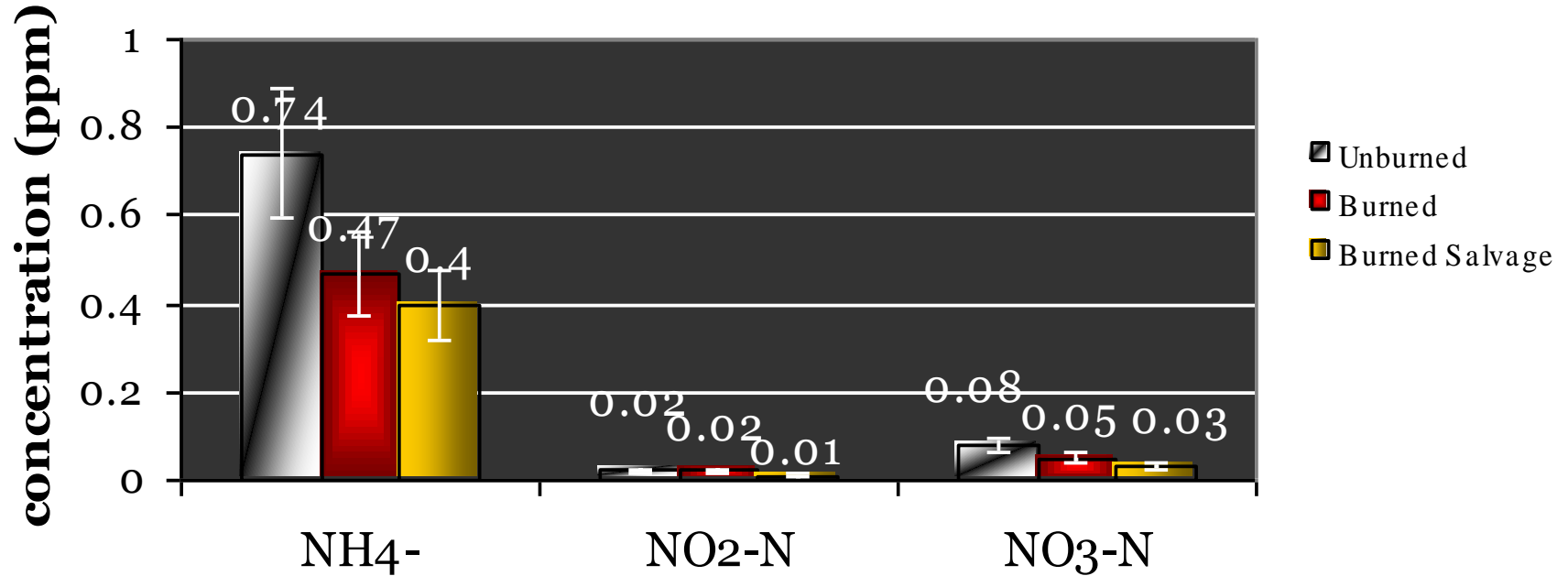


# Function of Nitrogen

- **Ammonia ( $\text{NH}_4^-$ )** – preferred by late seral forests
  - Litter, duff, detritus, urine
- **Nitrite ( $\text{NO}_3^-$ )**– intermediate step between ammonia and nitrate
  - Toxic
- **Nitrate ( $\text{NO}_2^-$ )**– preferred by early seral pioneers
  - Fixed and bound by bacteria
  - Converted to ammonia at biota death
  - Mineralized from ammonia as bacterial byproduct



# Comparison of Nitrogen Levels in Forest Soils



# Burned vs. Unburned

<b>Decreasing factors</b>	<b>&gt;   t  </b>	<b>Significant?</b>
▪ <b>Ammonia</b>	<b>.018</b>	<b>yes</b>
▪ <b>Nitrate</b>	<b>.05</b>	<b>yes</b>
<b>Increasing factors</b>		
▪ <b>Phosphorus</b>	<b>.049</b>	<b>yes</b>
▪ <b>Potassium</b>	<b>.95</b>	<b>no</b>
<b>No change</b>		
▪ <b>Nitrite</b>	<b>.33</b>	<b>no</b>



# Burned vs. Burned Salvage

<b>Decreasing factors</b>	<b>&gt;   t  </b>	<b>Significant?</b>
▪ <b>Ammonia</b>	<b>.257</b>	<b>no</b>
▪ <b>Nitrate</b>	<b>.201</b>	<b>no</b>
▪ <b>Nitrite</b>	<b>.15</b>	<b>no</b>
▪ <b>Phosphate</b>	<b>.71</b>	<b>no</b>
▪ <b>Potassium</b>	<b>.63</b>	<b>no</b>



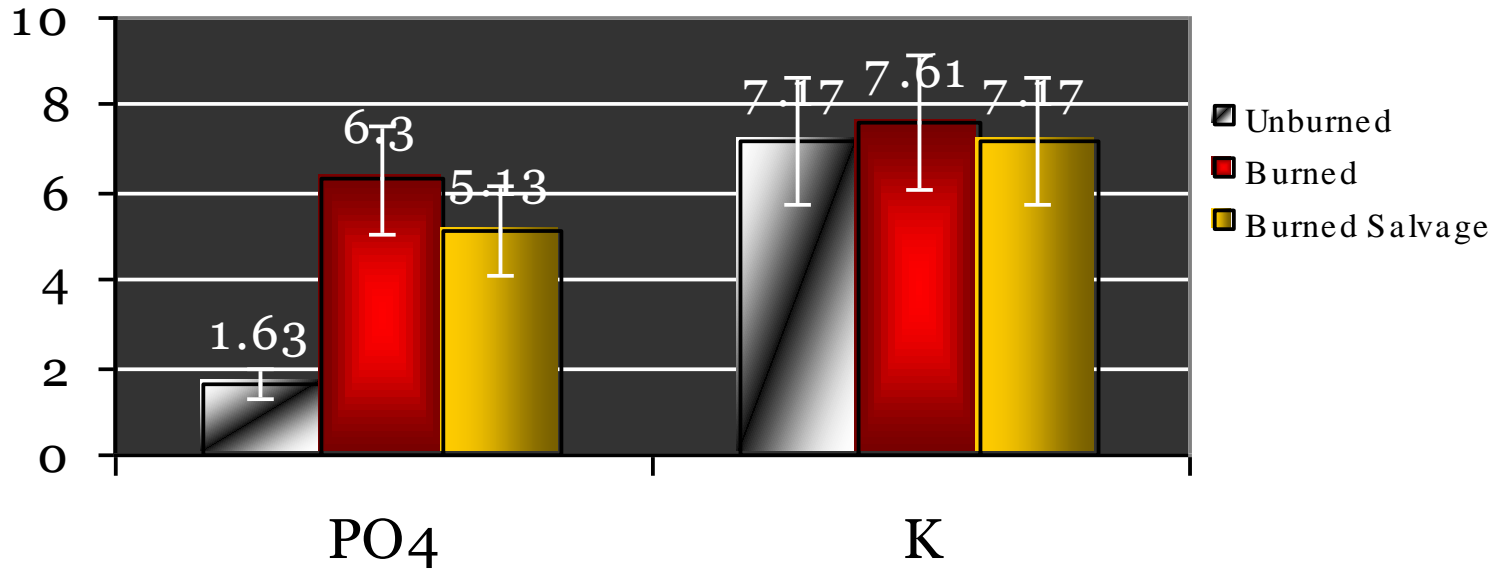
# Function of Other Macronutrients

- **Phosphate ( $\text{PO}_4$ )** – from mineral soil
  - Makes up phospholipid bilayer of cell membrane
  - Responsible for energy (ATP)
- **Potassium (K)** – from potash, a volcanic ash
  - Aids in diffusing nutrients into roots - turgor pressure
  - Aids in fruit sizing
  - Aids in nerve transmission



# Comparison of Phosphate and Potassium in Forest Soils

concentration (ppm)



# Soil Chemistry Statistics

## *Unburned vs. Burned Forest Soils*

**Statistically significant results included ammonia, nitrate, phosphorus**

## *Burned vs. Burned Salvaged Forest Soils*

**None of the parameters compared were statistically significant.**



# Importance of Soil Depth

**Soil depth is indicative of plant size, density, and source of topsoil.**



# Importance of Duff and Litter

- **Litter comes from deciduous trees which has LNE (low nitrogen efficiency)**
- **Duff comes from conifers which has HNE (high nitrogen efficiency)**

## **Litter and duff:**

- **Hold soil moisture**
- **Block sun and cool soil**
- **Sequester Ammonia**



# Importance of Rhizome Depth

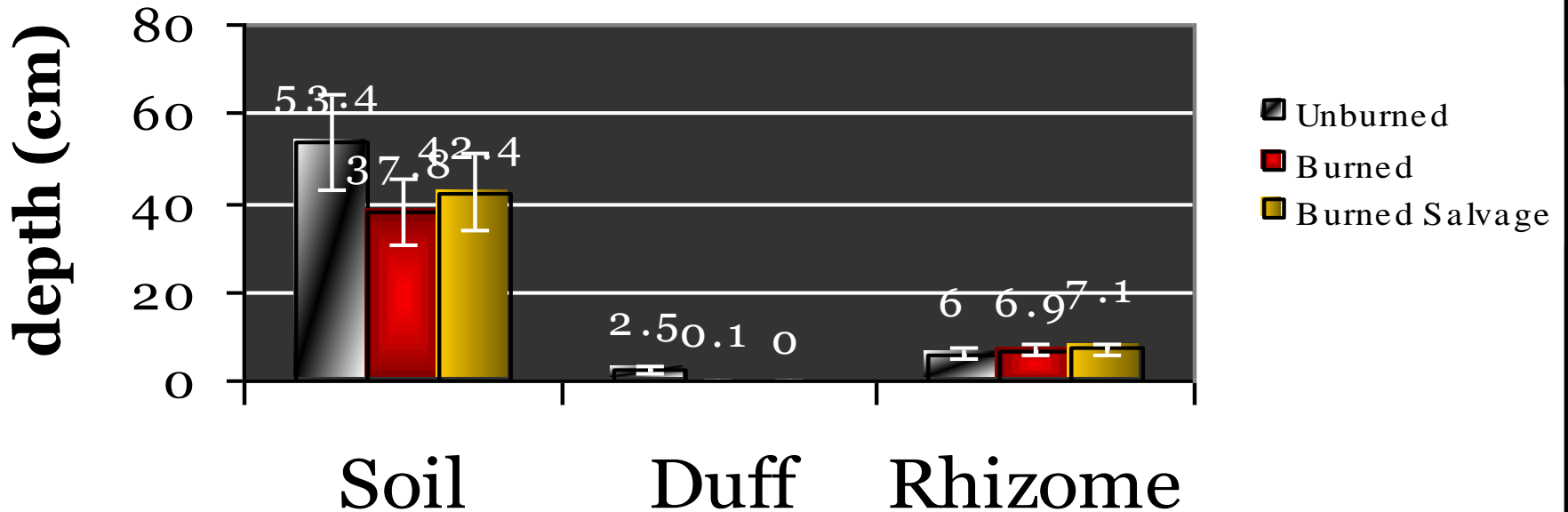
**Rhizomes occupy the root zones where most:**

- **Water is diffused**
- **Micronutrients are captured**
- **Nitrogen cycling occurs**

**Rhizomes are the most active part of the root. The symbiotic relationship between microbes and plants allow Nitrogen cycling. Microbes consume humus releasing  $\text{NO}_3^-$  as a byproduct.**



# Comparison of Depth in Forest Soils



# Importance of Moisture

**Soil moisture is a limiting factor in Eastern Oregon forests.**

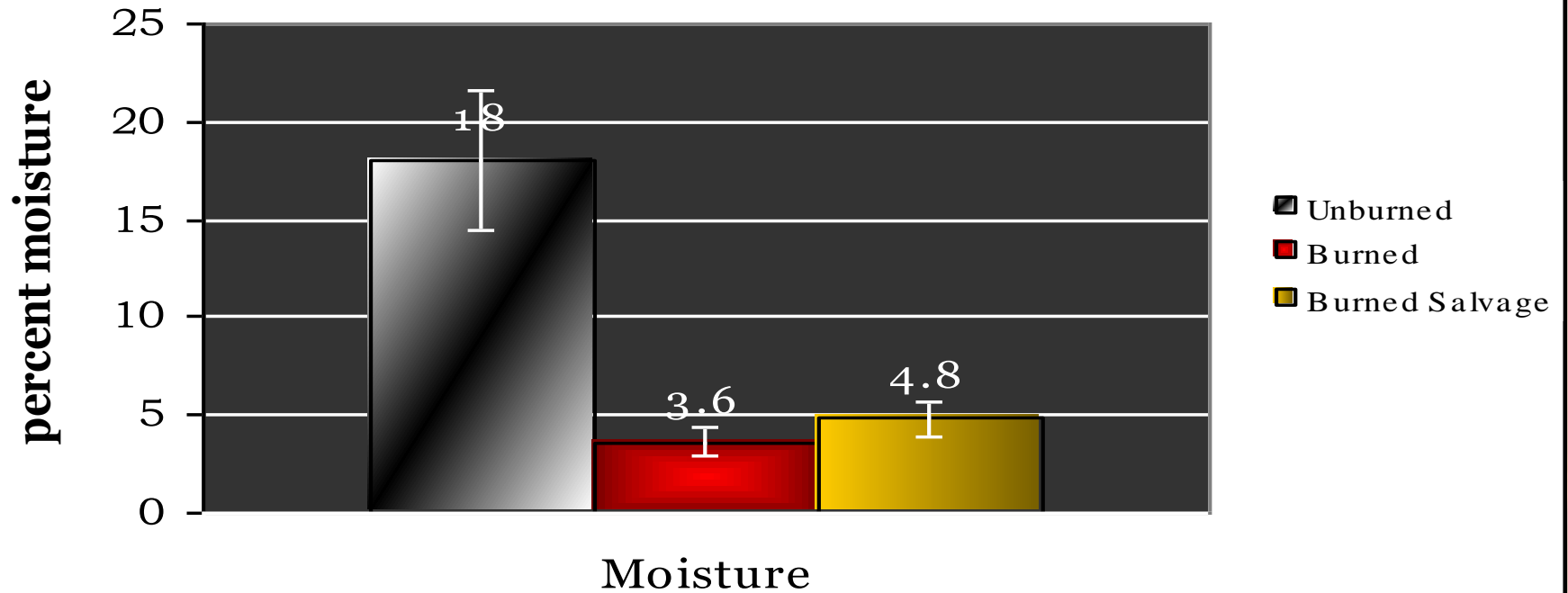
**Moisture determines the:**

- **Rate of plant growth**
- **Density of vegetation**
- **Climax species**

**Moisture also affects the severity of fire impact on soils**



# Comparison of Moisture in Forest Soils



# Importance of Temperature

**High temperature is caused by lack of canopy, shrubs, and exposed soils and:**

- **Lowers soil moisture**
- **Increases soil biota activity**
- **Cycles Nitrogen irregularly**

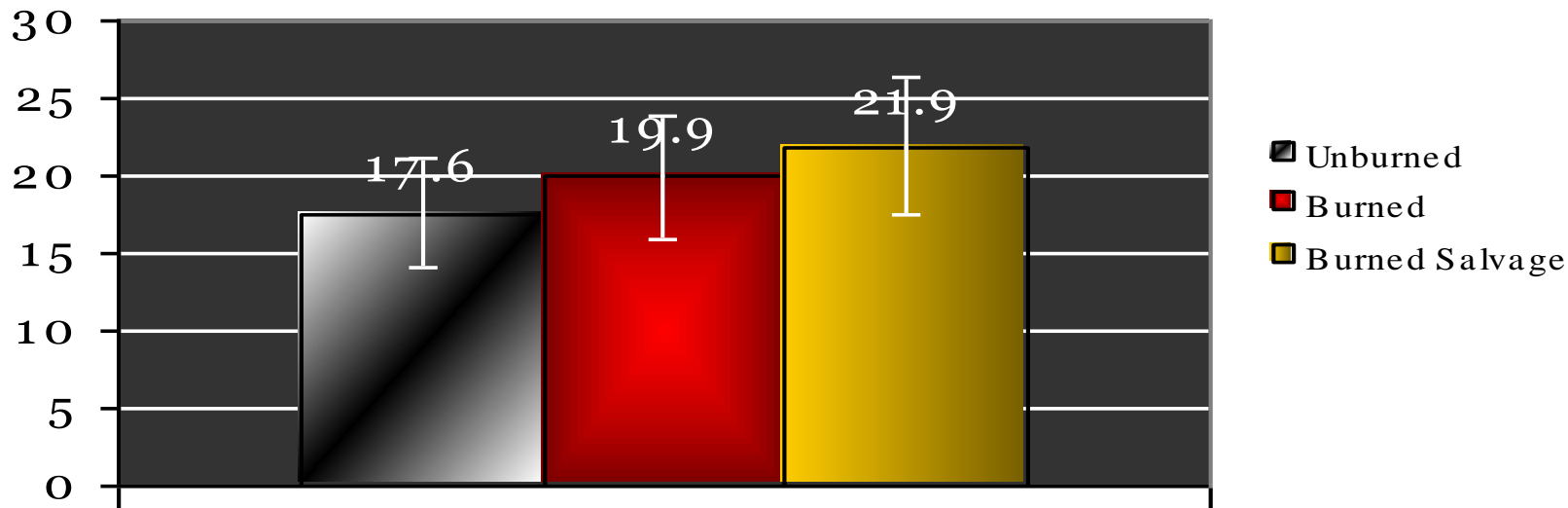
**Low temperature is the result of high shade, thick litter and:**

- **Raise soil moisture**
- **Decrease soil biota activity**
- **Cycles Nitrogen evenly**



# Comparison of Temperature in Forest Soils

degrees centigrade



Temperature

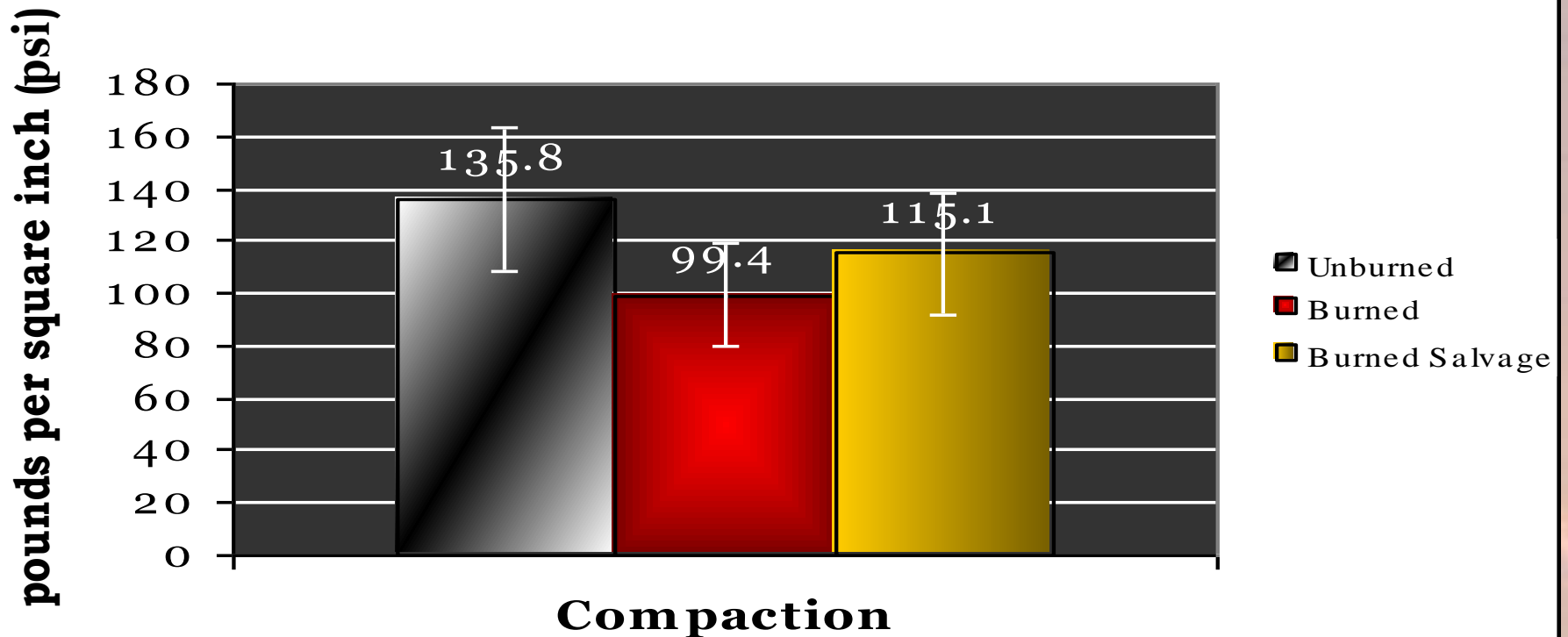


# Importance of Compaction

- **Soil peds are made up of sand/silt/clay particles**
- **Soil texture determines how much air and water space exists**
- **Low compaction indicates peds with good air and water capacity**
- **High compaction indicates soils with low water capacity and infiltration.**



# Comparison of Compaction in Forest Soils



# Burned vs. Unburned

<b>Decreasing factors</b>	<b>&gt;   t  </b>	<b>Significant?</b>
▪ <b>Soil depth</b>	<b>.0001</b>	<b>yes</b>
▪ <b>Percent moisture</b>	<b>.0001</b>	<b>yes</b>
▪ <b>Compaction</b>	<b>.358</b>	<b>no</b>
<b>Increasing factors</b>		
▪ <b>Duff depth</b>	<b>.0001</b>	<b>yes</b>
▪ <b>Rhizome depth</b>	<b>.041</b>	<b>yes</b>
▪ <b>Temperature</b>	<b>.0001</b>	<b>yes</b>



# Burned vs. Burned Salvage

Duff depth was similar and mostly absent

▪Decreasing factors	>   t	Significant?
▪Compaction	.524	no
▪Increasing factors		
▪Soil depth	.167	no
▪Rhizome depth	.716	no
▪Percent moisture	.016	no
▪Temperature	.0001	yes



# Soil Characteristics Statistics

## *Unburned vs. Burned Forest Soils*

- Statistically significant results included soil depth, litter depth, rhizome depth, percent moisture, and temperature.

## *Burned vs. Burned Salvaged Forest Soils*

- The only statistical significant difference was temperature.



# Interpretations

- **6 years following fire, nitrogen decreases due to**
  - **Denitrification – converted to  $N_2$  (78% of atmosphere)**
- **Potassium and Phosphate increase due to**
  - **Mineralization**
- **Following salvage, nitrogen decreased slightly**
  - **Incineration of nitrogen-rich leaves occurred during fire previously**
  - **Dead trunks contain little nitrogen (cellulose)**



# Implications for Treatment

- **Treat soils immediately following fire to maintain high nitrogen**
  - **Especially in the form of Ammonia**
    - **Supports perennials and late seral succession**
- **Encourage nitrogen fixing plants**
  - **Ex. Silver Lupine (*Lupinus argentius*)**
- **Seed within first year to sequester released nitrogen**

