Impact of Forest Management on Wood Stake Decomposition in Mineral Soil: Index for Soil Productivity



Photo by Anne H. Collins

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- Forest management practices impact soil organic matter decomposition rates,which can change soil nutrient availability and carbon sequestration.

- Productivity of an area is determined by the soils capacity to support plant growth and is reflected by site index and biomass accumulation (Powers, 1991).

- It has been shown that organic matter decomposition rates and site productivity are directly related (Kurka and Starr,1997).

- Many decomposition studies of organic matter have been conducted using leaf litter as the substrate in forest soils, on the forest floor and throughout the soil column (Berg et al., 1996).

- Little has been done to explore the physical properties of soils (mineral soil) that influence root growth and nutrient uptake (Dyck et al., 1991).

- There is currently no definitive measure of soil quality that is directly related to site productivity (Fox 2000).

- Literature has indicated that most soil decomposition studies have been on the surface using litter bags
- Therefore a study observing the decomposition of woodstakes in the mineral soil, would be a beneficial measurement.

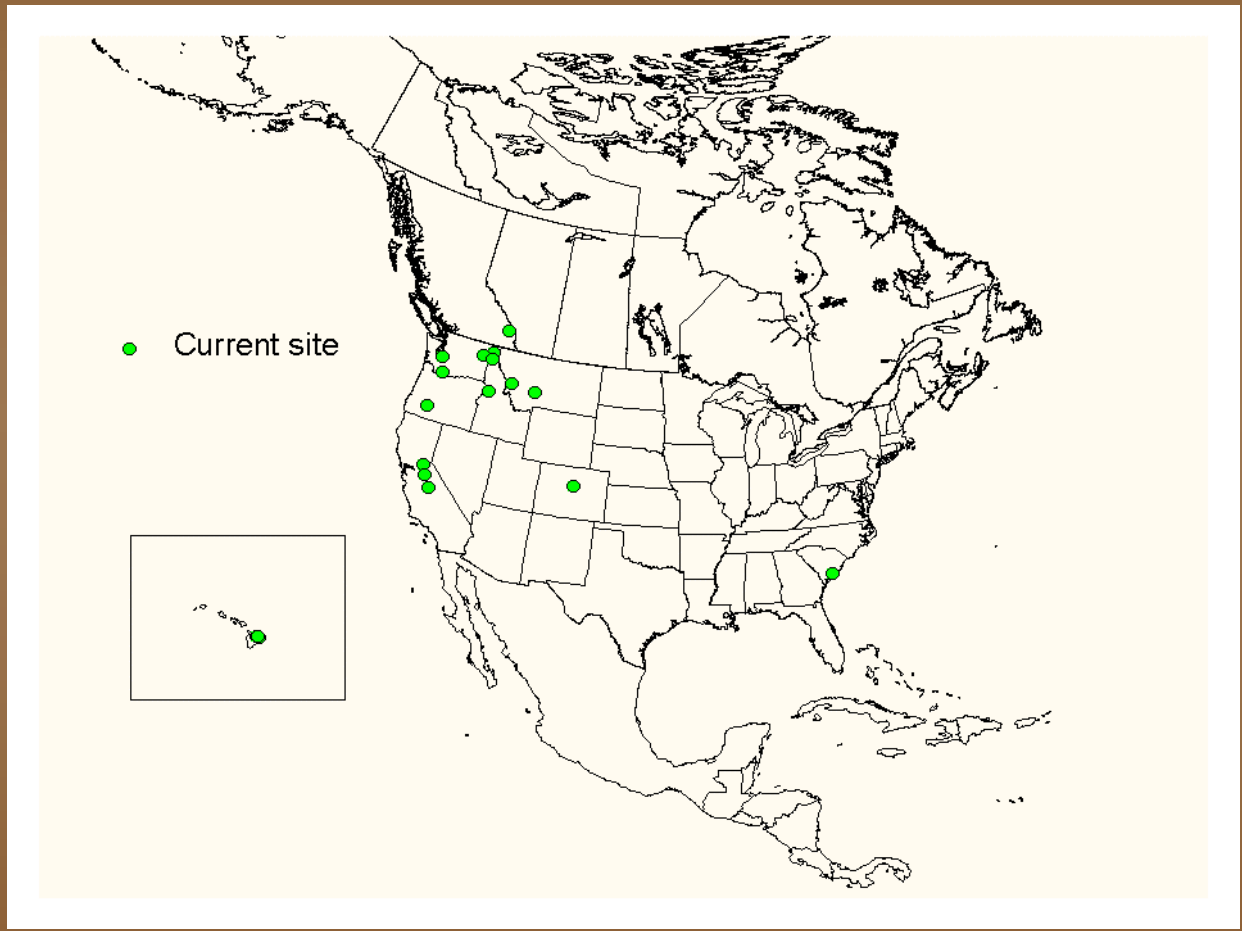


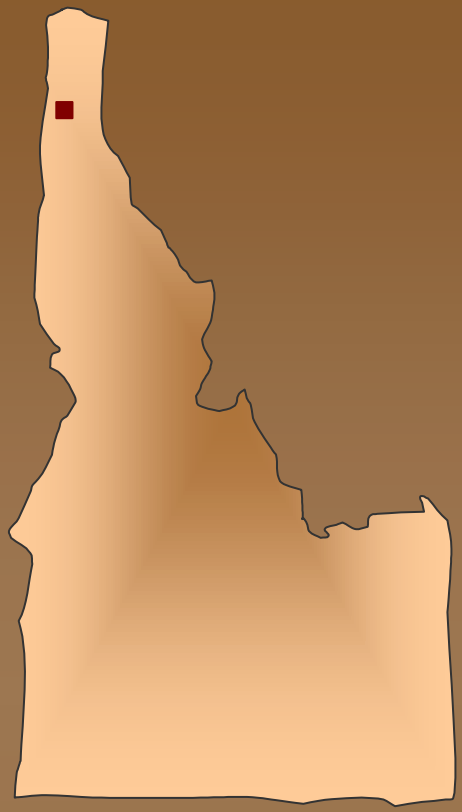
The objectives of this study are:

- Estimate the effects of surface organic matter removal and soil compaction on wood decomposition in the mineral soil.

- Determine the effects of soil moisture and temperature on decomposition rates and the microbial decay patterns.

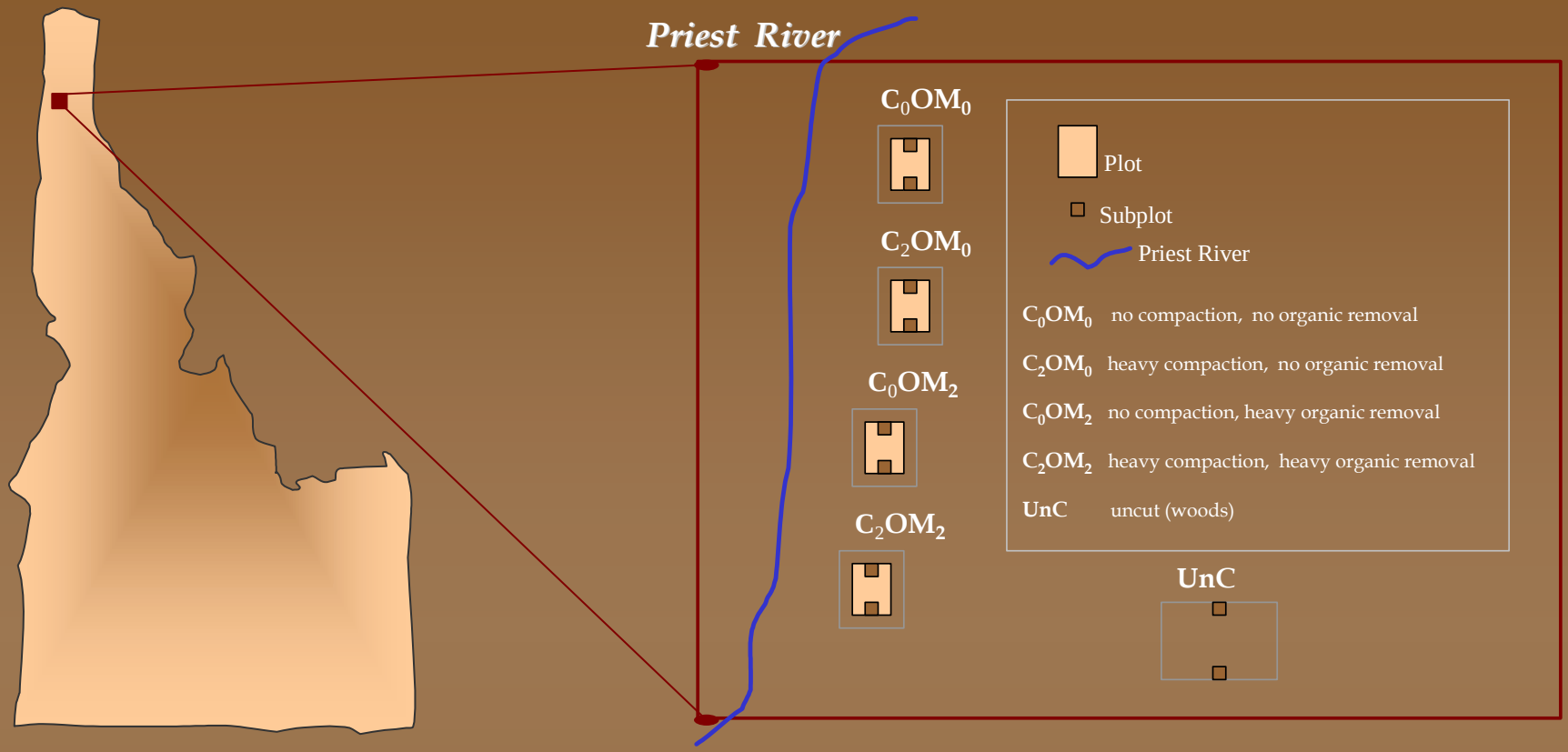
Twenty-five sites have been established in North America since 1998





- **Priest River Experimental Forest**
  - 715 m in Elevation (Lat. 48°21′ N, Long. 116°50′ W)
  - *Abies grandis/Clintonia uniflora* complex
  - Silt loam, medial, frigid Orchreptic Fragixeralf soil
- **Long Term Soil Productivity Site (LTSP)**




Priest River
C_0OM_0
C_2OM_0
C_0OM_2
C_2OM_2
UnC
Plot
Subplot
Priest River
C_0OM_0 no compaction, no organic removal
C_2OM_0 heavy compaction, no organic removal
C_0OM_2 no compaction, heavy organic removal
C_2OM_2 heavy compaction, heavy organic removal
UnC uncut (woods)









Two Standard wood stakes were used

- Southern yellow pine (softwood)
- Trembling Aspen (hardwood)

  - **Uniform or defined organic material (not from study site)**
  - **Removes OM quality as a decomposition factor**
  - **Measures effect of abiotic soil factors water, temperature, pH, nutrients, etc.**
  - **Comparison among different sites in the Large Stake Study**

Two Insertion Date Established

- October 1997
- April 1998

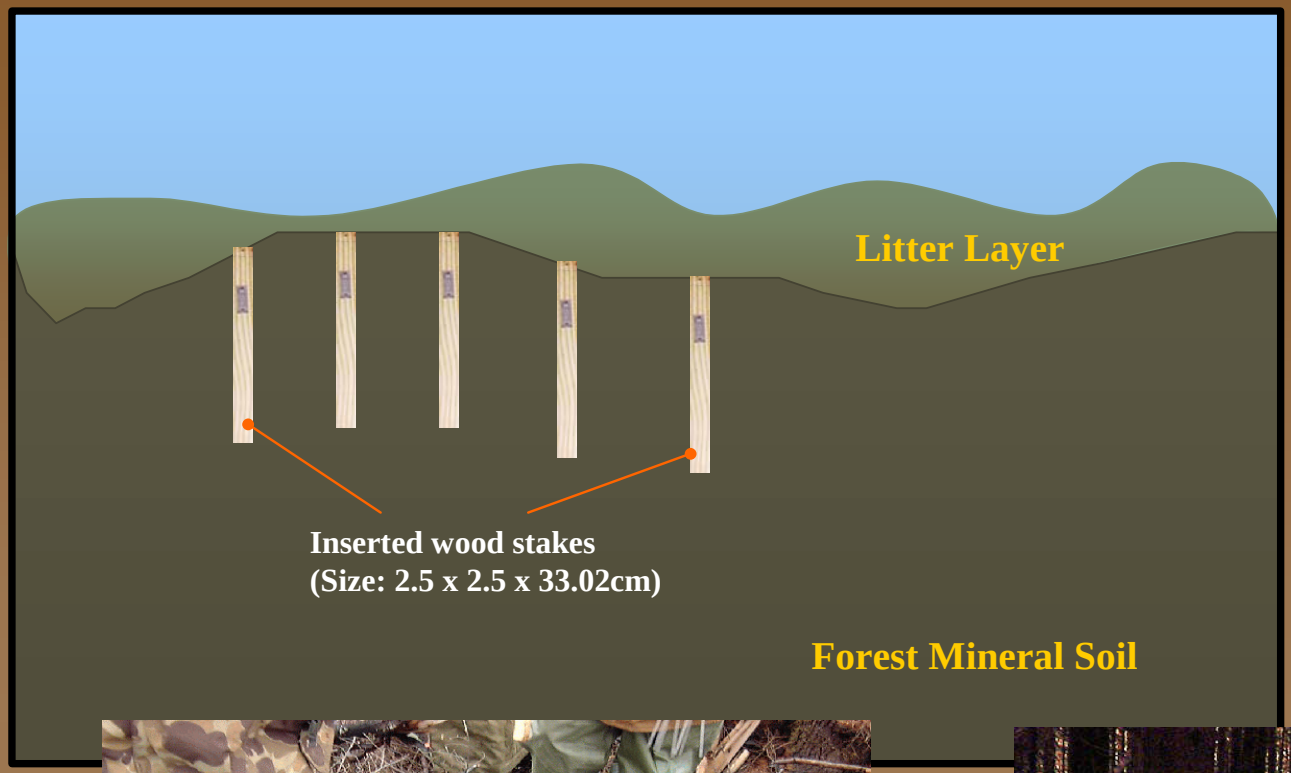
Mother Stake

2.5 cm x 2.5 cm x 91.44cm (fall)
2.5 cm x 2.5 cm x 76.2 cm (spring)

Daughter Stake-1	Control	Daughter Stake-2
2.5 cm x 2.5 cm x 33.0 cm	2.5 cm x 2.5 cm x 25.4 cm (f) 2.5cm x 2.5cm 10.1cm (s)	2.5 cm x 2.5 cm x 33.0 cm

500 Stakes inserted in October 1997

500 Stakes inserted in April 1998

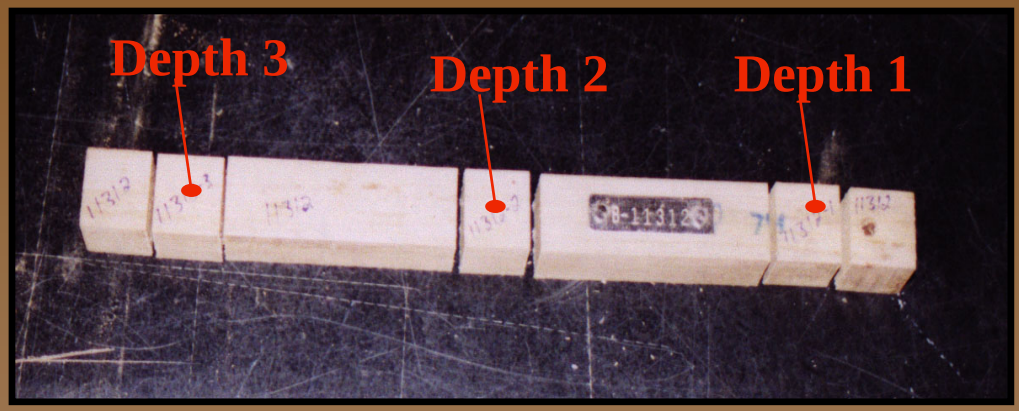

Litter Layer
Inserted wood stakes
(Size: 2.5 x 2.5 x 33.02cm)
Forest Mineral Soil





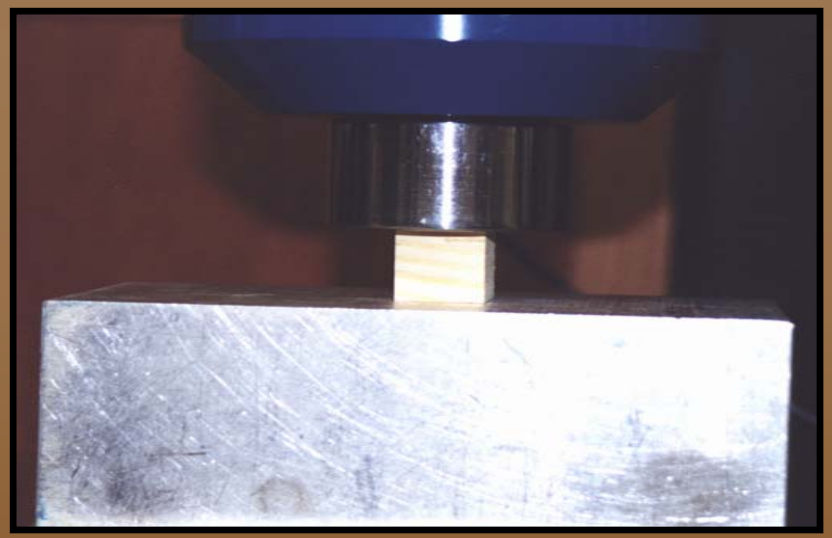


- The Stakes were extracted every 6 months from each subplot for 2.5 years
- Three Penetrometer Readings were taken 5.1 cm from stake



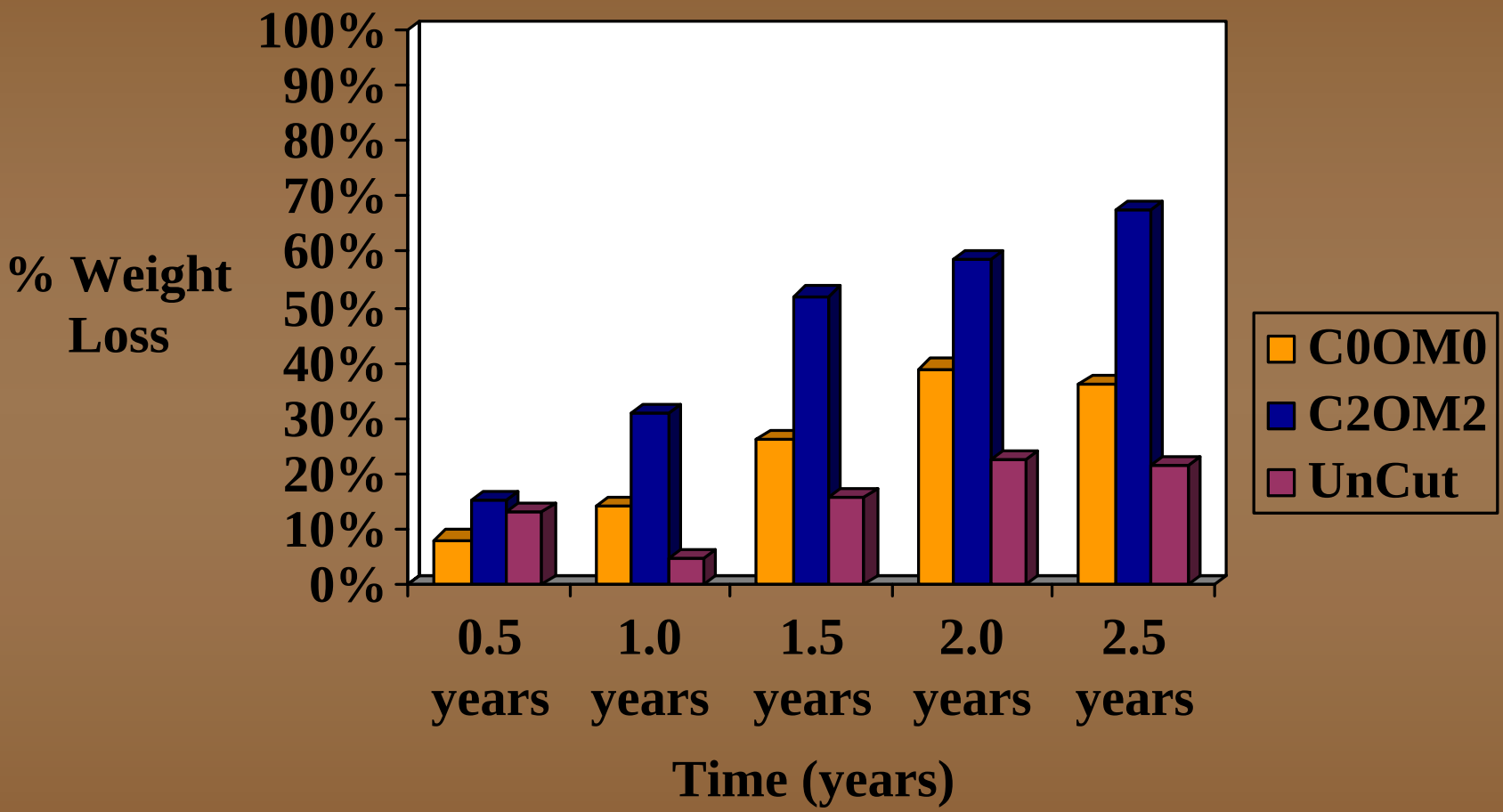
- Depth 1: 2.5 cm - 5.1 cm
- Depth 2: 15.2cm -17.8 cm
- Depth 3: 27.9 cm - 30.5 cm





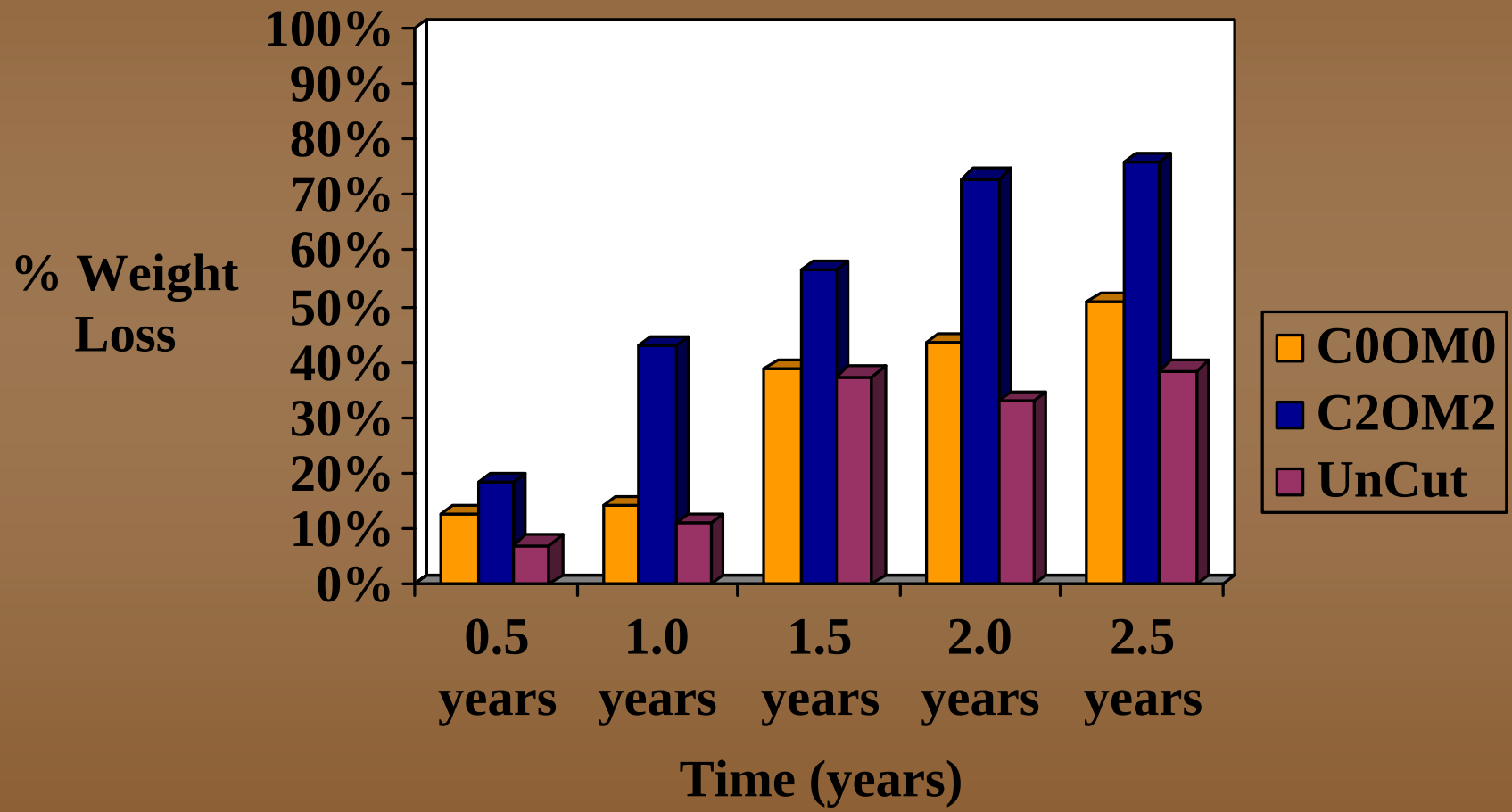
Pine Stake Decomposition

By treatment

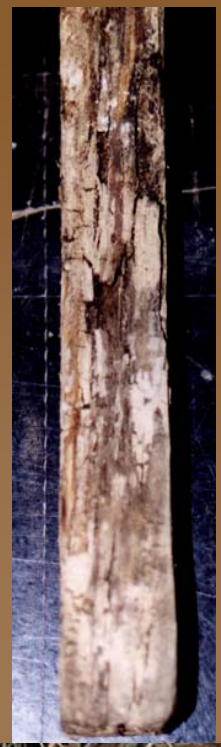


Aspen Stake Decomposition

By treatment







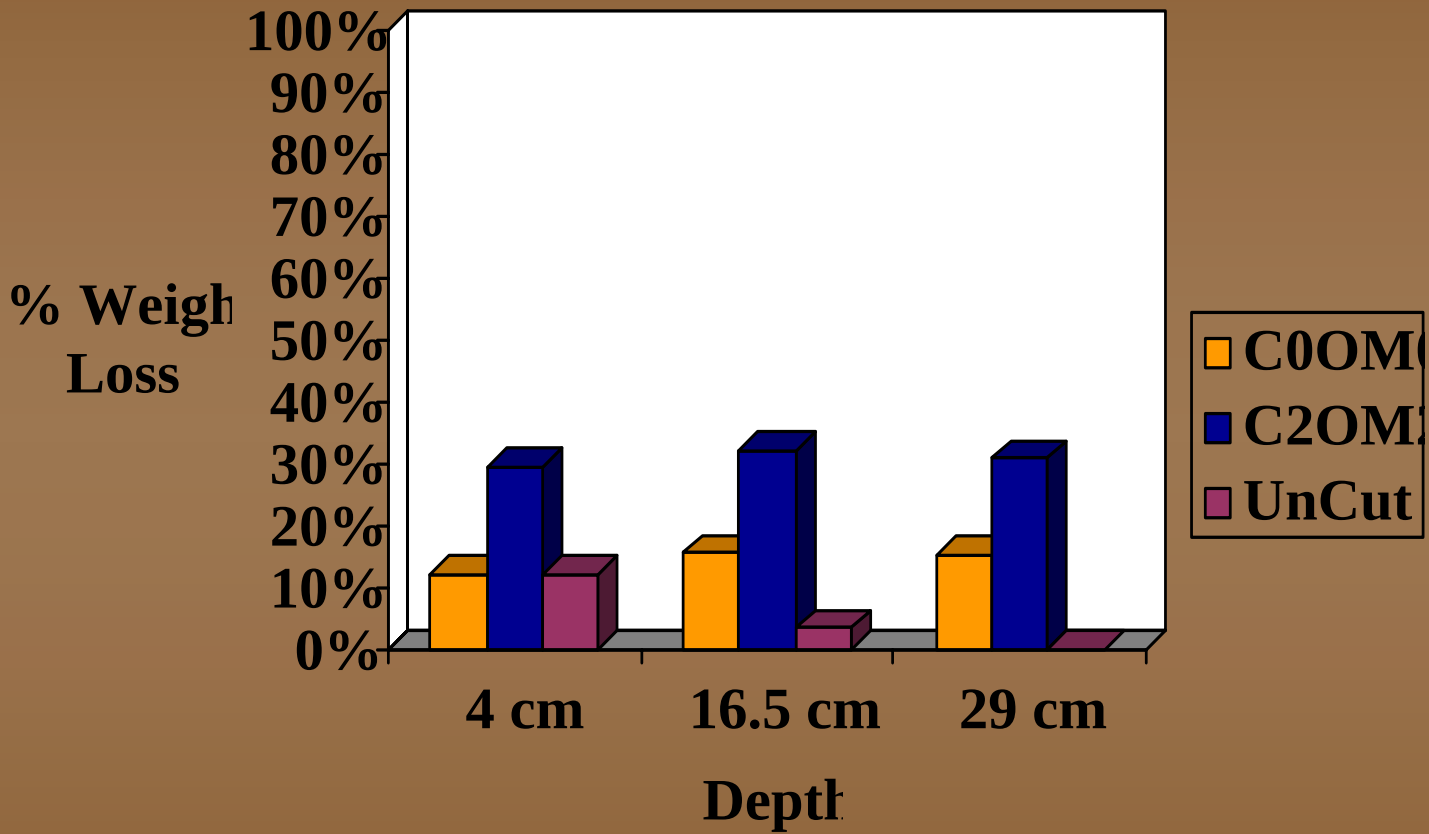




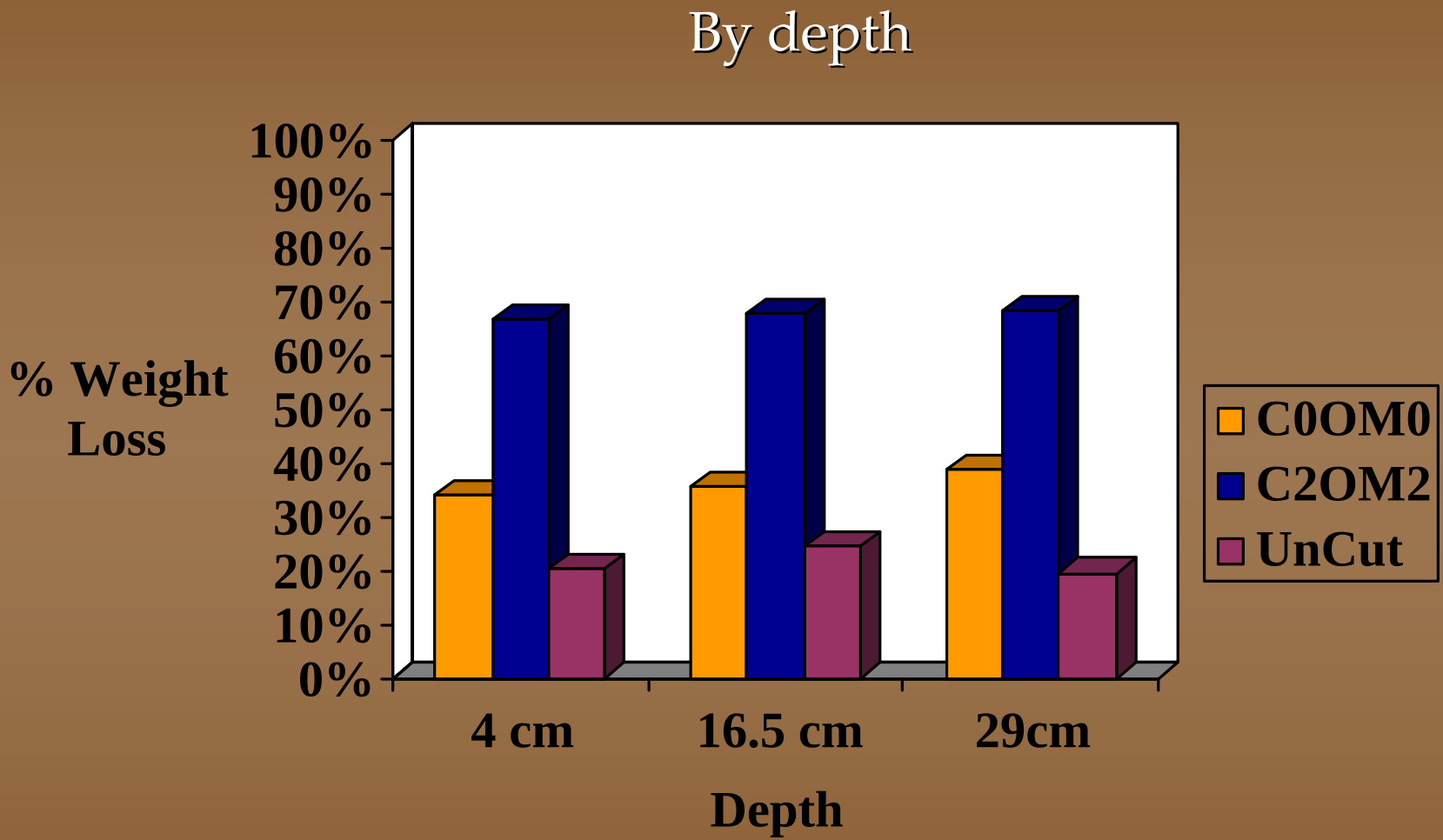

Nikon

Pine Stake Decomposition at 1.0 years

By depth

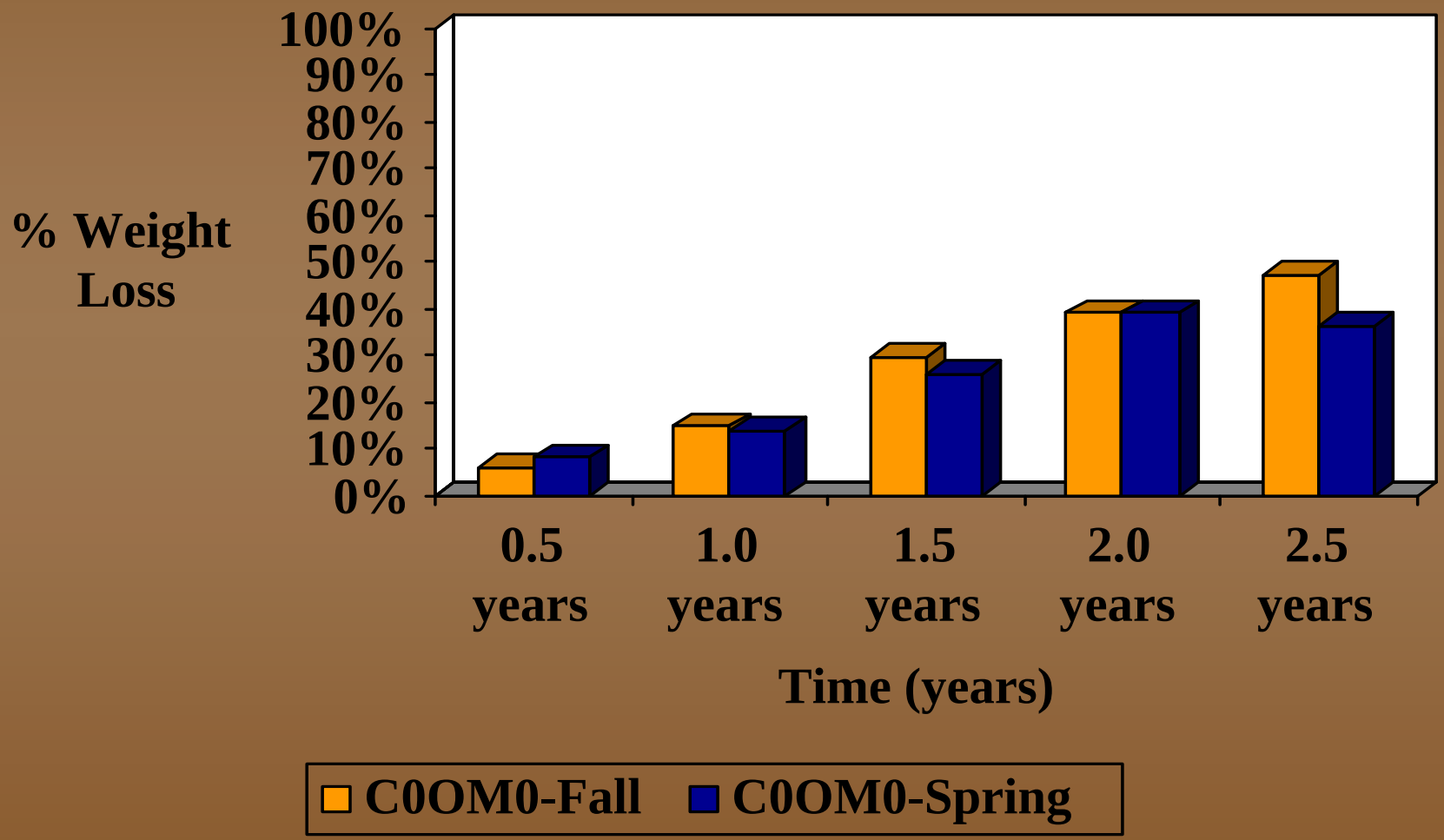


Pine Stake Decomposition at 2.5 years



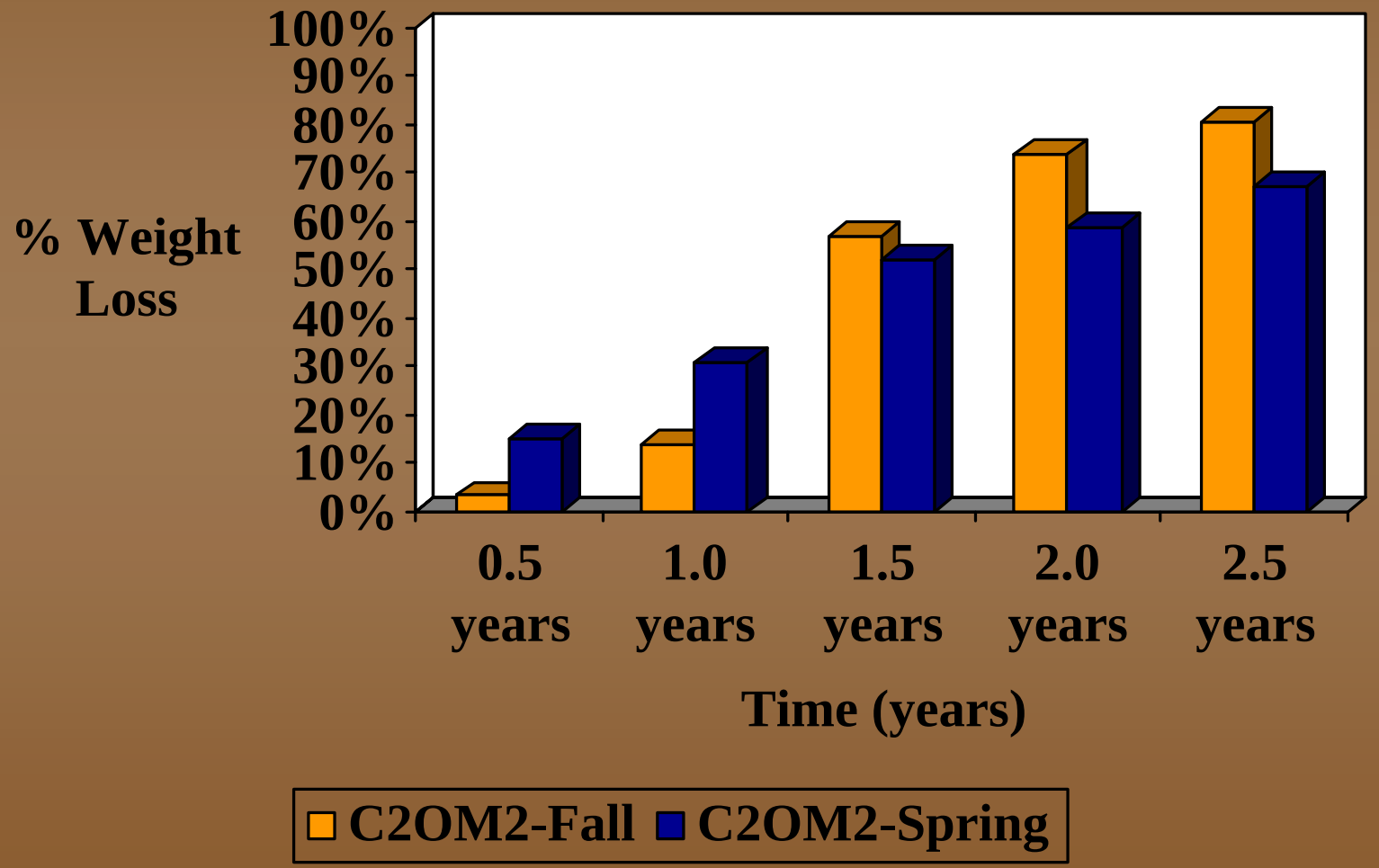
Pine Stake Decomposition

By insertion time



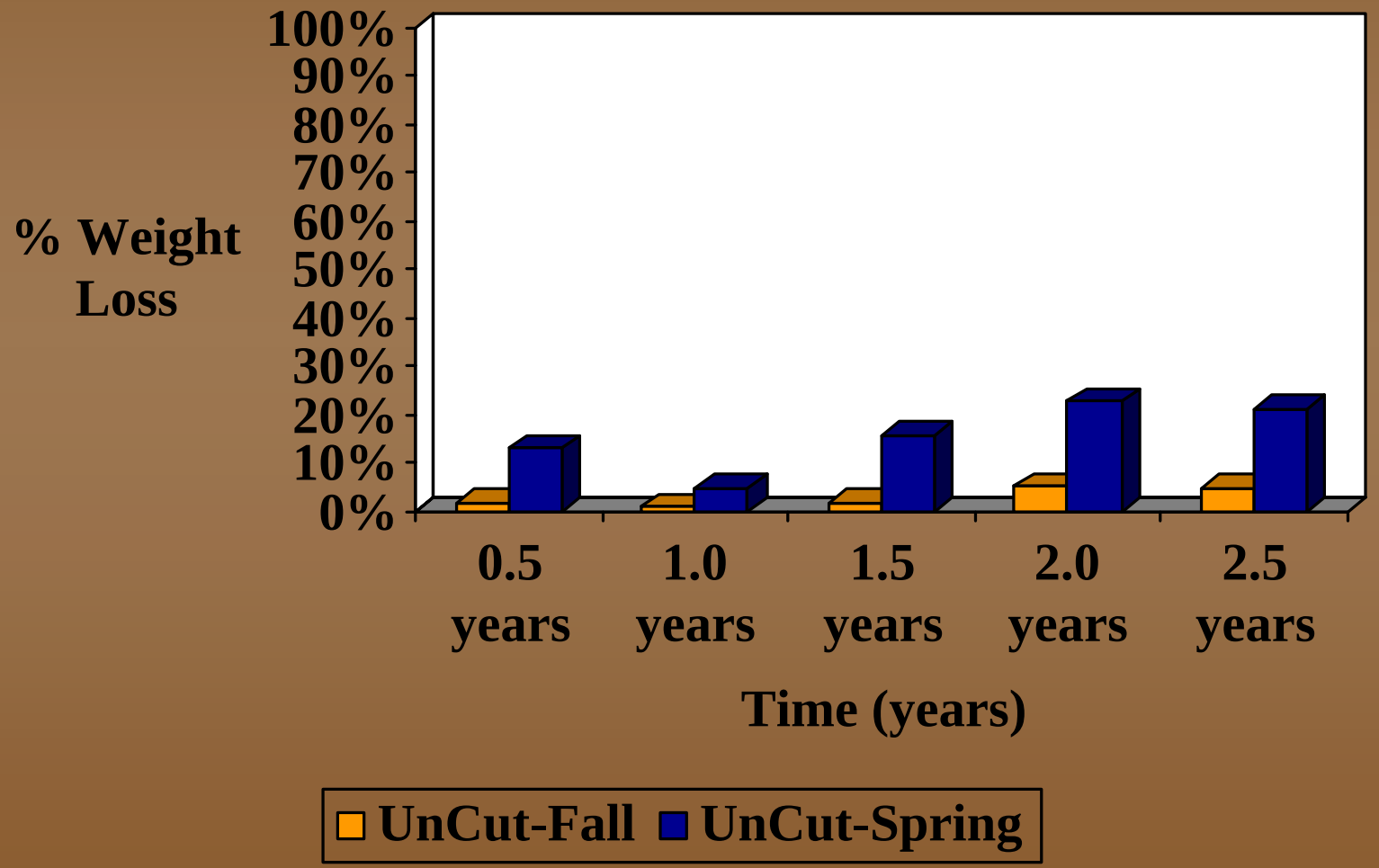
Pine Stake Decomposition

By insertion time

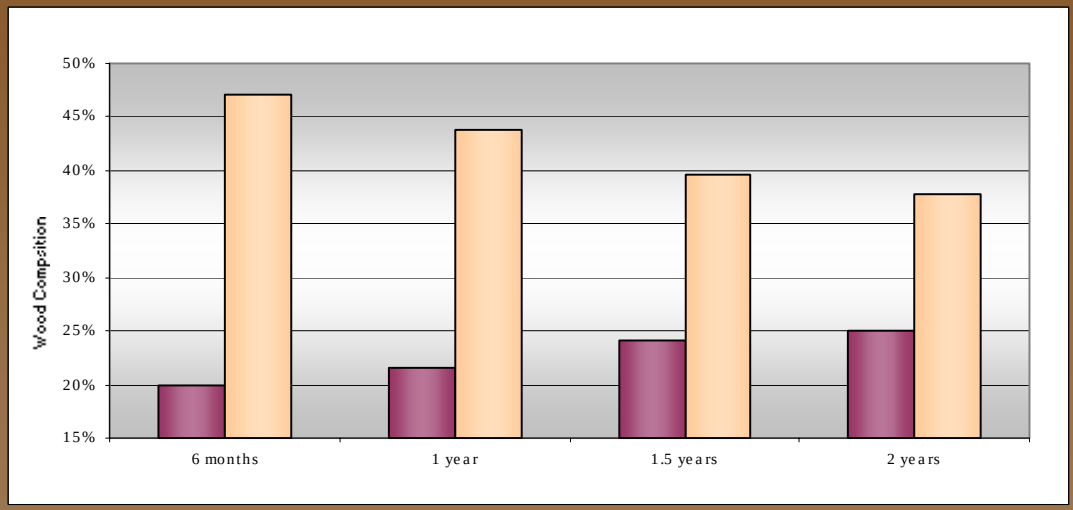


Pine Stake Decomposition

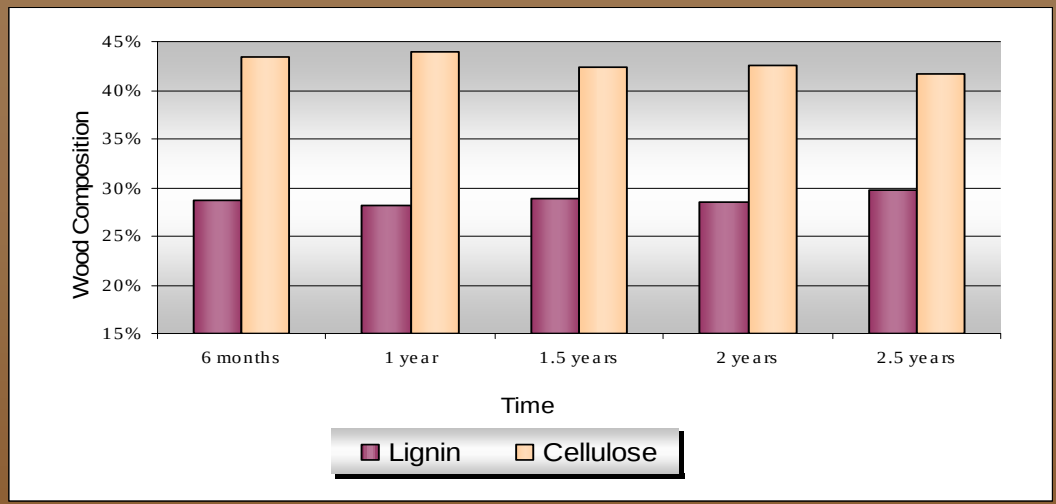
By insertion time



Aspen


50%
45%
40%
35%
30%
25%
20%
15%
Wood Composition
6 months
1 year
1.5 years
2 years

Pine


45%
40%
35%
30%
25%
20%
15%
Wood Composition
6 months
1 year
1.5 years
2 years
2.5 years
Time
Lignin
Cellulose

Summary

- Compaction played an important role in the amount of wood stake decomposition.

- Surprisingly, there was no depth effect of decomposition by treatment or time. The UnCut showed some effect initially, but later measurements did not show it.

- There was a definite seasonal effect

References

Berg, B. 1986. Nutrient release from litter and humus in coniferous forest soils- a mini review. Scand. J. For. Res. 1: 359-369.

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Thank You

