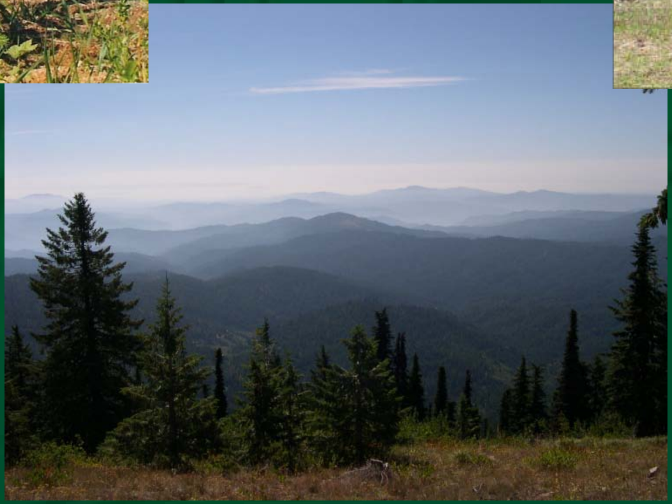
Long Term Growth and Nutrition Consequences of Intensive Treatment

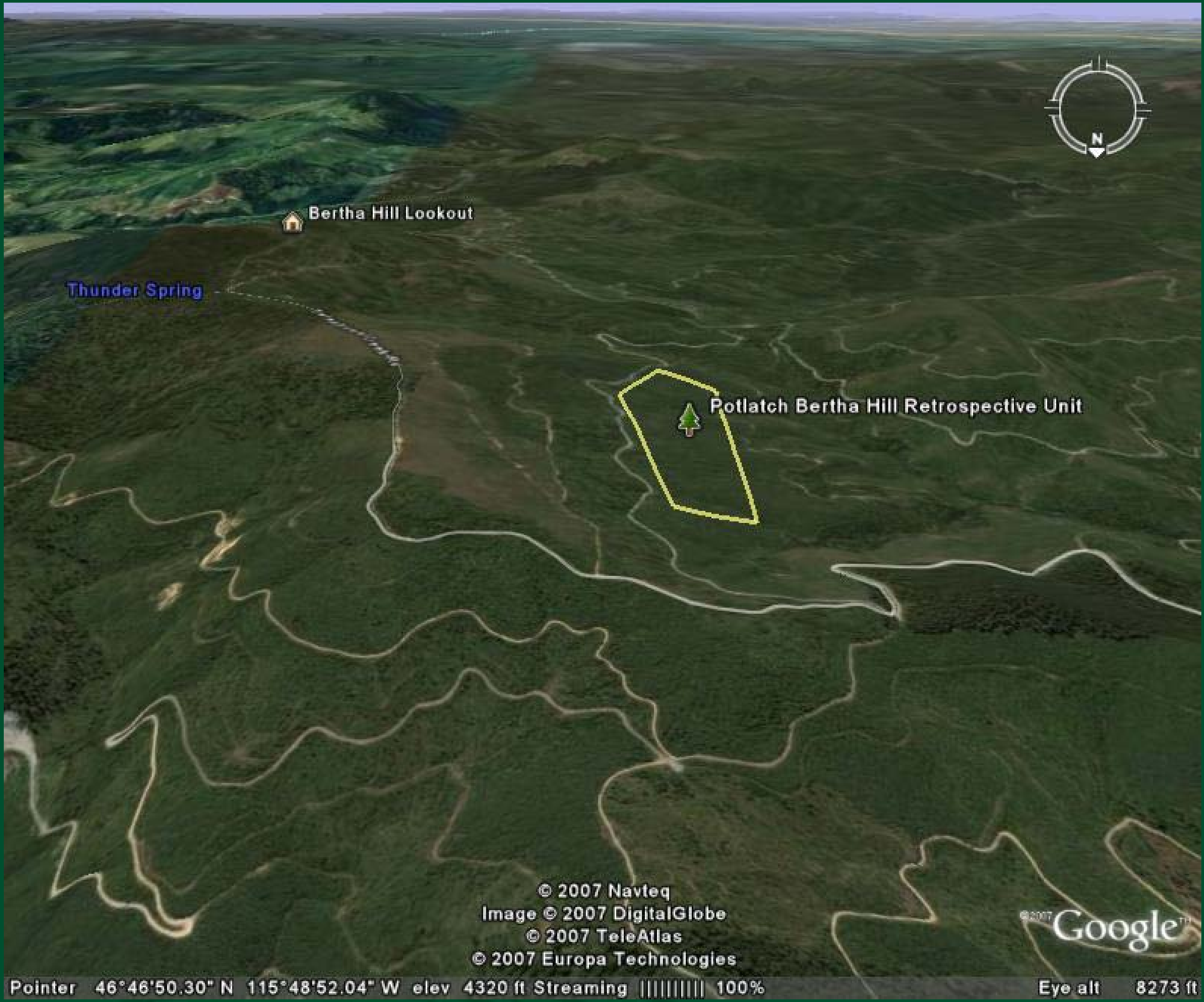
Bertha Hill:

A Case Study



Mark Kimsey

2007 IFTNC Annual Meeting


Bertha Hill Lookout
Thunder Spring
Potlatch Bertha Hill Retrospective Unit
N
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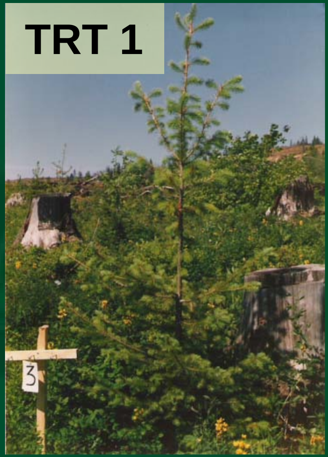
Google
Pointer 46°46'50.30" N 115°48'52.04" W elev 4320 ft Streaming |||||||||| 100%
Eye alt 8273 ft

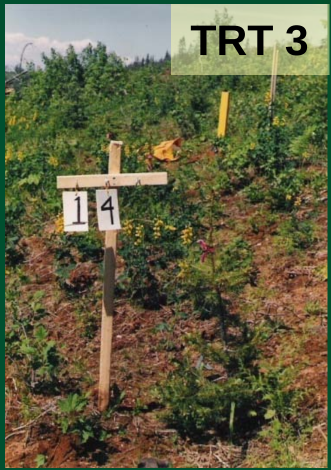
Bertha Hill Timeline

- Clear cut: 1979 – 1981
- Mechanical Site Prep: Fall 1981
- Jackpot/Broadcast Burn: 1982
- Planted: Spring 1983 (Douglas-fir)
- First Research Entry: 1988
- Second Research Entry: 1996
- Third Research Entry: 2006

Treatments

- Treatment 1 – Undisturbed
  - No mechanical disturbance
  - Fire exclusion
- Treatment 2 – Undisturbed/Burn
  - No mechanical disturbance
  - Broadcast burned
- Treatment 3 – Scalp
  - Straight blade dozer slash removal
  - Competing vegetation “rooted out”
  - Surficial soil and litter layer disturbance
  - Fire exclusion
- Treatment 4 – Pile/Burn
  - Straight blade dozer slash pile
  - Jackpot burned
- Treatment 5 – Skid Trail





Treatment Assignment

Modified randomized block design:

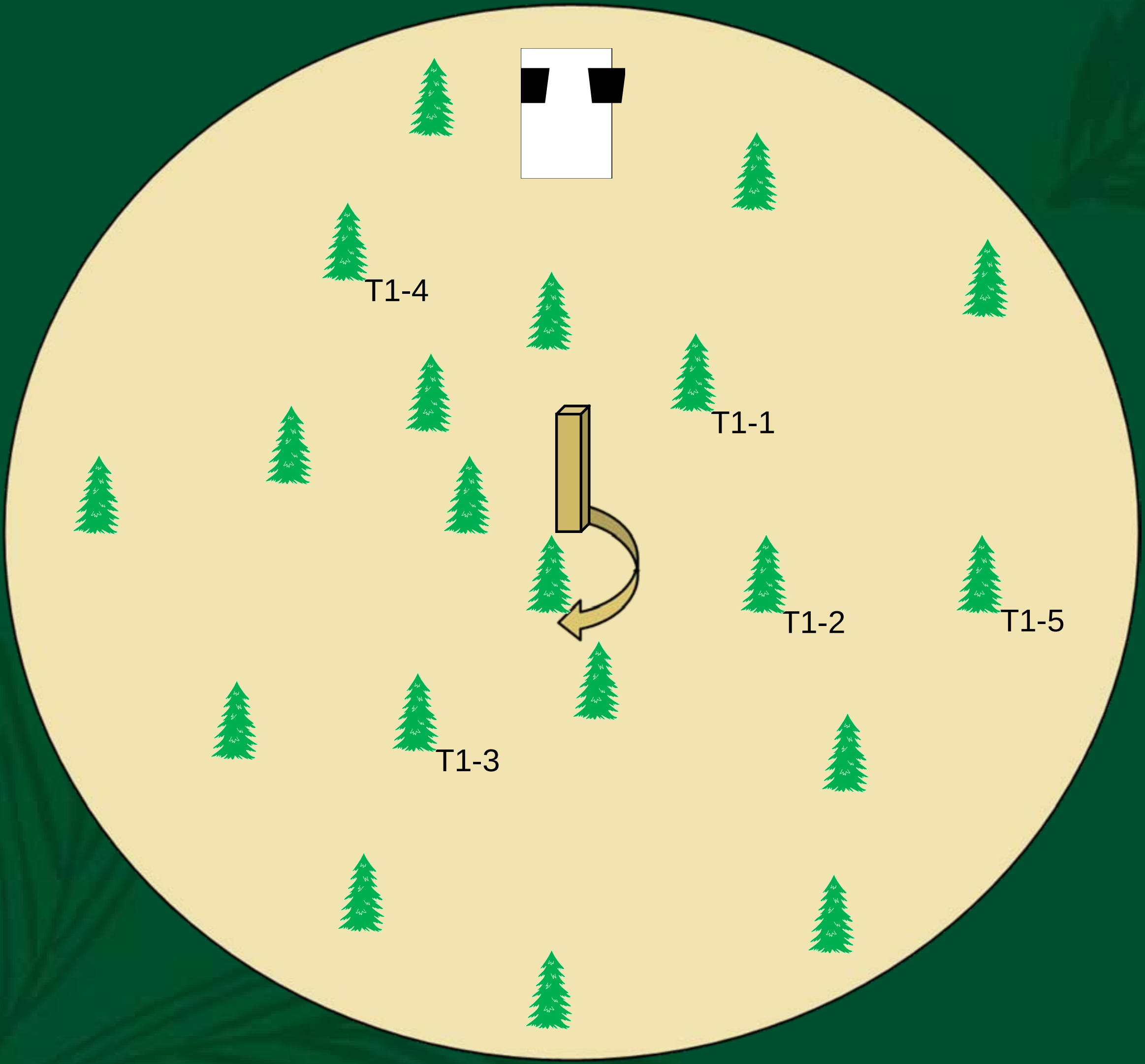
- Five Douglas-fir seedlings assigned to Treatments 1-4

- Treatments 1-4 were replicated across nine plots

- Ten Douglas-fir seedlings were assigned to Treatment 5 on two separate skid trails

- Sampling Intensity:
  - 45 DF seedlings per treatment (1-4)
  - 20 DF seedlings for treatment 5
  - Total sample size: 200

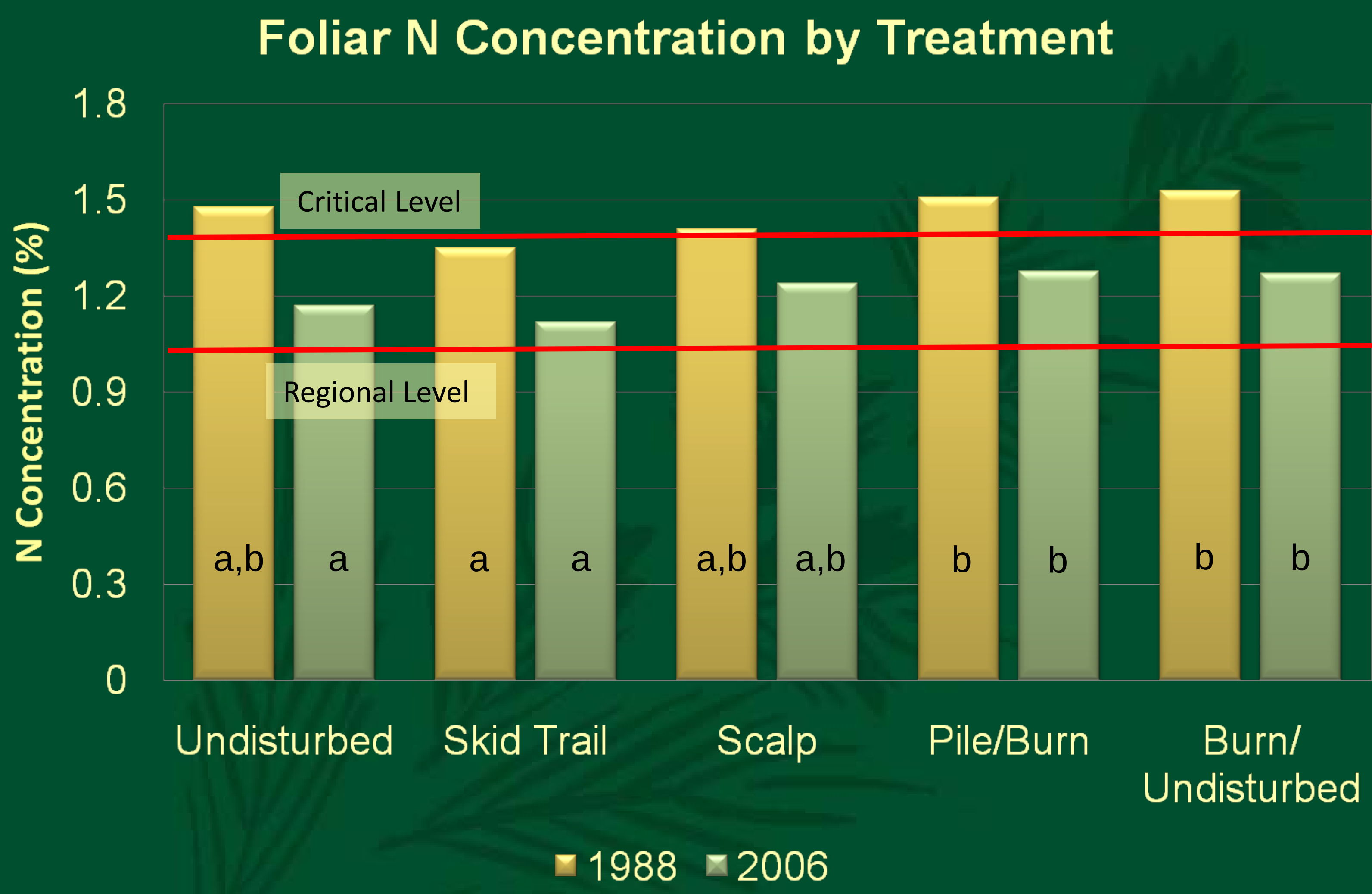
Plot Layout

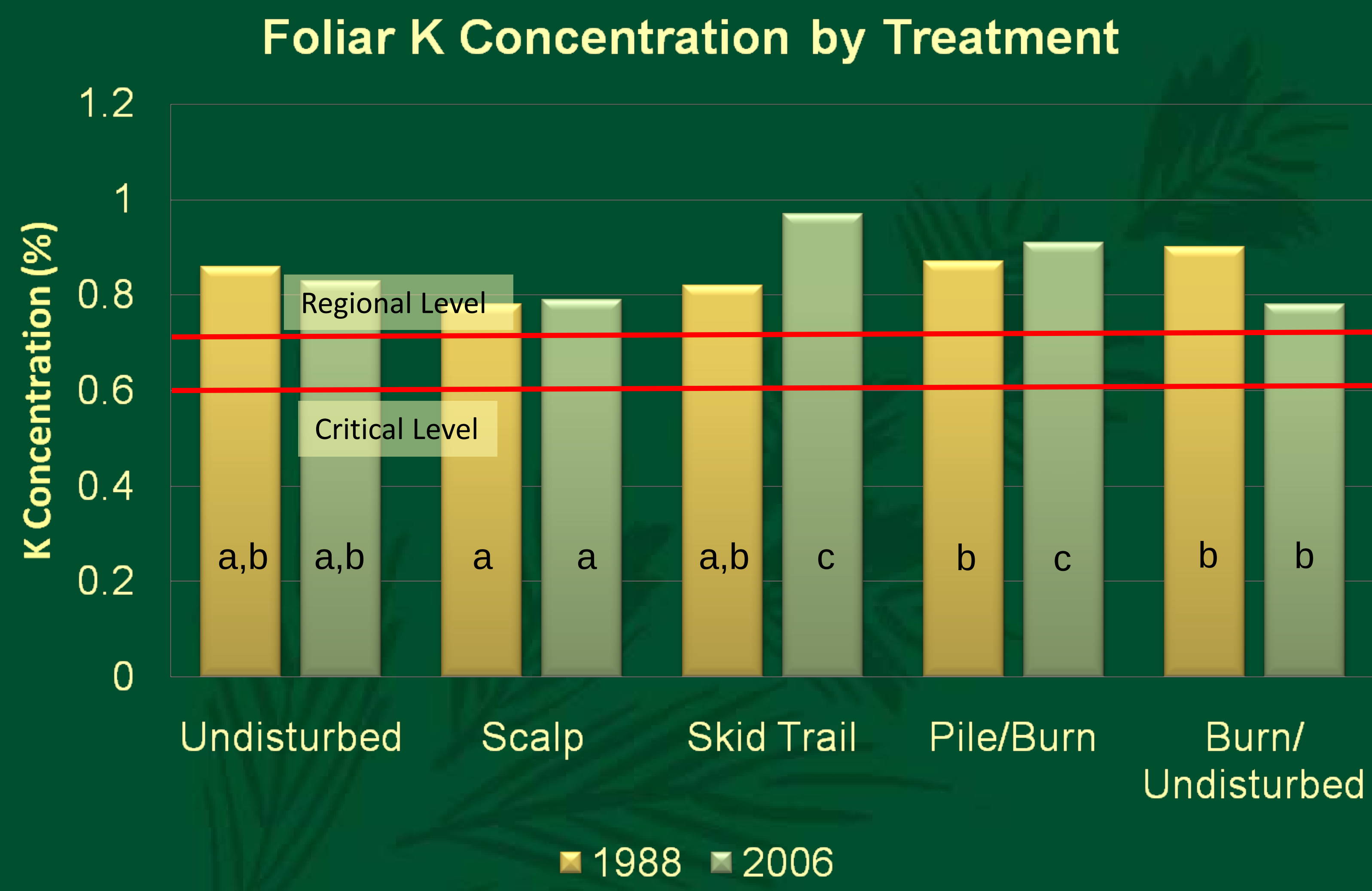


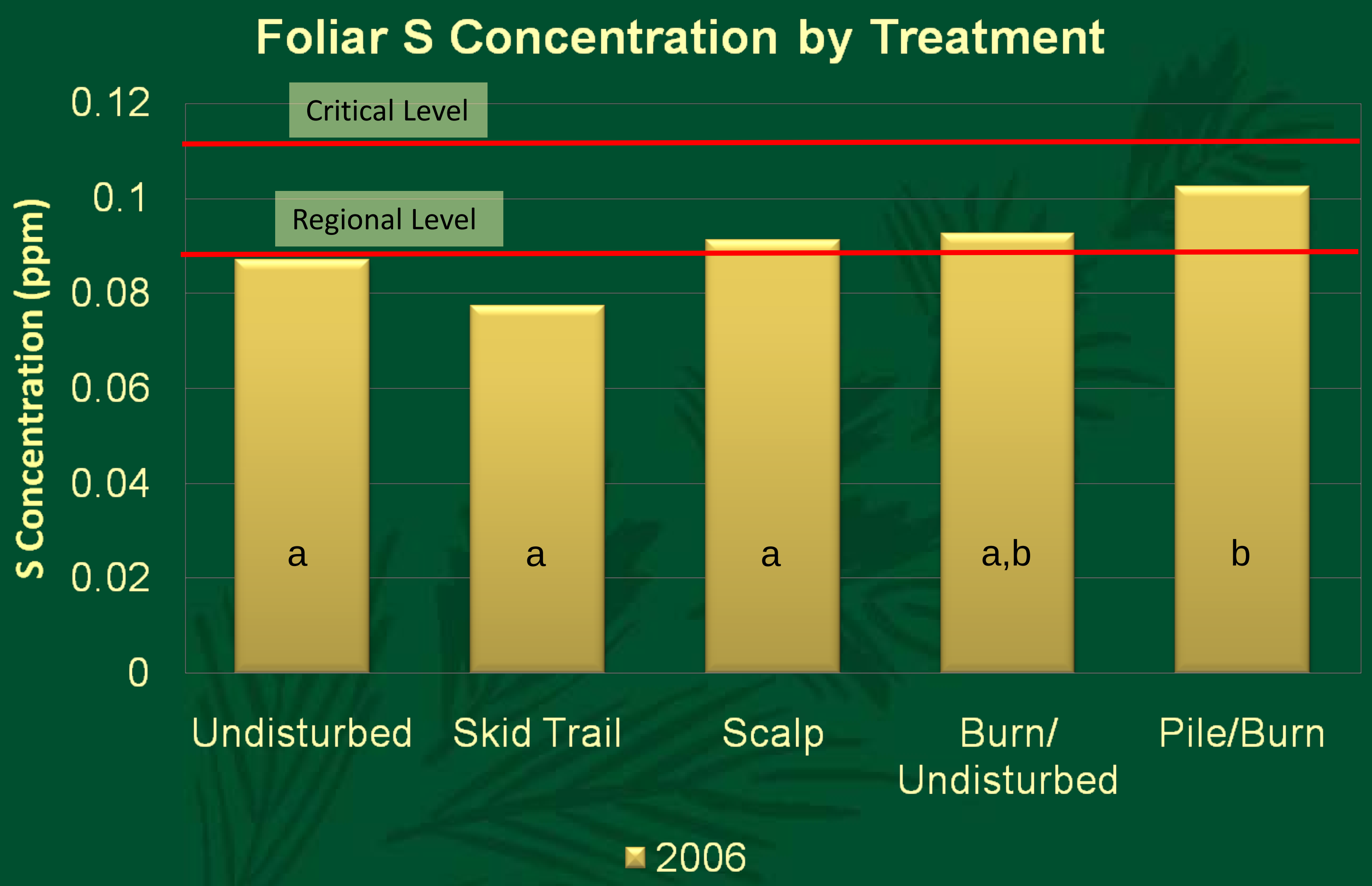
Foliar Nutrition and Diagnostics

Nutrition Overview

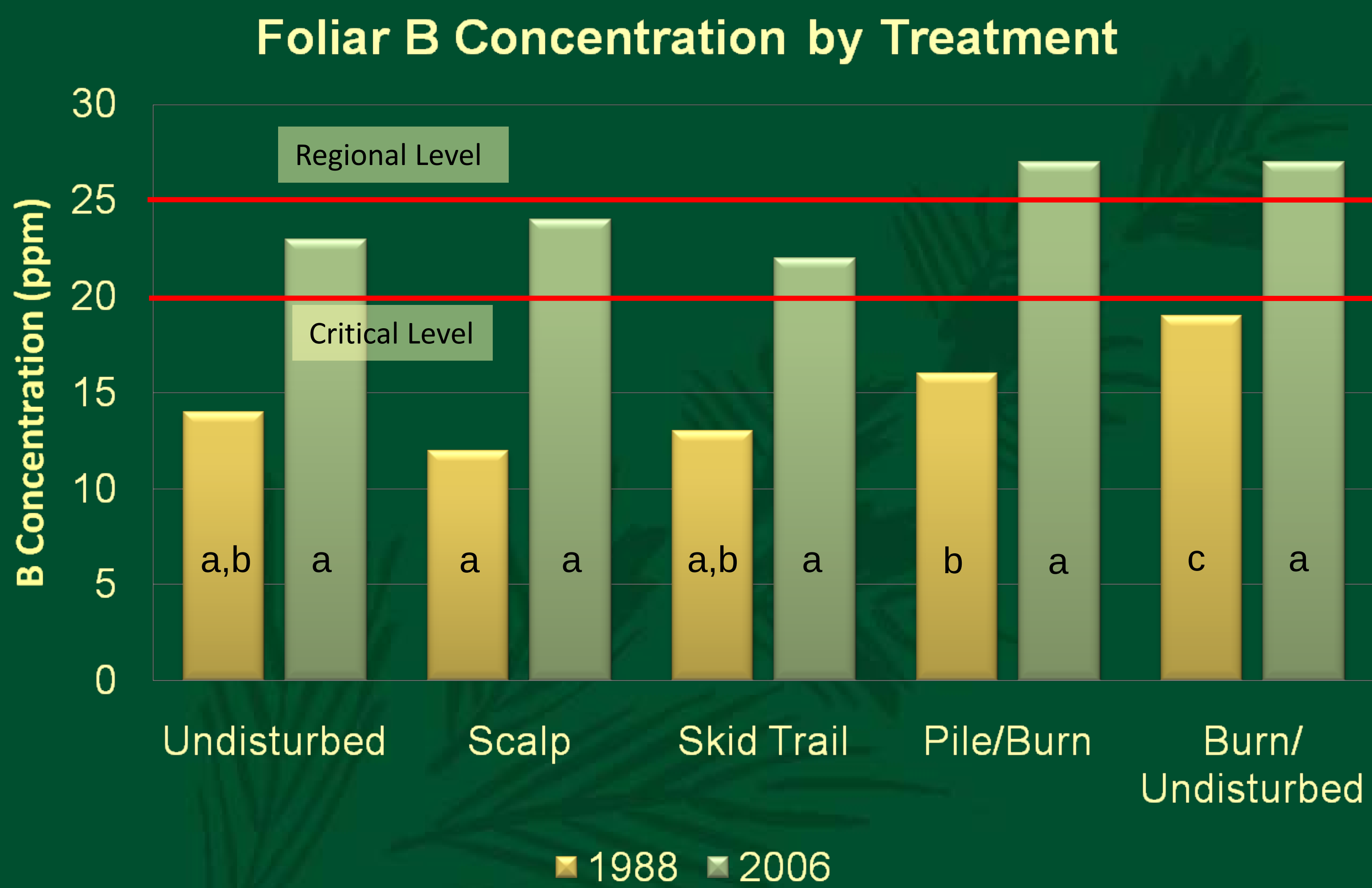
Element	Function	Source	Deficiency
Nitrogen	Photosynthesis, biomass	Atmosphere	Almost always
Phosphorus	Metabolism	Rock	Seldom
Potassium	Stomatal control, defensive chemicals	Rock	Common
Sulfur	Photosynthesis, pest resistance	Atmosphere - Rocks	Common
Boron	Cell wall structure, translocation of sugars	Rock	Very Common
Copper	Photosynthesis, N processing	Rock	Occasional
Zinc	Enzyme structure	Rock	Occasional
Magnesium	Chlorophyll synthesis	Rock	Seldom
Iron	Respiratory metabolism	Rock	Seldom

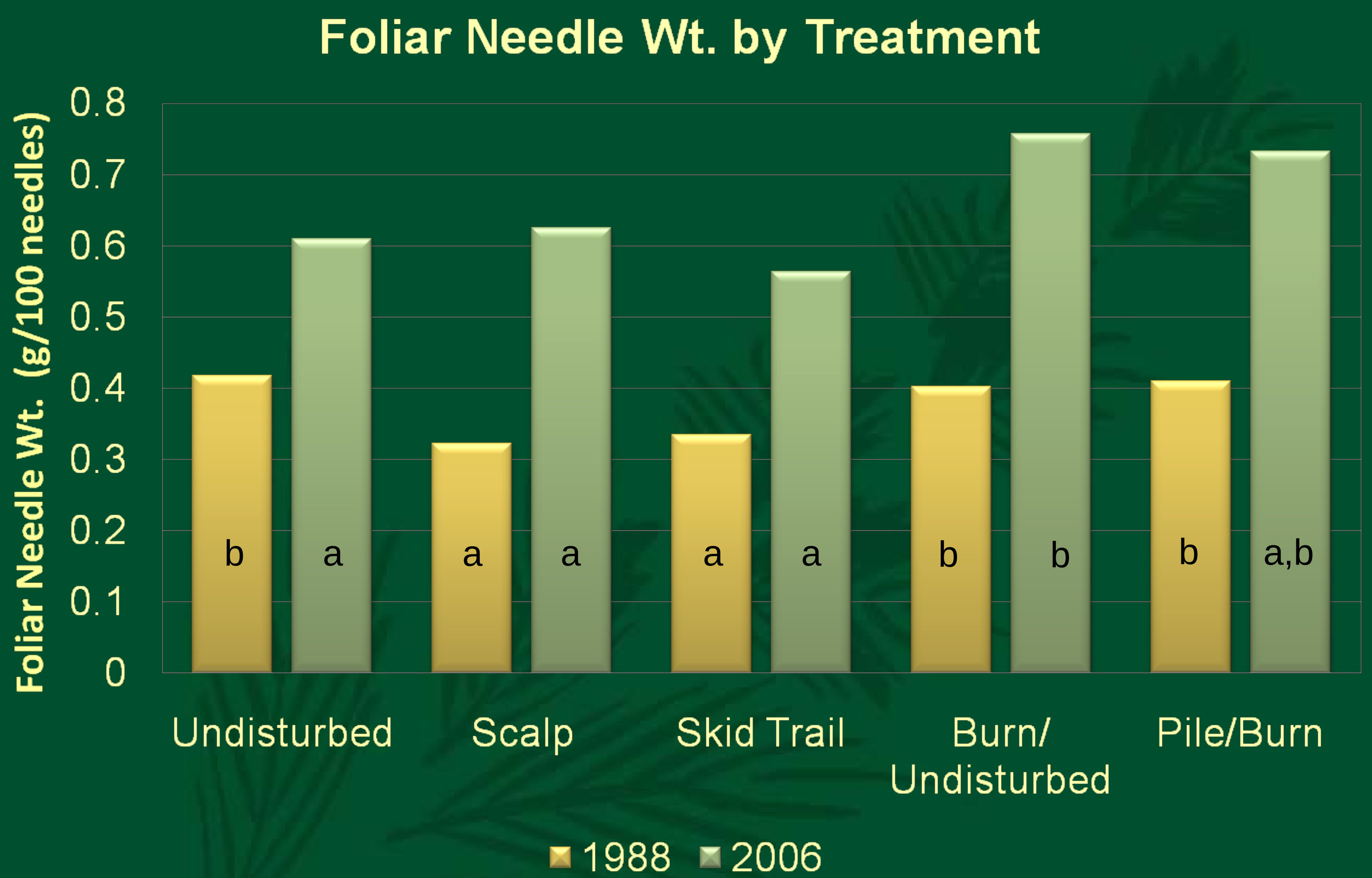

Foliar N Concentration by Treatment
N Concentration (%)
1.8
1.5
1.2
0.9
0.6
0.3
0
Critical Level
Regional Level
a,b
a
a
a
a,b
a,b
b
b
b
b
Undisturbed
Skid Trail
Scalp
Pile/Burn
Burn/ Undisturbed
1988
2006


Foliar K Concentration by Treatment
K Concentration (%)
1.2
1
0.8
0.6
0.4
0.2
0
Regional Level
Critical Level
a,b
a,b
a
a
a,b
c
b
c
b
b
Undisturbed
Scalp
Skid Trail
Pile/Burn
Burn/ Undisturbed
1988
2006



Foliar S Concentration by Treatment
Critical Level
Regional Level
S Concentration (ppm)
0.12
0.1
0.08
0.06
0.04
0.02
0
a
a
a
a,b
b
Undisturbed
Skid Trail
Scalp
Burn/ Undisturbed
Pile/Burn
2006


Foliar B Concentration by Treatment
B Concentration (ppm)
30
25
20
15
10
5
0
Regional Level
Critical Level
a,b
a
a
a
a,b
a
b
a
c
a
Undisturbed
Scalp
Skid Trail
Pile/Burn
Burn/ Undisturbed
1988
2006



Foliar Needle Wt. by Treatment
Foliar Needle Wt. (g/100 needles)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
b
a
a
a
a
a
b
b
b
a,b
Undisturbed
Scalp
Skid Trail
Burn/ Undisturbed
Pile/Burn
1988
2006

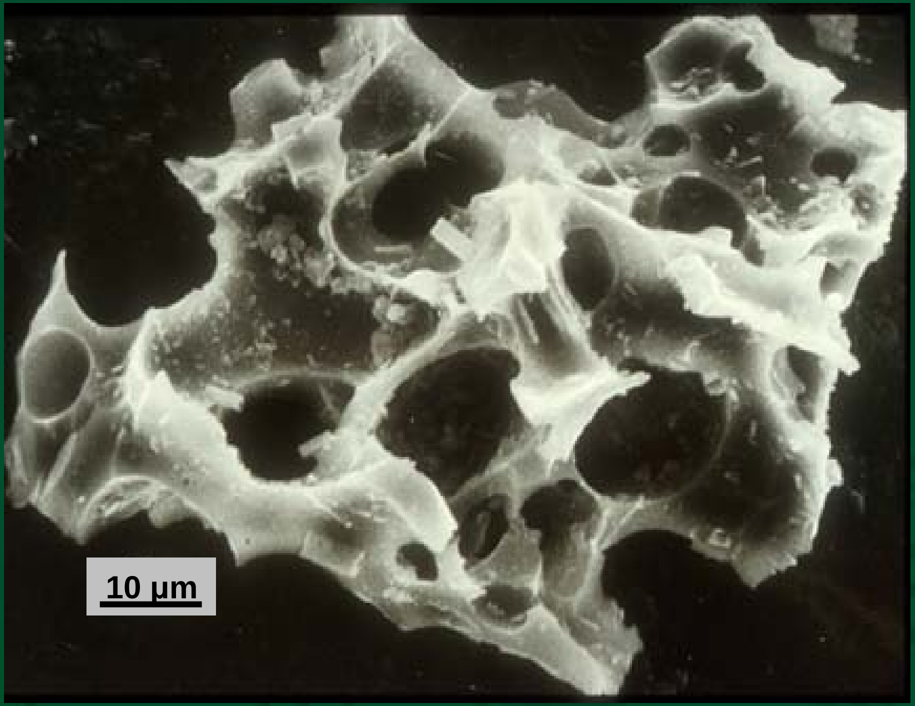
Soil Bulk Density

Bulk Density

	Mean (g cm^3)	Min	Max
Andic (n = 271)	0.90 (0.75-0.9)	0.46	1.68

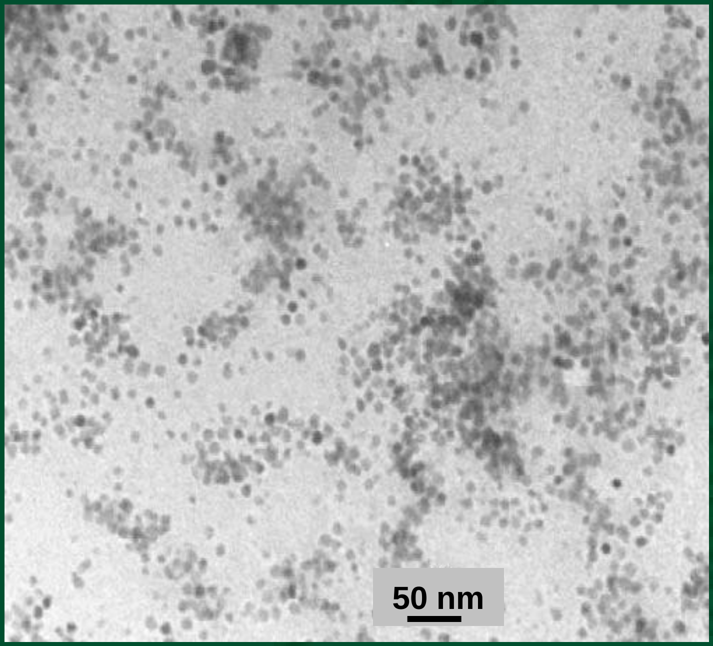
Palouse Silt Loam ~ 1.2 g/cm^3
Basalt Silty Clay Loam ~ 1.7 g/cm^3

Photo and Data by McDaniel et al., 2005

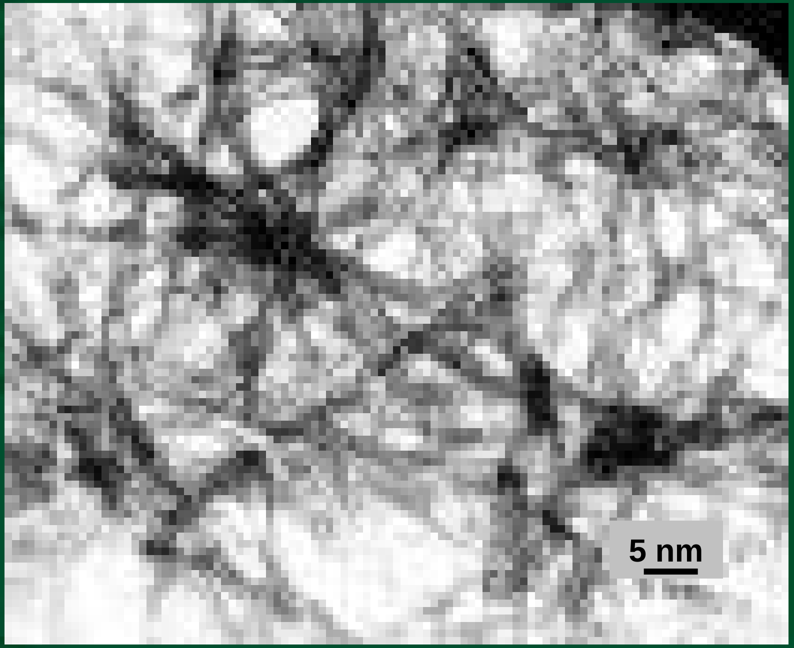


Glass shard

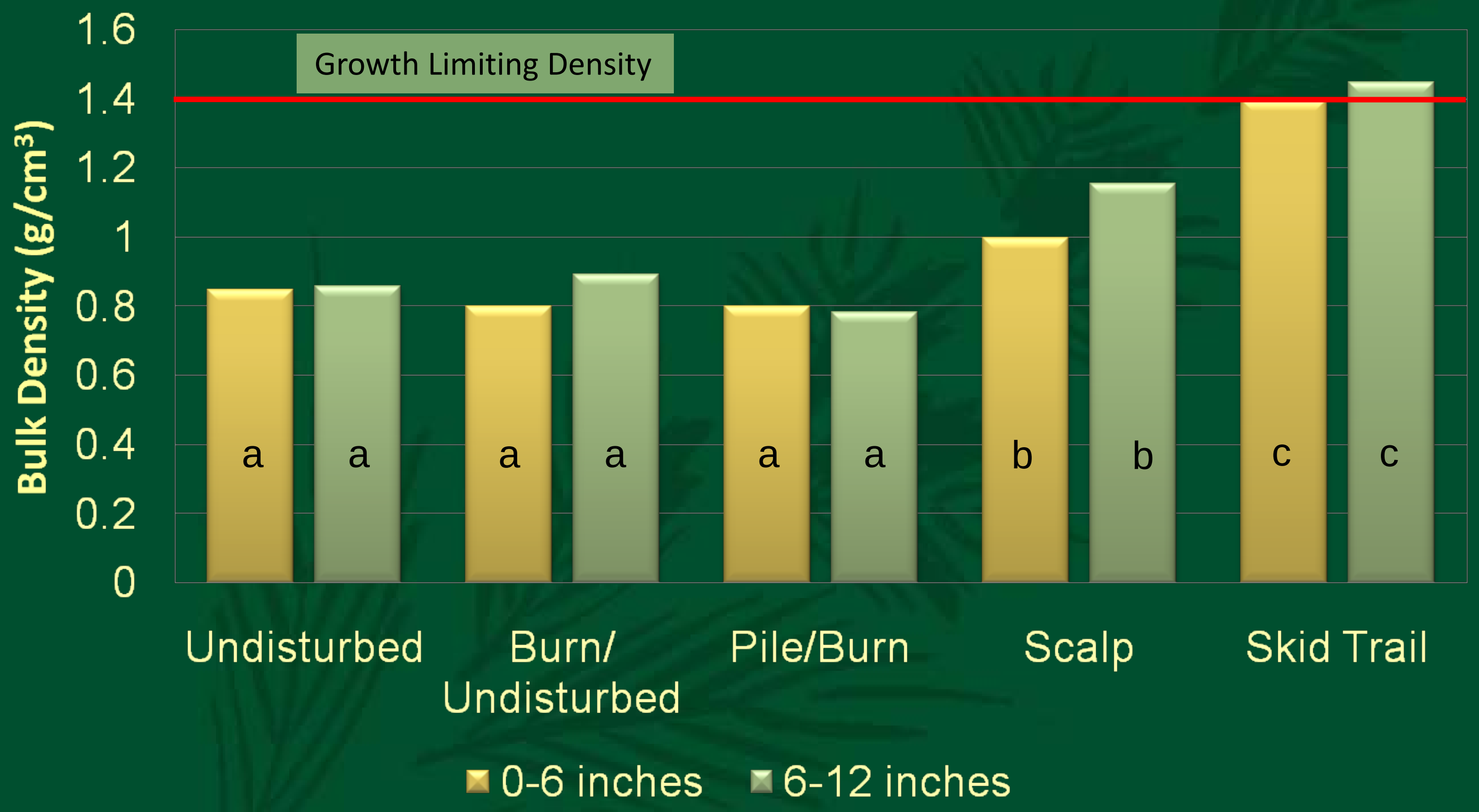
Ferrihydrite

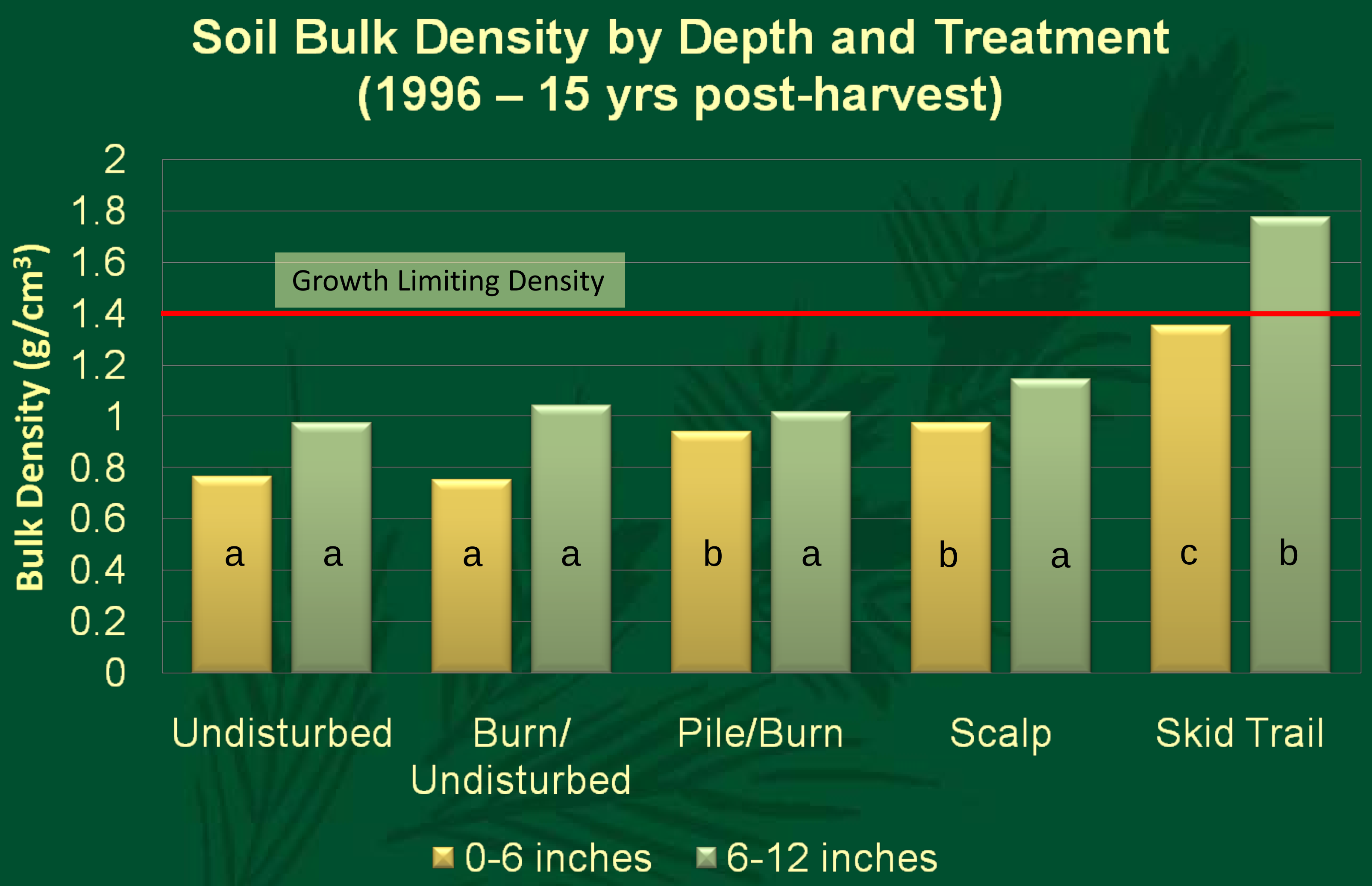


Allophane/
Imogolite



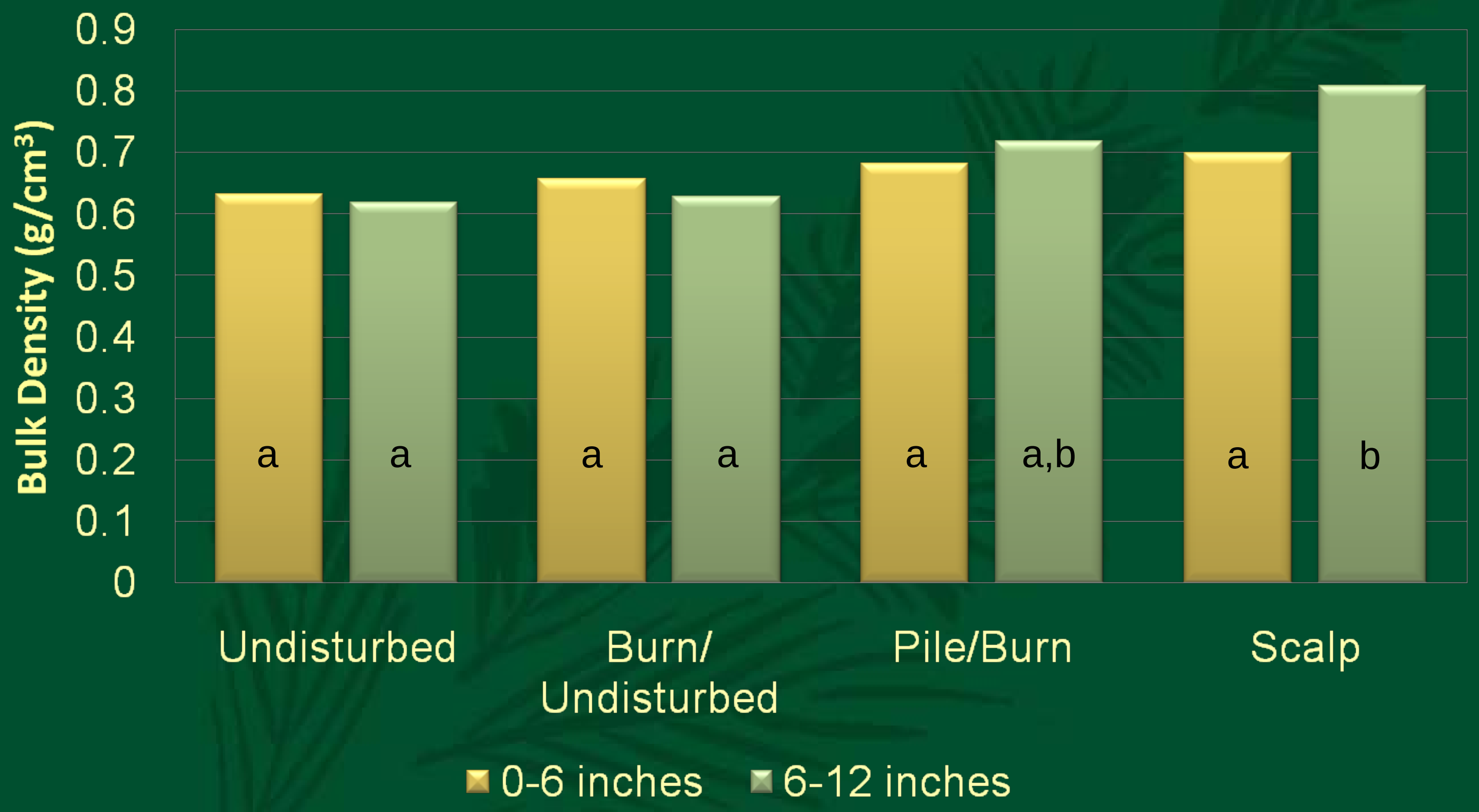
Soil Bulk Density by Depth and Treatment (1988 – 7 yrs post-harvest)





Soil Bulk Density by Depth and Treatment
(1996 – 15 yrs post-harvest)
Bulk Density (g/cm³)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Growth Limiting Density
a
a
a
a
b
a
b
a
c
b
Undisturbed
Burn/ Undisturbed
Pile/Burn
Scalp
Skid Trail
0-6 inches
6-12 inches

Soil Bulk Density by Depth and Treatment (2006 – 25 yrs post-harvest)



Foliage and Soil Summary

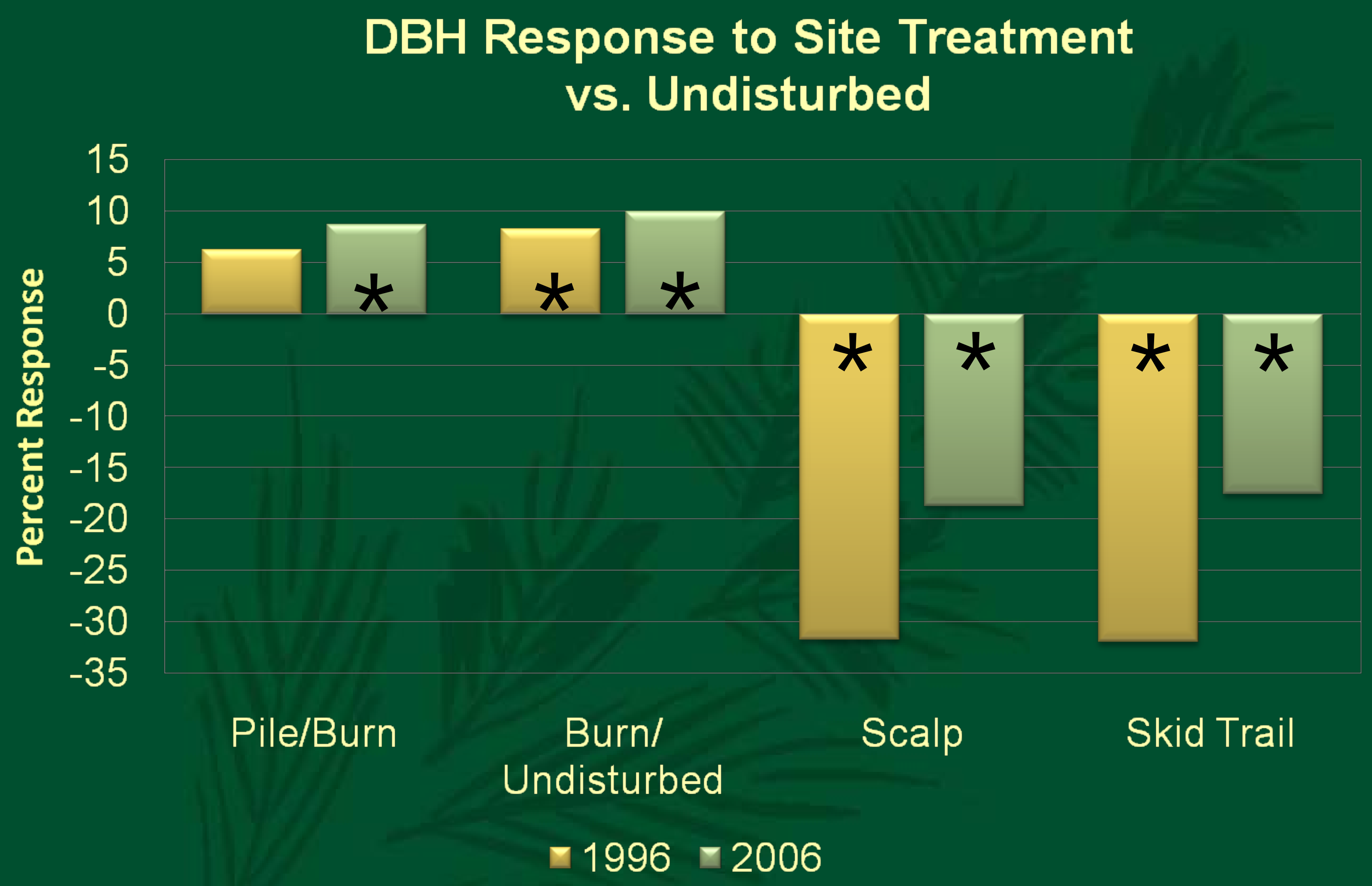
- Foliar N, S, and B concentrations were significantly lower on scalp and skid trail treatments 6 yrs post-planting. Foliar N and S concentrations were significantly higher after 24 yrs on the pile/burn treatment. N and B foliar concentrations on the scalp treatment are similar to burn treatment levels after 24 years.

- Foliar biomass showed significantly lower weights on scalp and skid trail treatments 6 and 24 yrs post-planting.

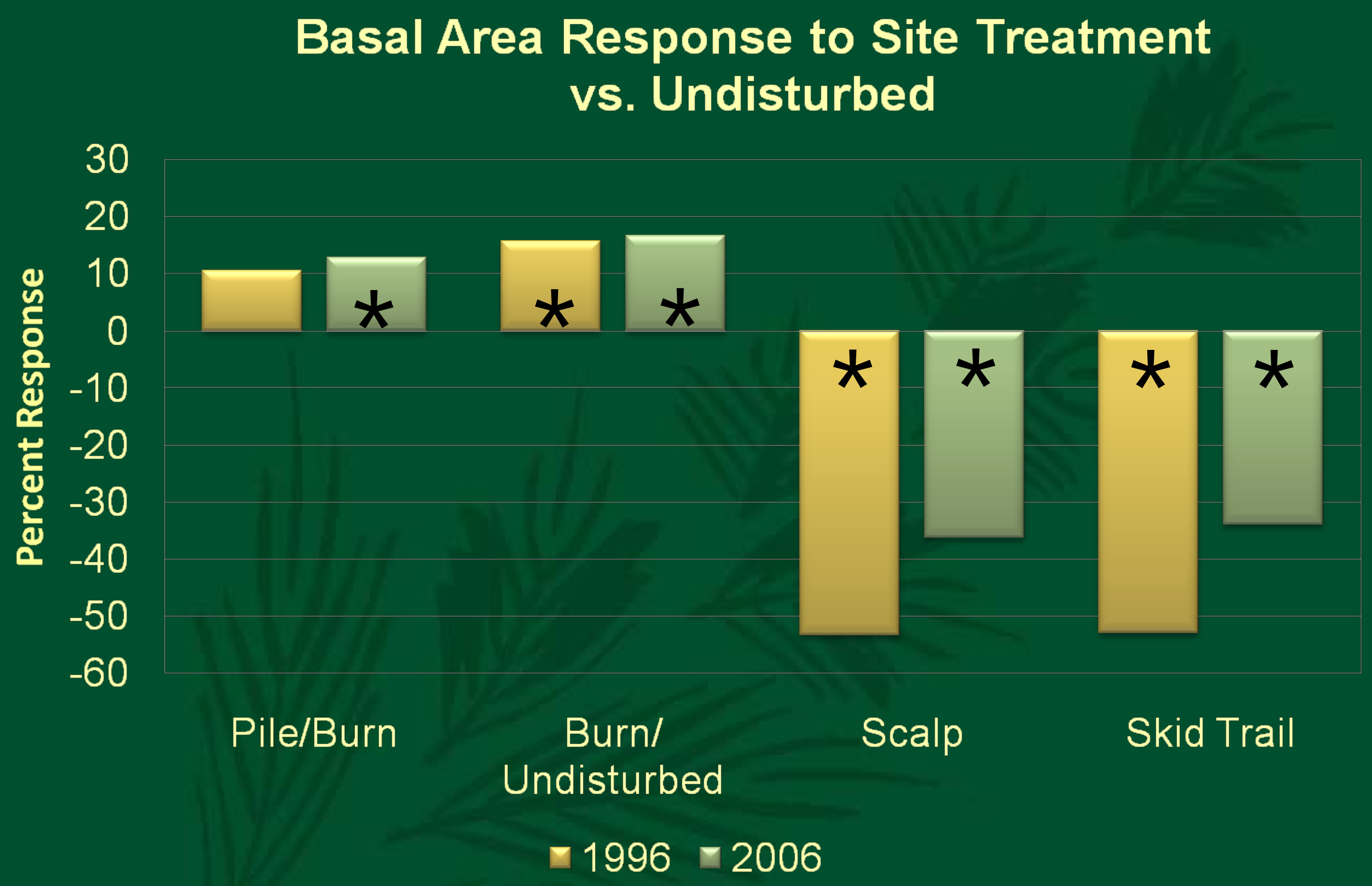
- Mechanical site prep treatments showed significantly higher bulk densities up to 15 yrs post-treatment. Densities were not growth-limiting in the definitional sense.

- Lower surface soil bulk density was significantly higher on mechanical site prep treatments after 25 yrs.

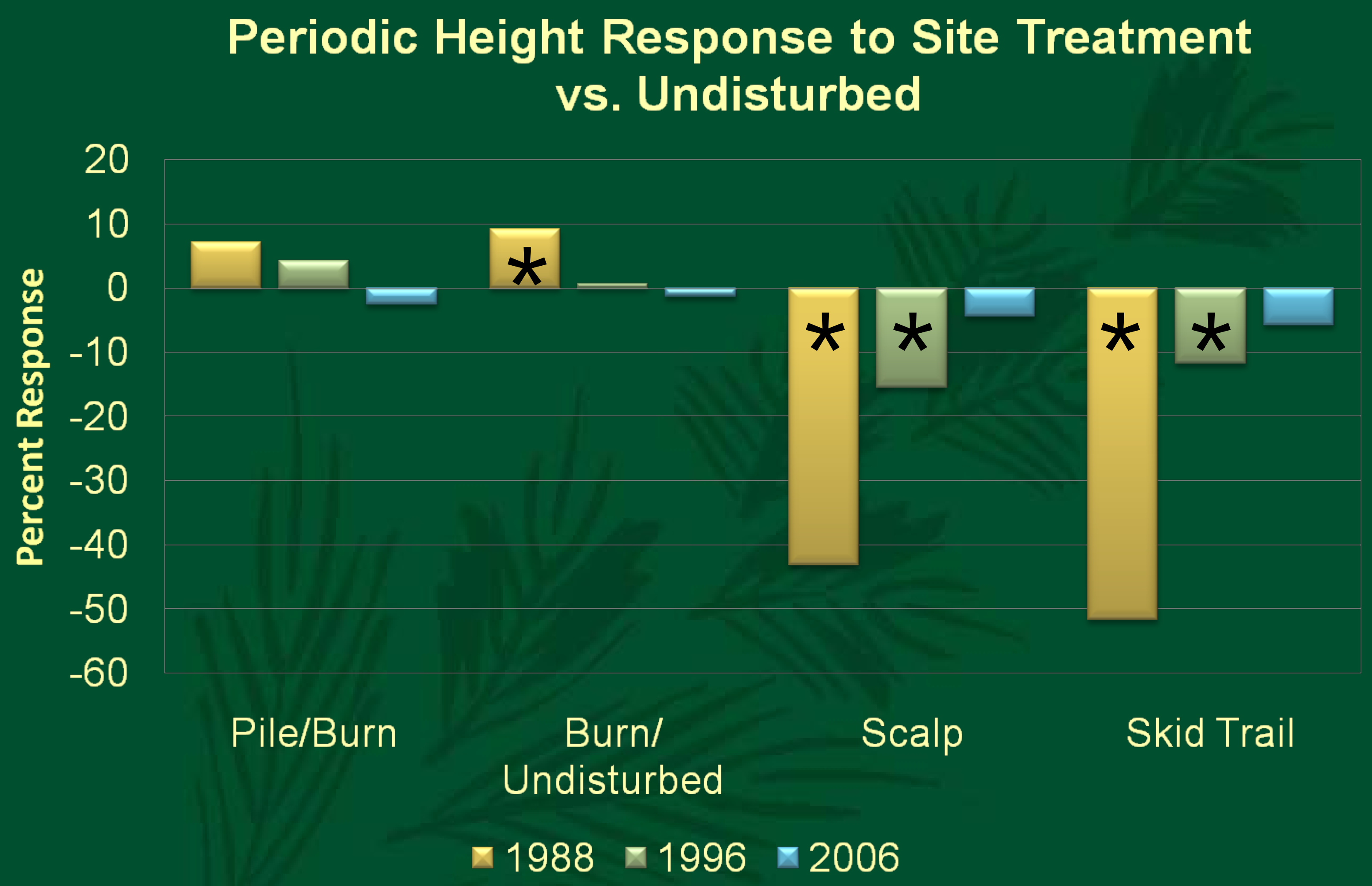
Growth Response to Treatment

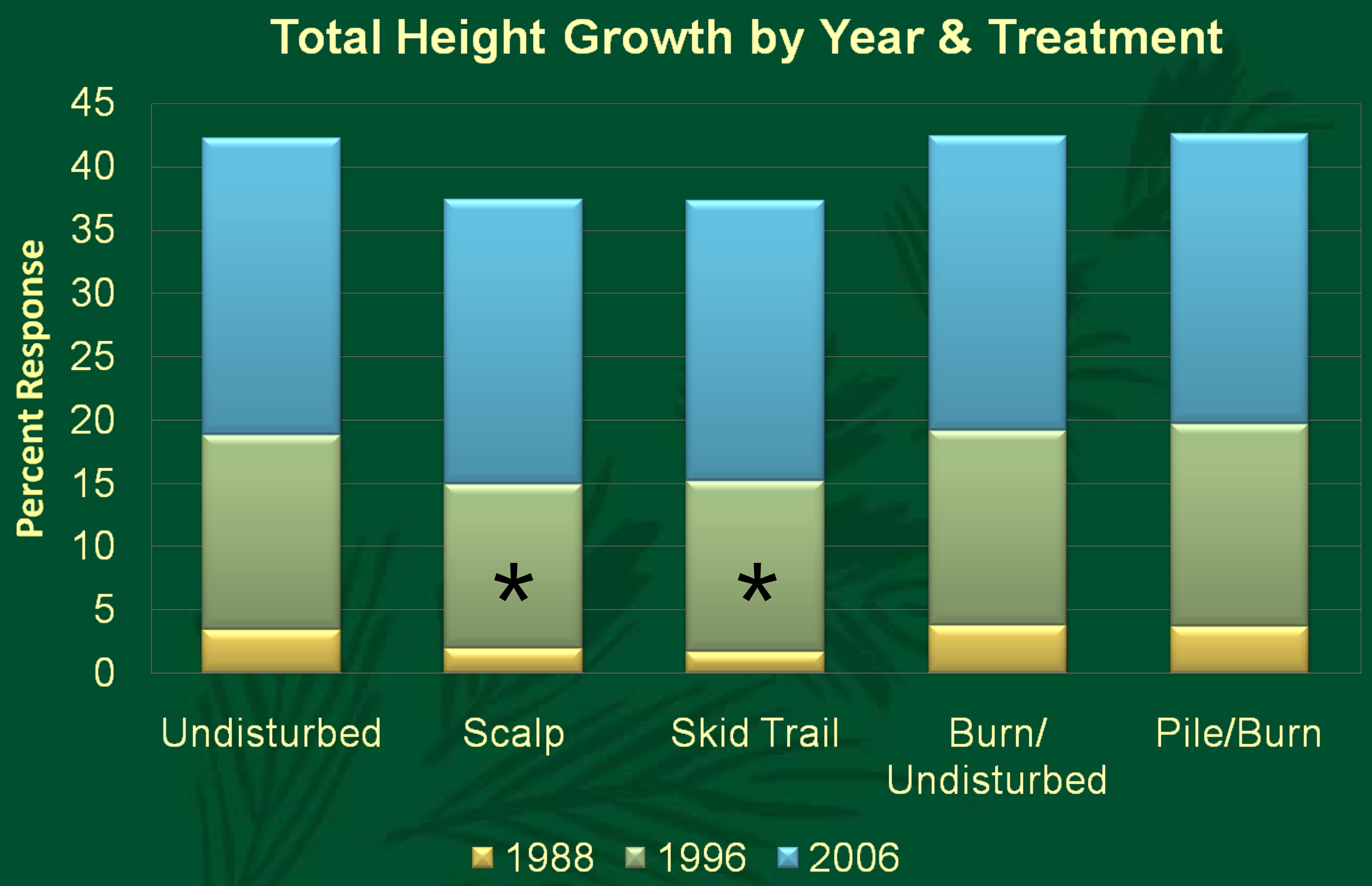


DBH Response to Site Treatment
vs. Undisturbed
Percent Response
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
*
*
*
*
*
*
*
Pile/Burn
Burn/
Undisturbed
Scalp
Skid Trail
1996
2006

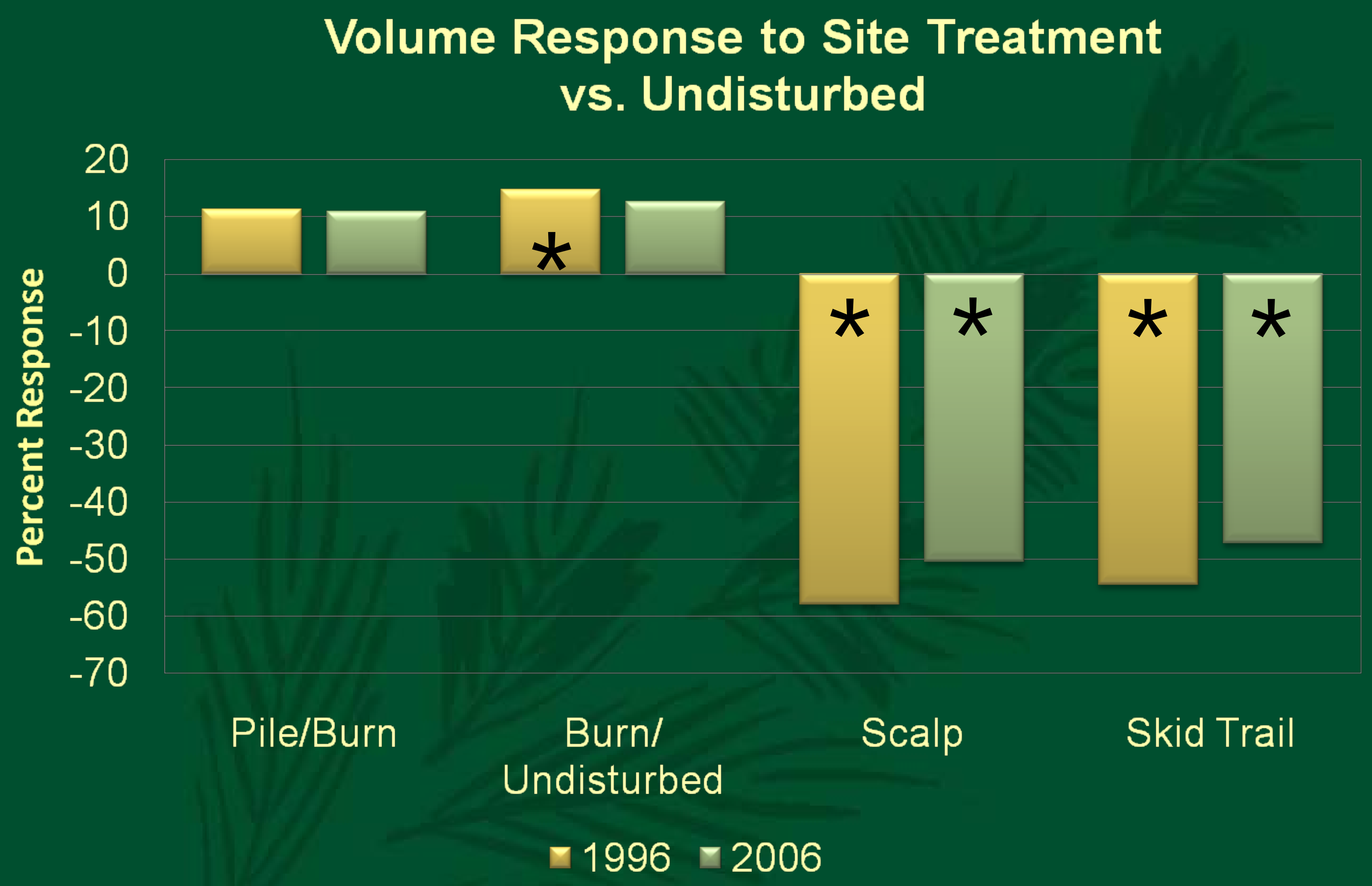


Basal Area Response to Site Treatment
vs. Undisturbed
Percent Response
30
20
10
0
-10
-20
-30
-40
-50
-60
*
*
*
*
*
*
*
Pile/Burn
Burn/
Undisturbed
Scalp
Skid Trail
1996
2006


Periodic Height Response to Site Treatment
vs. Undisturbed
Percent Response
20
10
0
-10
-20
-30
-40
-50
-60
*
*
*
*
*
Pile/Burn
Burn/
Undisturbed
Scalp
Skid Trail
1988
1996
2006



Total Height Growth by Year & Treatment
Percent Response
45
40
35
30
25
20
15
10
5
0
*
*
Undisturbed
Scalp
Skid Trail
Burn/ Undisturbed
Pile/Burn
1988
1996
2006


Volume Response to Site Treatment
vs. Undisturbed
Percent Response
20
10
0
-10
-20
-30
-40
-50
-60
-70
*
*
*
*
*
Pile/Burn
Burn/
Undisturbed
Scalp
Skid Trail
1996
2006

Growth Response Summary

- Burn treatments show a 10-15% Basal Area increase over undisturbed conditions; while scalp and skid trail treatments show a significant >50% decrease 14 yrs post-planting. After 24 yrs, burn treatments continue to show a 15% increase over undisturbed conditions, and a 35% decrease for scalp and skid trail treatments.
- Burn treatments show no overall significant increase in height growth 6, 14, and 24 yrs post-planting. However, scalp and skid trail treatments show >40% and >10% decrease in height growth over 6 and 14 yrs, respectively. Scalp and skid trails showed no significant height growth differences after 24 yrs.
- Volume gained 10-15% on burn treatments after 14 and 24 yrs. Volume showed a significant loss of ~ 50% on scalp and skid trails after 24 yrs.

Conclusions

- Foliar nutrient concentration levels of N, K, S, and B do not show large differences across treatments, but they do differ significantly.
- Initial slash leaching could be responsible for higher concentrations across all treatments.
- Lower foliar biomass on scalp and skid trails can be attributed to significantly lower foliar concentrations of N, S, and B.
- Low foliar nutrients, decreased foliar biomass, and higher soil bulk densities significantly reduced growth on scalped and skid trail treatments.

LESSONS LEARNED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