

Detecting the effects of past management practices on soil nutrient status using ion-exchange resins



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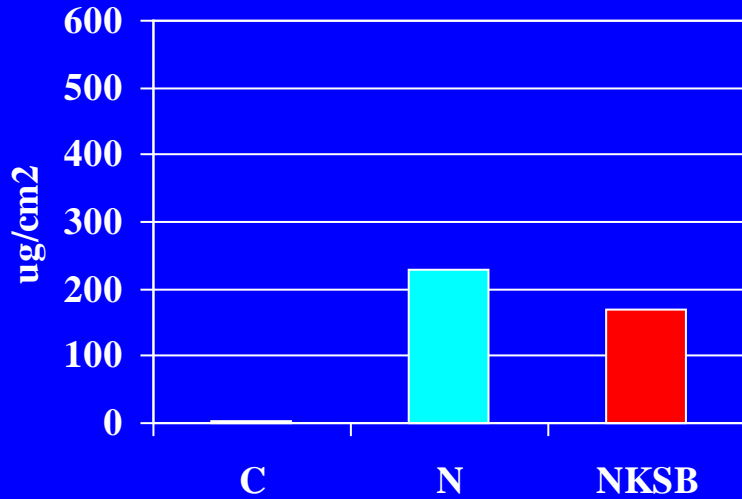
Management Practices

1. Current fertilization (resin capsules buried just before fertilization)
2. Past fertilization (resin capsules buried 6-9 years after fertilization)
3. Past clearcut (resin capsules buried 7-10 years after harvest)
4. Past site preparation by burning (resin capsules buried about 17 years after site preparation)

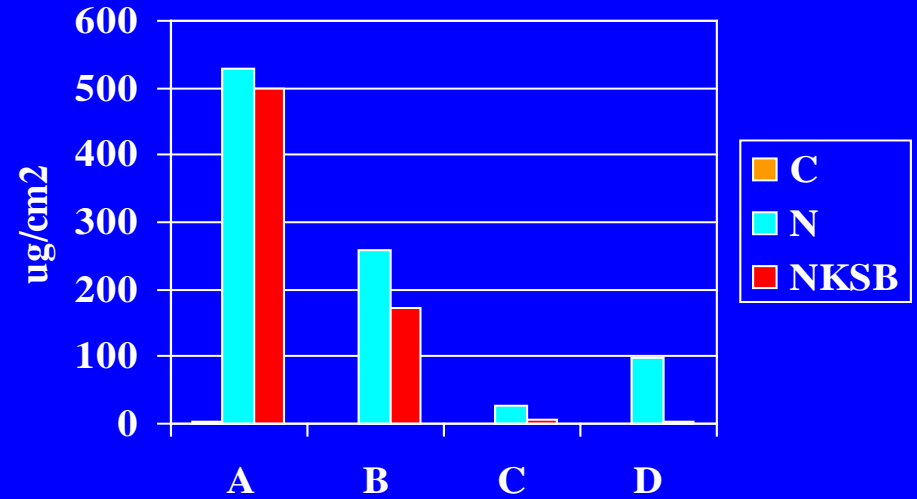
1. Current Fertilization

- Nine sites in northern Idaho
- Generally young stands (20-25 yr)
- Capsules buried prior to fertilization at depths:
 - Surface
 - 12-in
 - 24-in
 - 36-in
- Treatments included
 - Control (no fertilization)
 - N
 - NKSB

NH₄: Current Fertilization

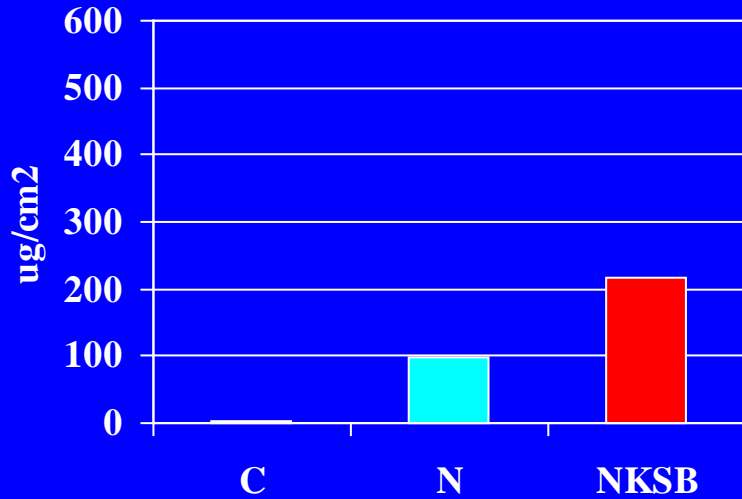


Treatment

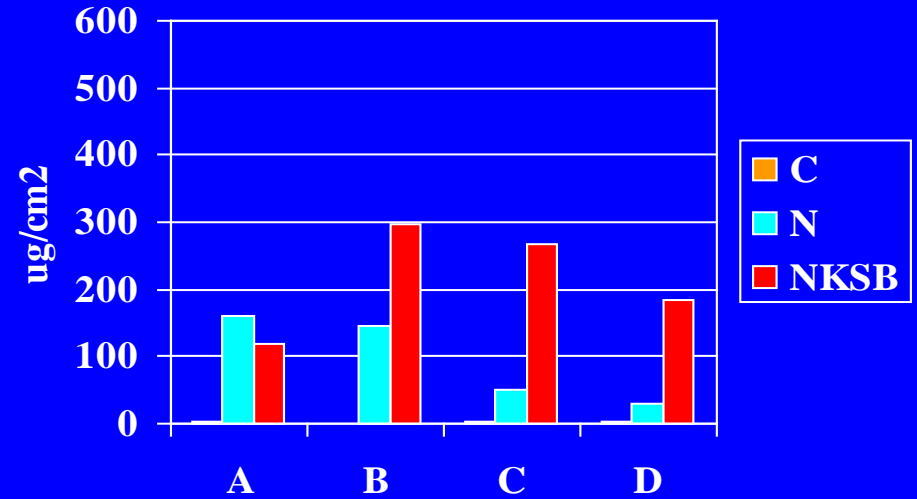


Depth Category

NO₃: Current Fertilization

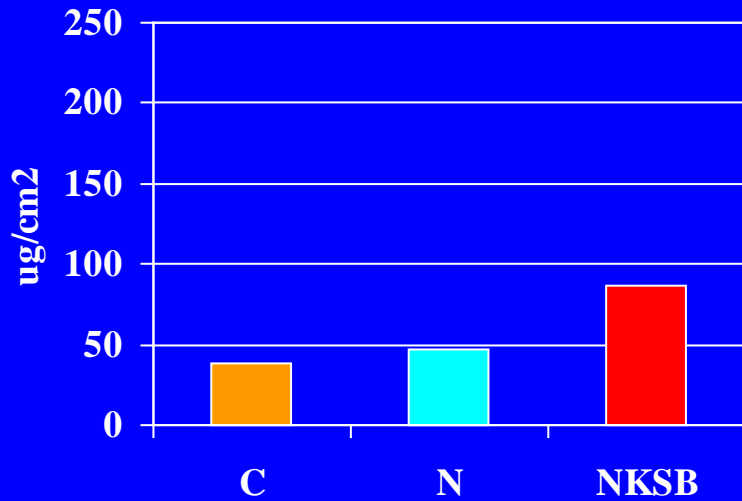


Treatment

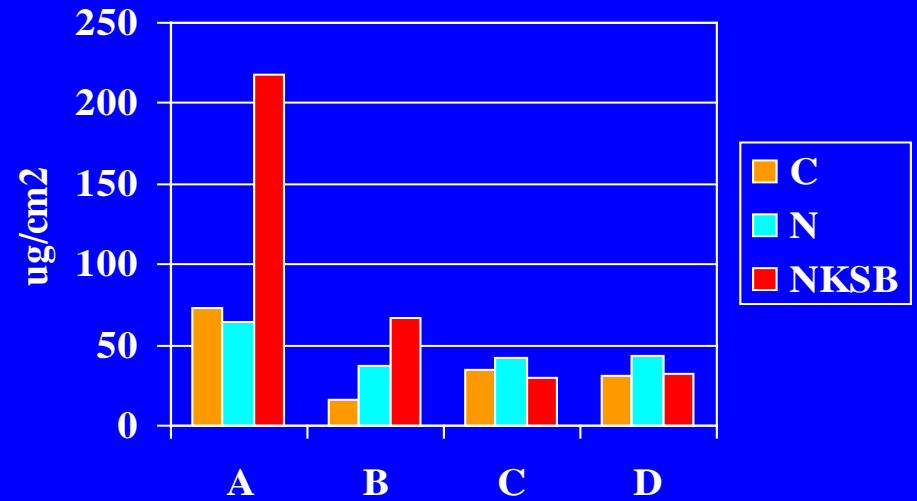


Depth Category

Potassium: Current Fertilization

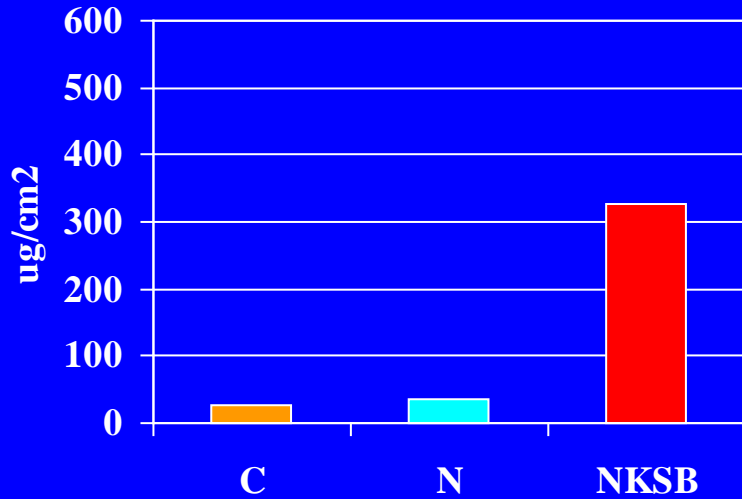


Treatment

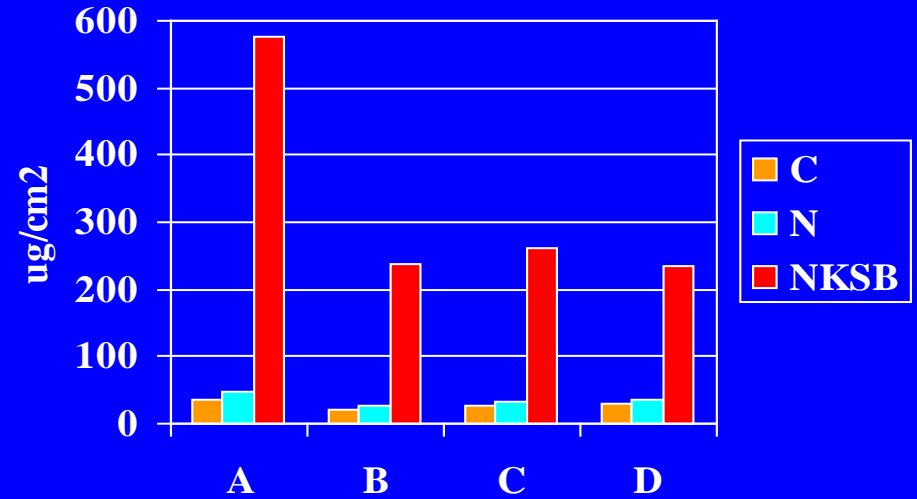


Depth Category

Sulfur: Current Fertilization

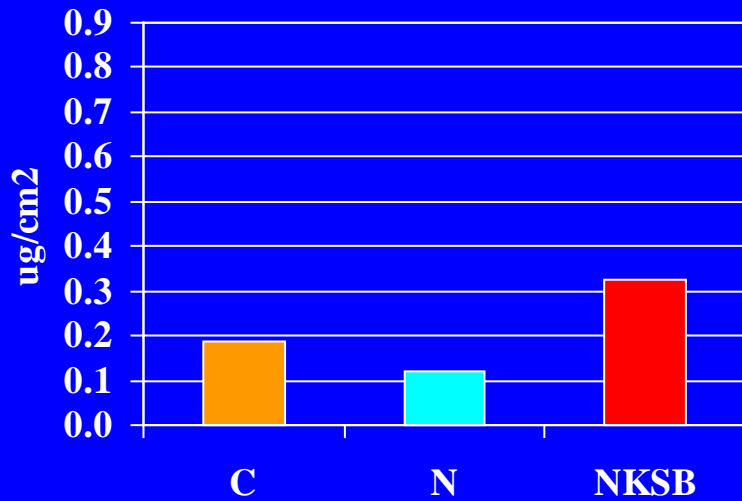


Treatment

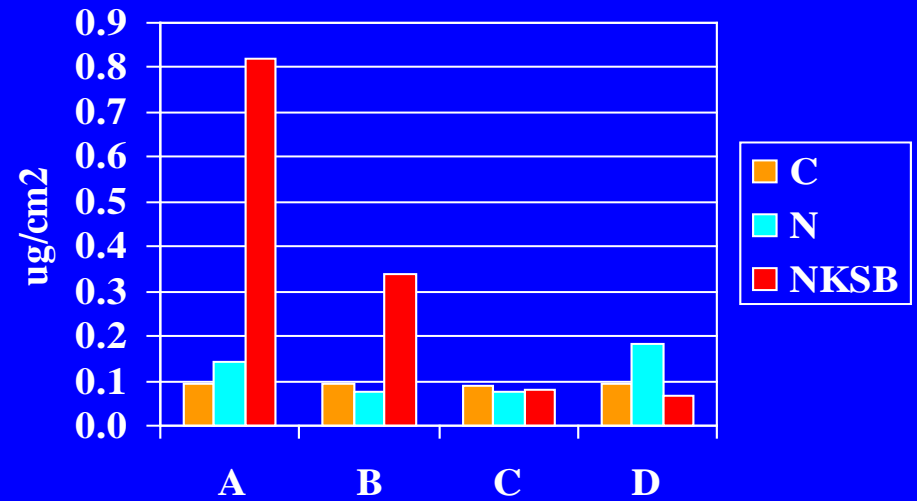


Depth Category

Boron: Current Fertilization



Treatment



Depth Category

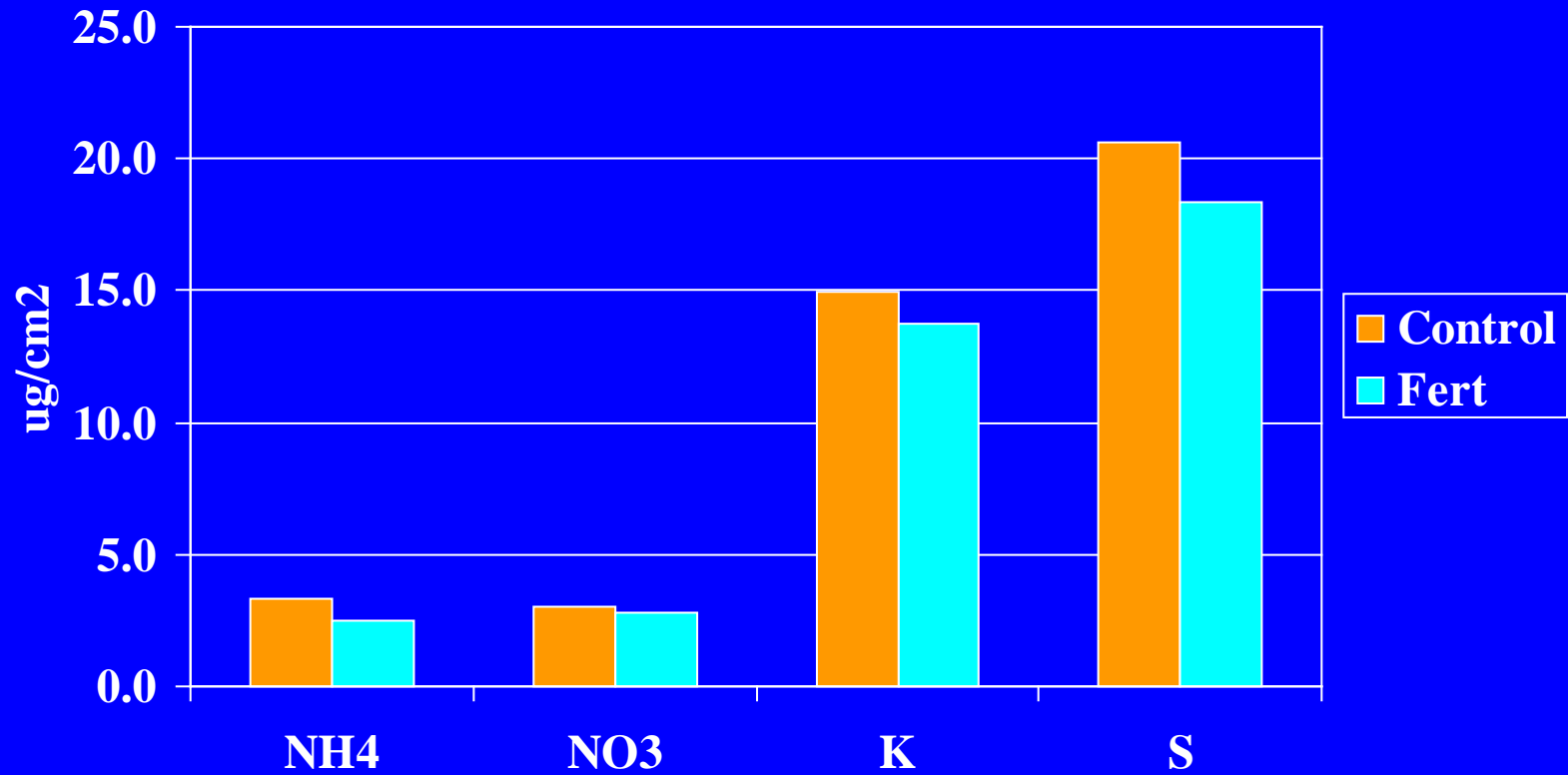
Current Fertilization: Summary

- All elements which were applied were detectable by ion-exchange capsules
- N-only and NKSB fertilization increased NH_4 and NO_3 availability
- NKSB fertilization increased NO_3 availability more than N-only did, indicating a favorable effect of K, S or B (or some interaction) on nitrification
- The increase in NO_3 also led to increased NO_3 leaching throughout the soil profile
- Sulfur also moved through the soil profile
- B and K stayed in the upper 0-12 inches of the soil profile

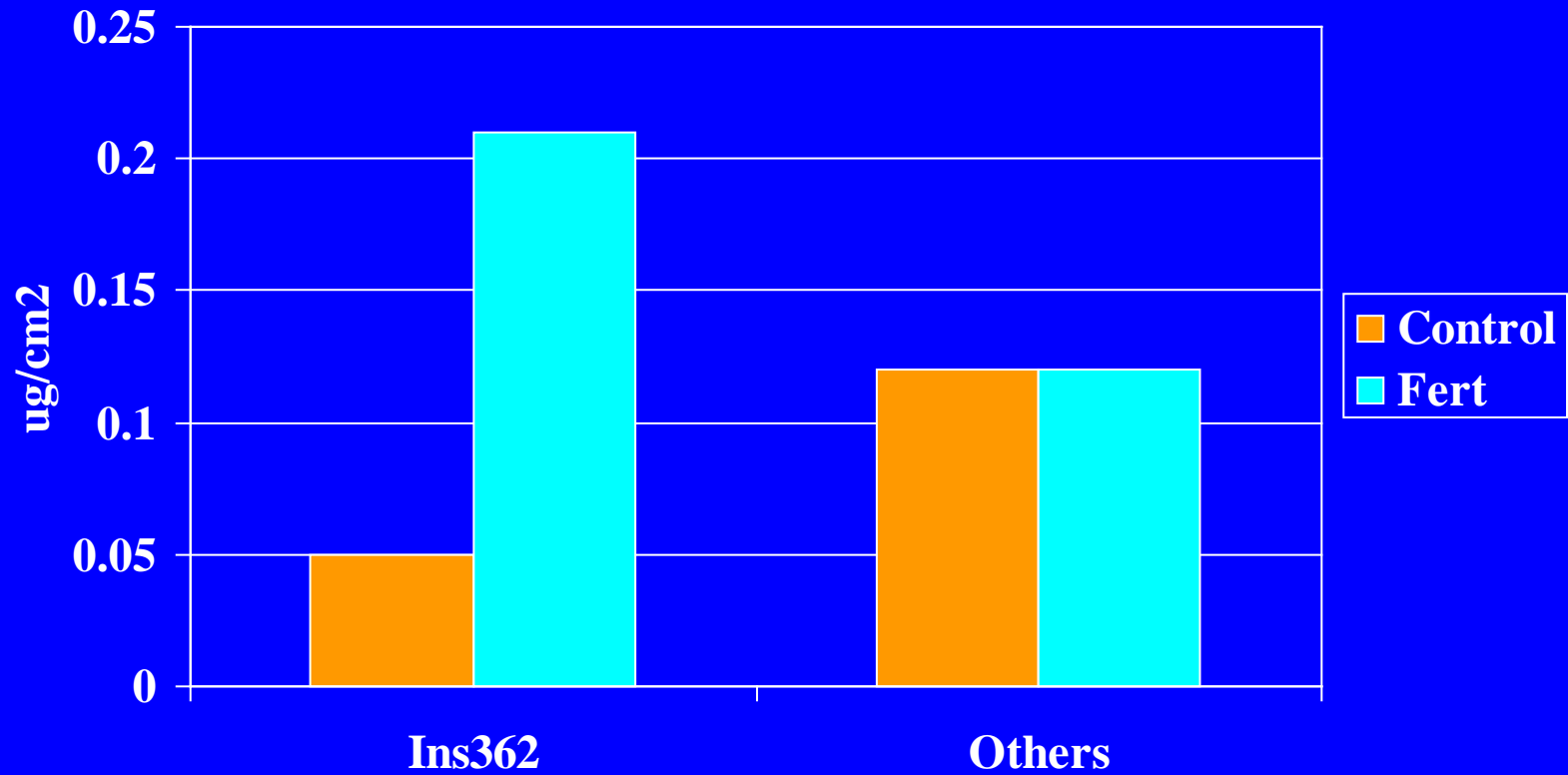
2. Past Fertilization

- Eight sites in Idaho and Washington
- Mature, second-growth stands, all are IFTNC Forest Health study sites
- Capsules buried at depths:
 - Surface
 - 12-inch
 - 24-inch
 - 36-inch
- Treatments were applied 6 to 9 years prior to capsule burial, and included:
 - Control (no fertilization)
 - N+K (some also had S and B)
- Capsules were removed one year after burial

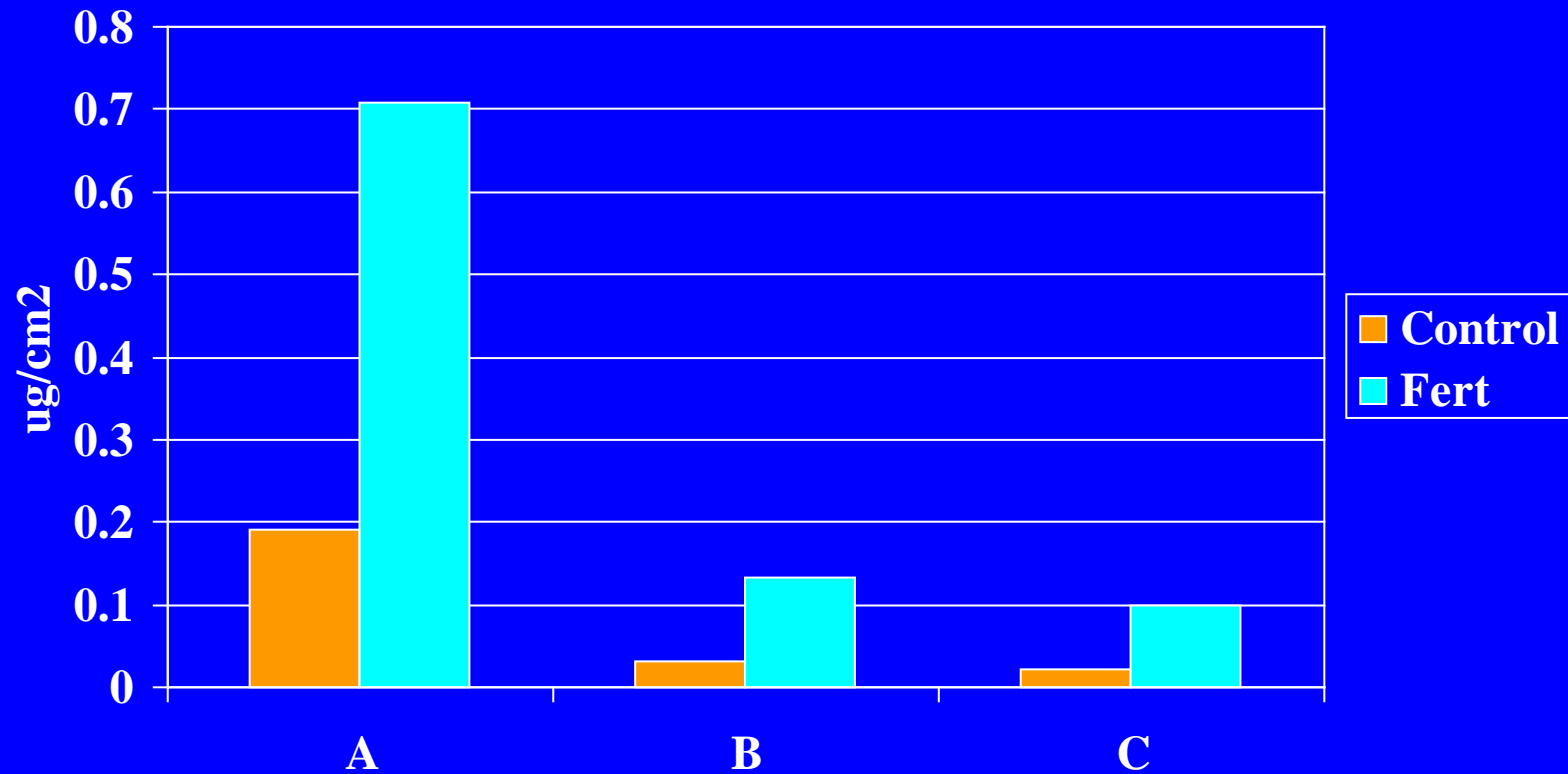
N, K and S: Past Fertilization



B: Past Fertilization



B: Past Fertilization (Ins 362, with B applied)



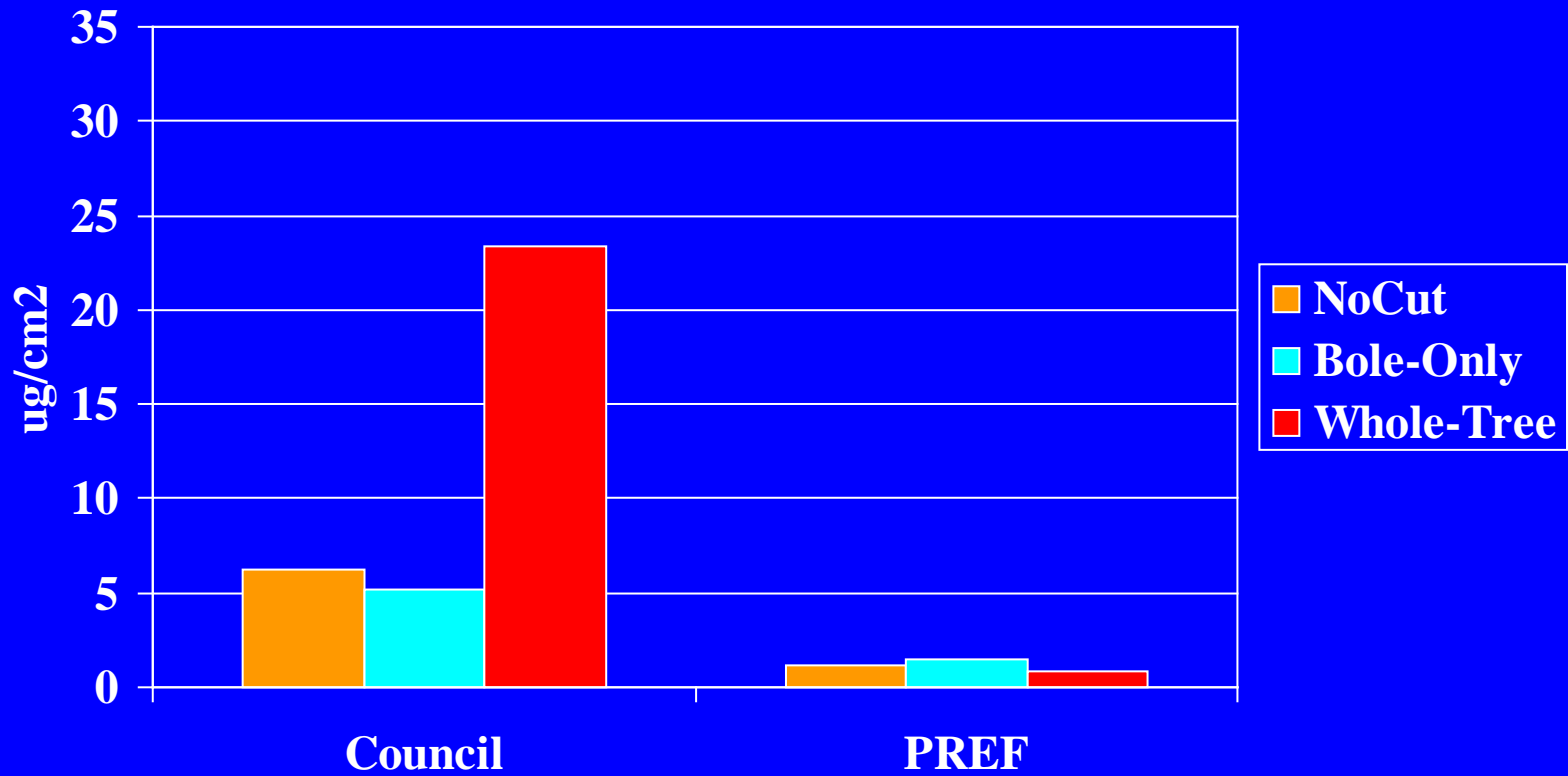
Past Fertilization Summary

- We cannot detect higher N, K or S soil availability on the plots fertilized with those elements 6-9 years ago
- There may even be a little higher availability on the unfertilized plots compared to the fertilized plots – possible indicator of increased demand on the fertilized plots
- We can still detect higher B availability where B was applied 6 years earlier, and availability is higher throughout the soil profile.
- Soil nutrient levels have returned to pre-fertilization levels

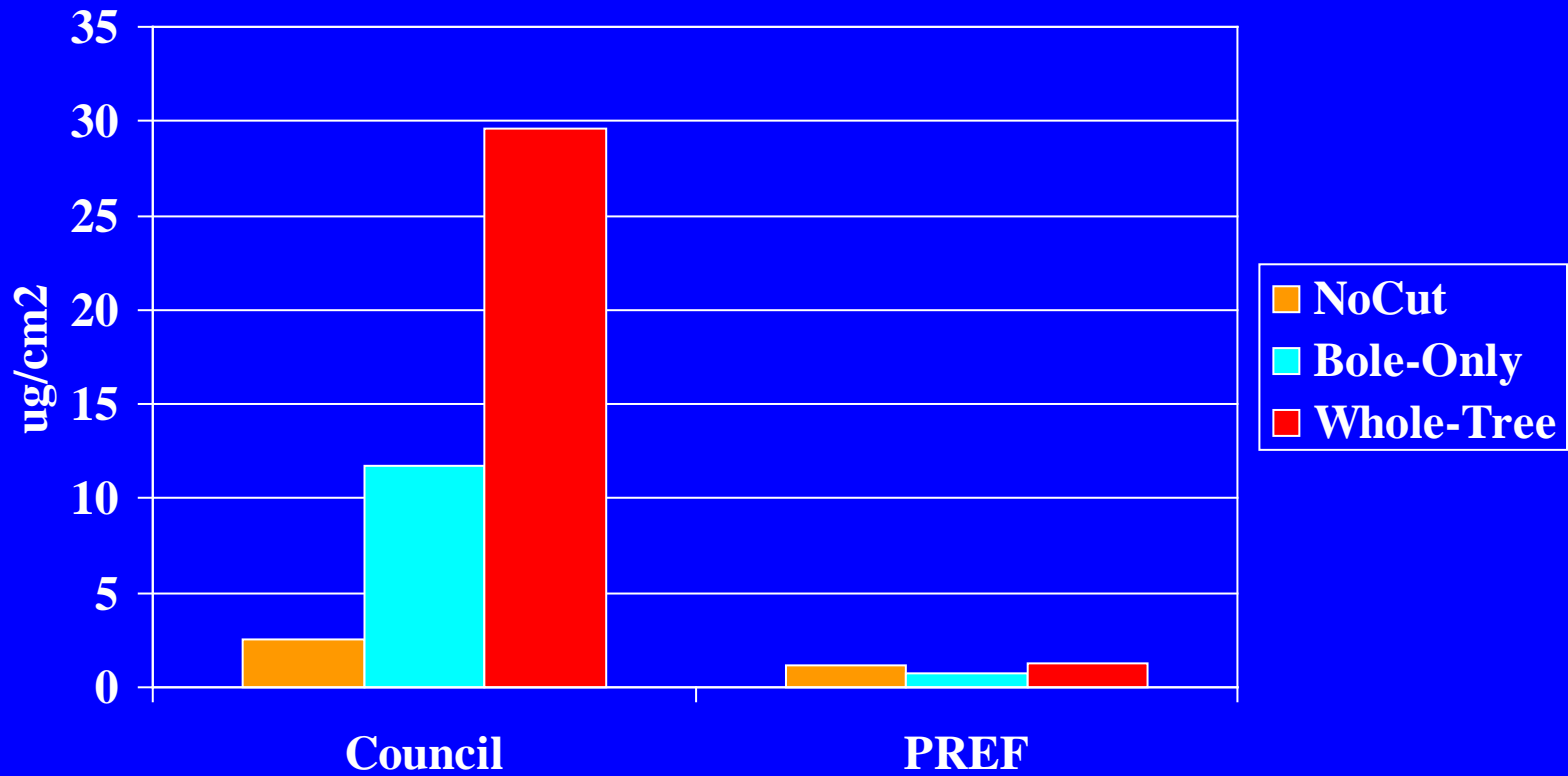
3. Past Clearcut Harvest

- Forest Service Long-Term Site Productivity (LTSP)
 - Whole-tree removal
 - Bole-only removal
 - Control
- Council
 - Harvested 1995
 - Basalt rock type
- Priest River Experimental Forest
 - Harvested 1992
 - Ash cap over metased.-influenced material
- Capsules buried at 0, 2, 6 and 10 inches

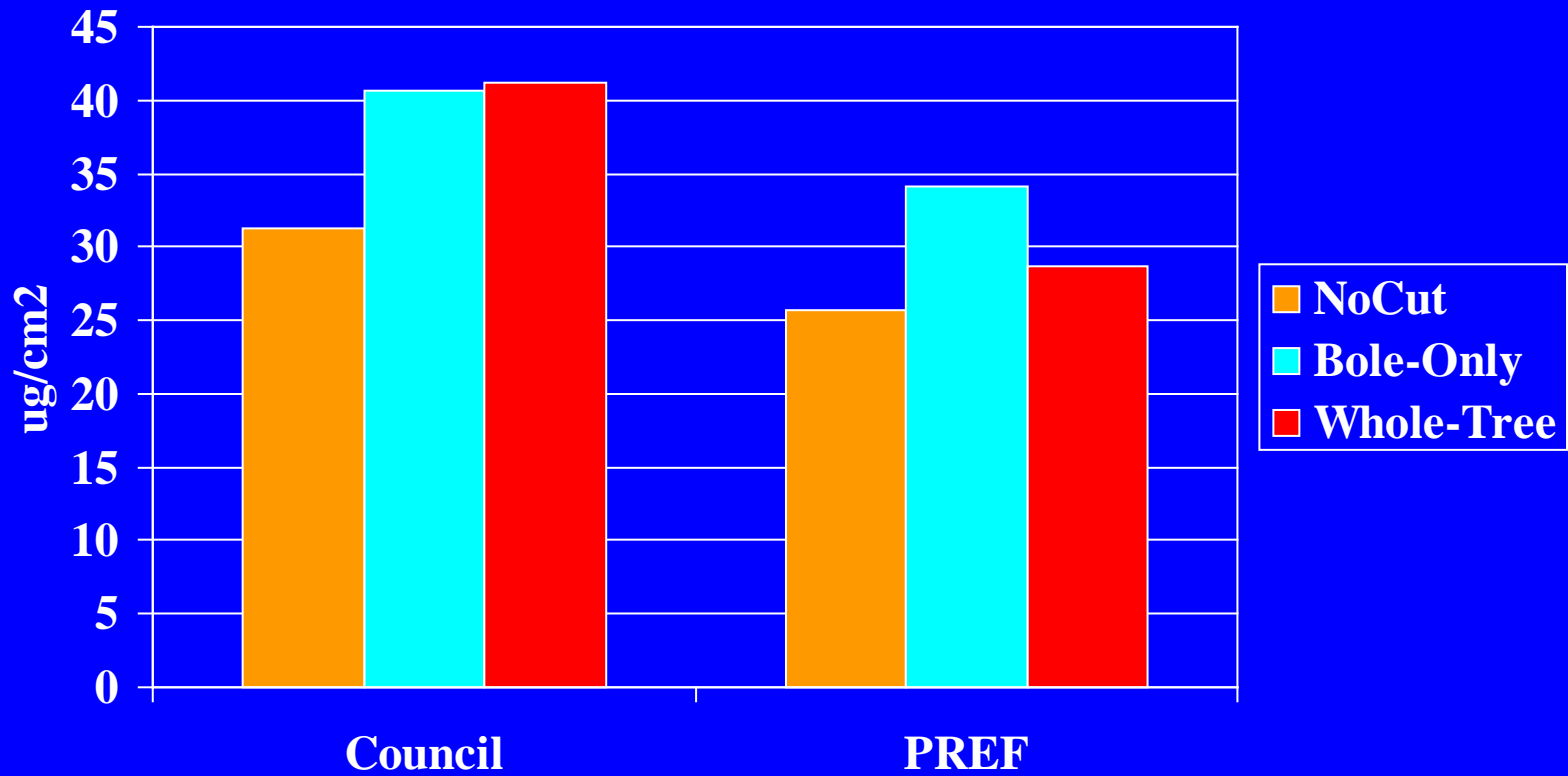
NH₄: Past Clearcut



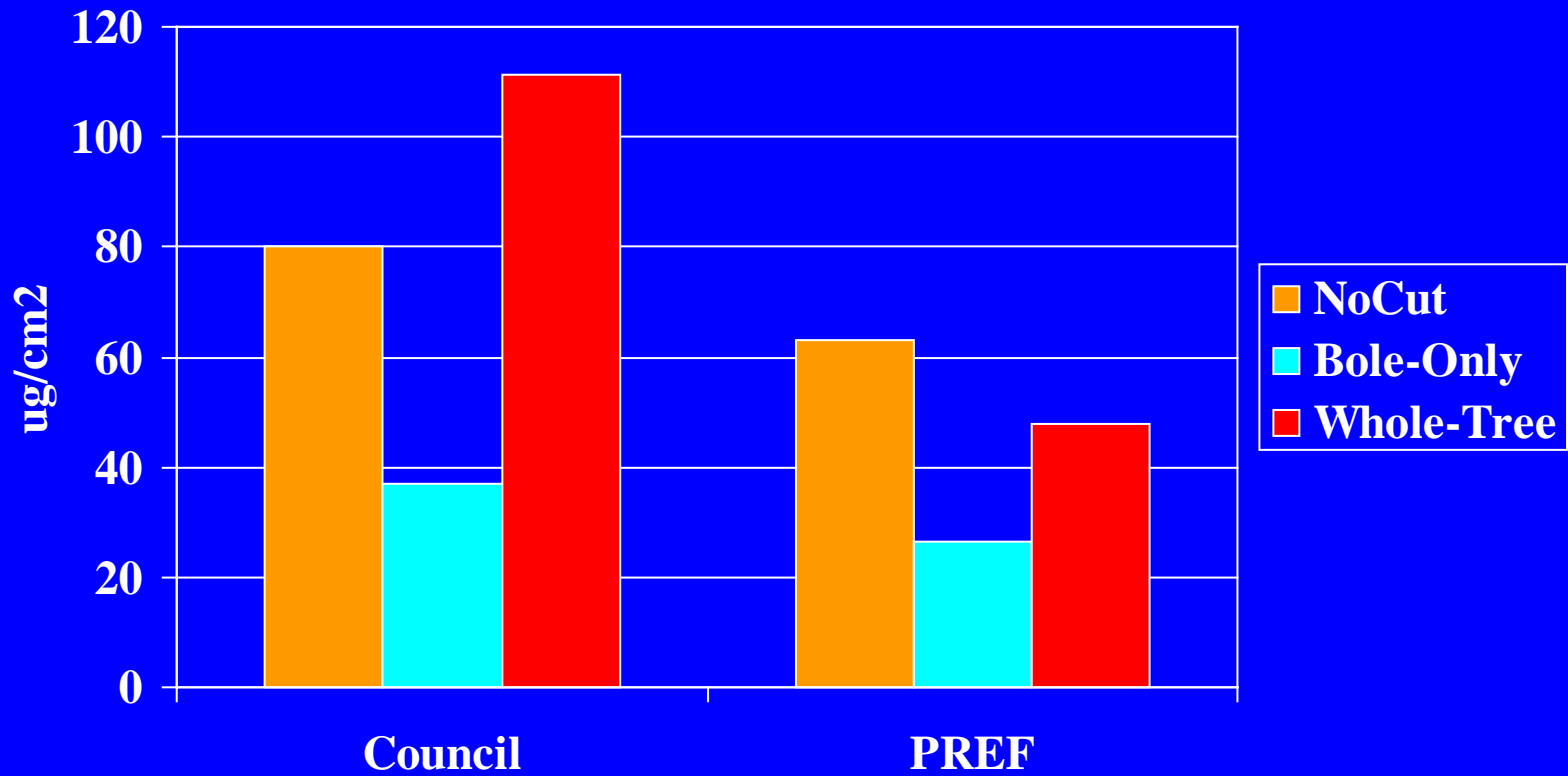
NO3: Past Clearcut



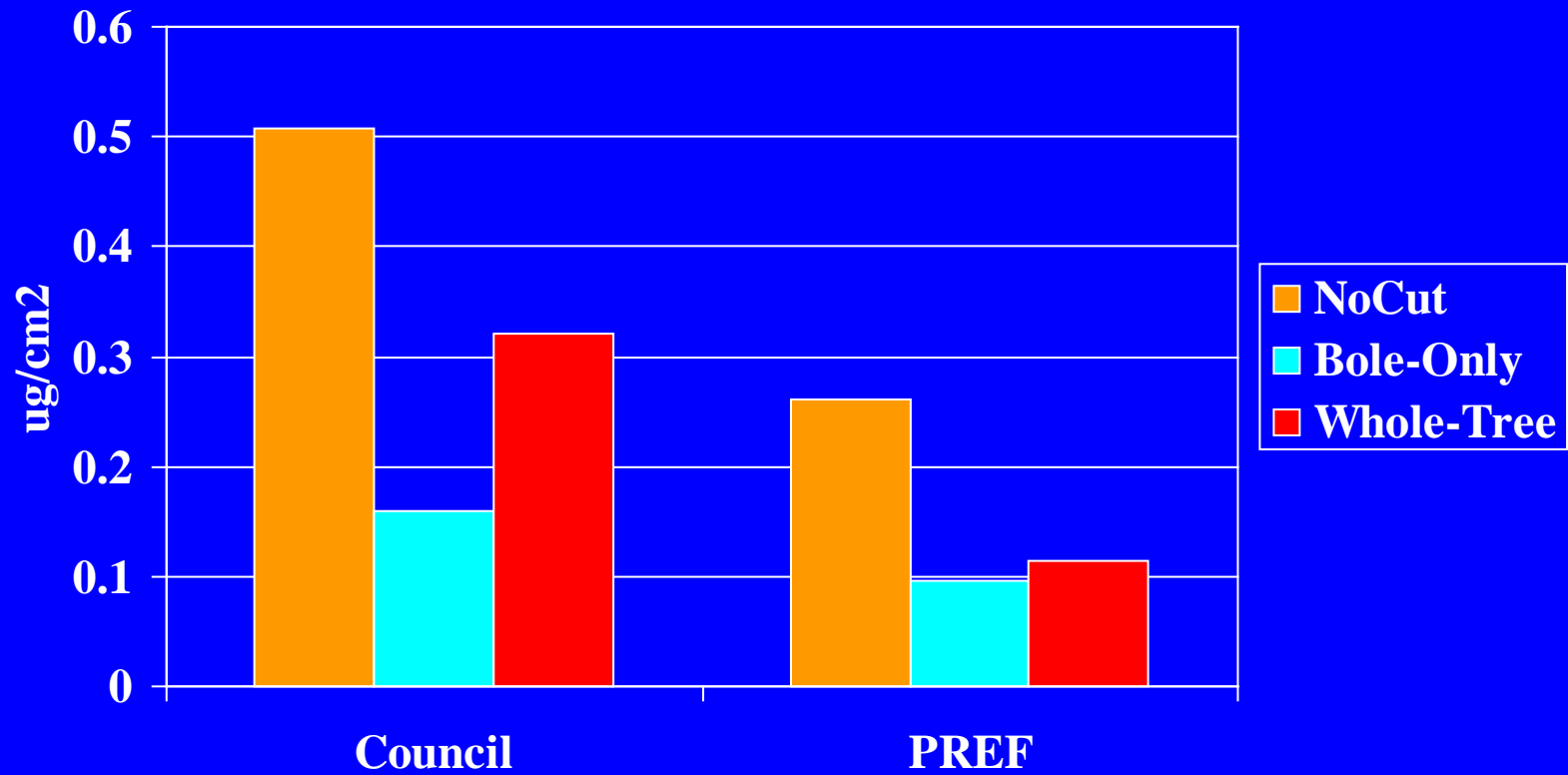
S: Past Clearcut



K: Past Clearcut



B: Past Clearcut



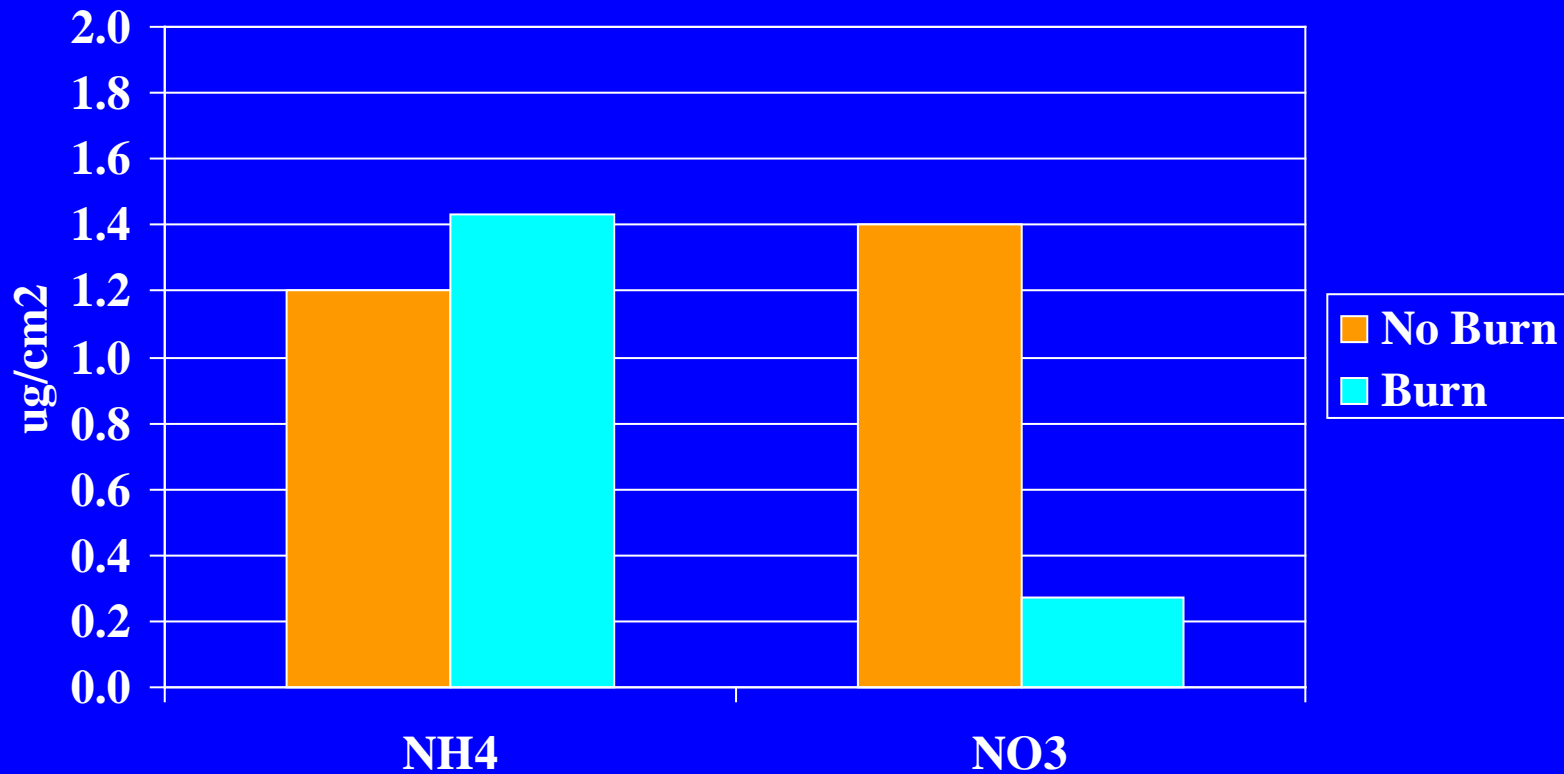
Past Clearcut: Summary

- Differences between treatments were not generally strong or consistent
 - Too few observations
 - Overwhelming site differences
- N and S were sometimes greater on harvested than on control plots – likely due to decreased plant uptake
- B availability was lower on harvested plots than on control plots – so it is likely that harvest removed much of the available B
- Council shows much higher nutrient availability than PREF (this is consistent with other sites on drier habitat series and basalt rock types)
- Council appeared to be better able to recover from harvesting removals of N than PREF

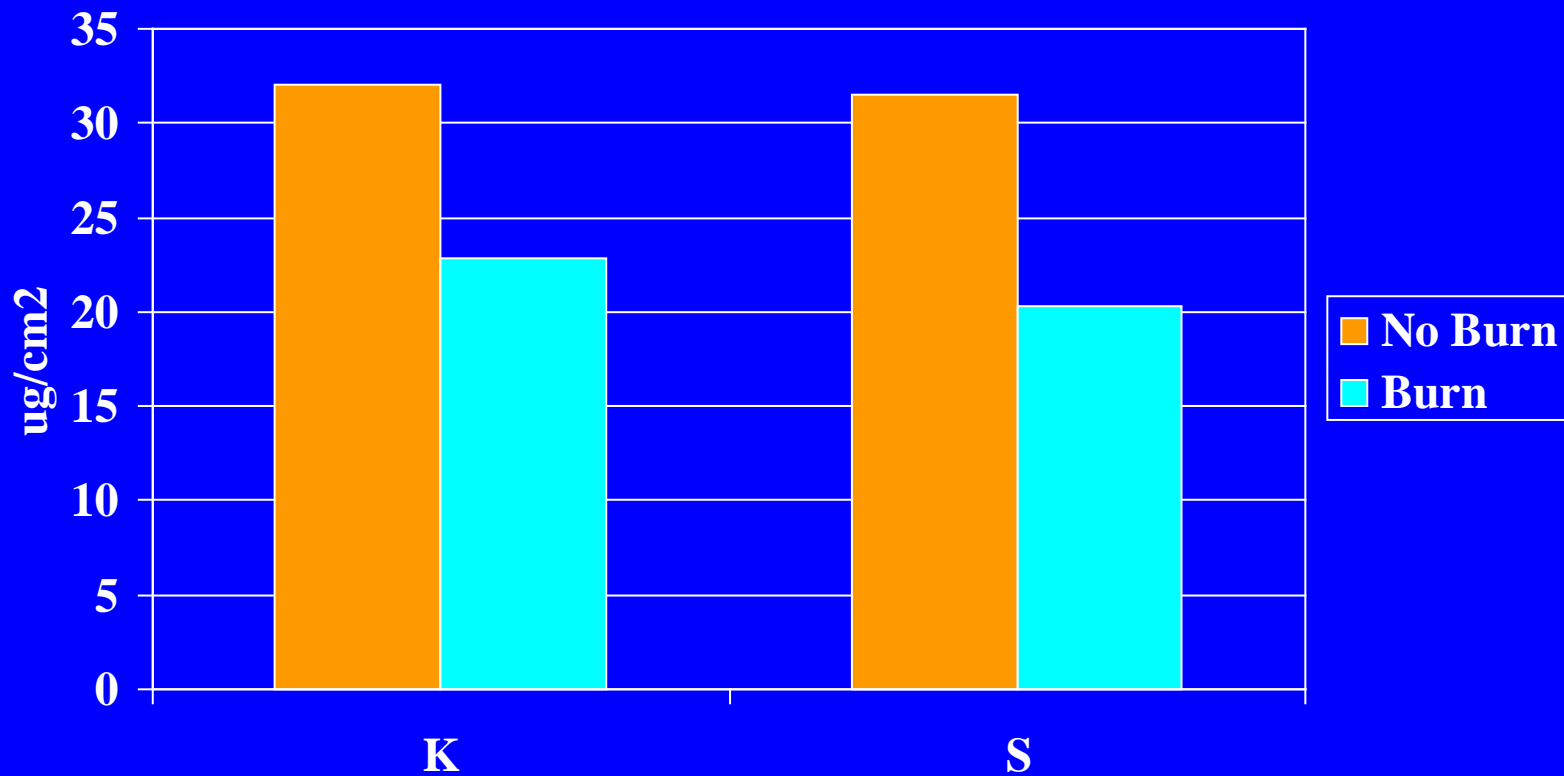
4. Past Site Preparation

- Four sites were harvested in the mid-1980's
- Two of the four were broadcast-burned in the fall of the harvest year, two received no site prep
- Capsules buried at depths:
 - Surface
 - 12-inch
 - 24-inch
 - 36-inch
- Comparison using unfertilized plots only

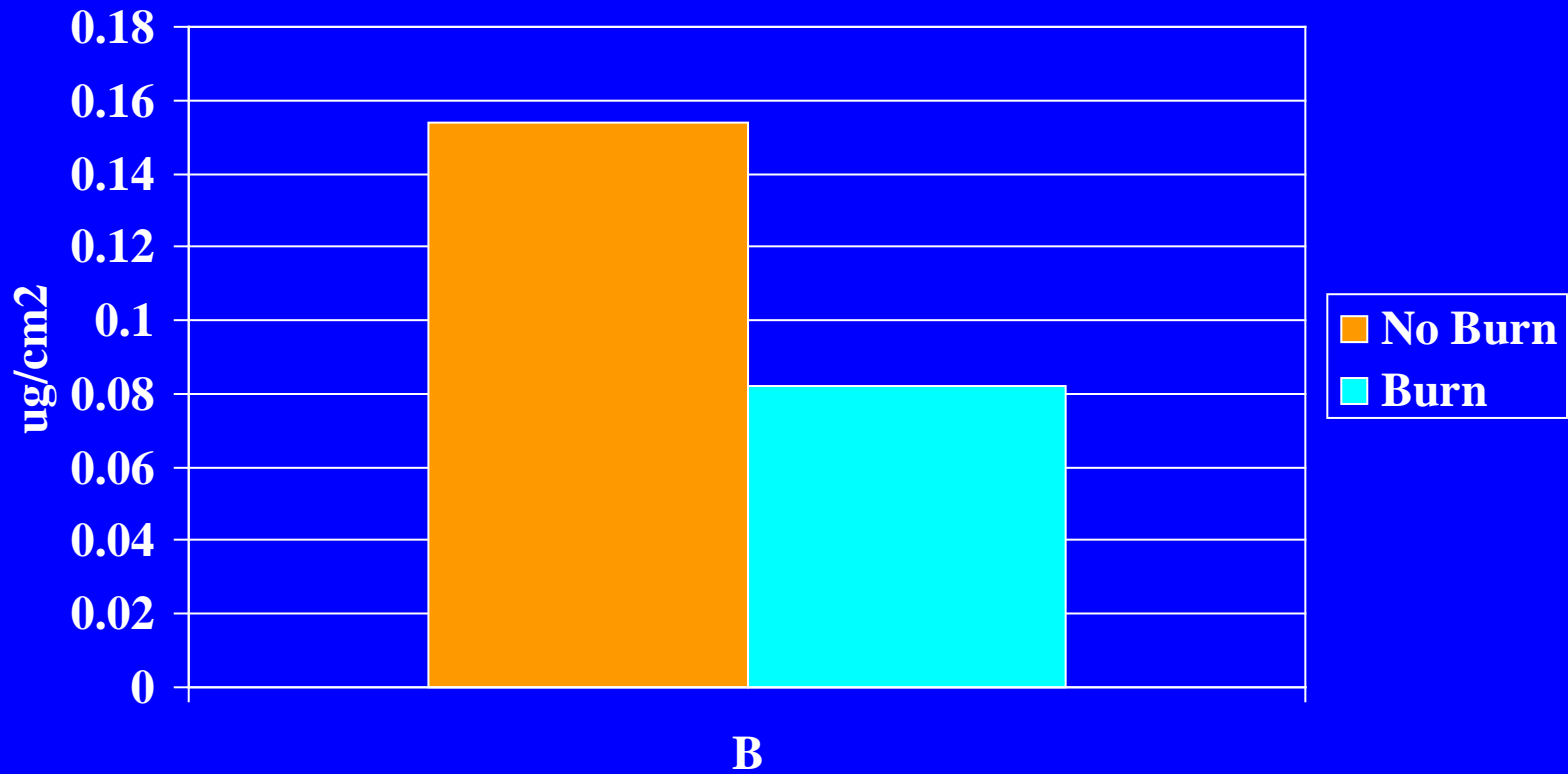
Nitrogen: Past Site Prep



K and S: Past Site Prep



B: Past Site Prep



Site Prep Summary

- NO₃, K, S, and B were higher on the unburned plots compared to the burned plots, and for S and B the difference was significant
- Difficult to know whether the differences are really due to 17 yr-ago burning, or some other factors, however this does seem to support observations that B and S are particularly sensitive to site preparation practices

Final Summary: Ion Exchangers for Detecting Fertilization Effects

- Applied N, K and S are detectable immediately after application, but by several years after fertilization can no longer be detected
- Applied B appears to remain detectable for a longer period of time than other elements
- Applied S appears to move through the soil profile more rapidly than K, B or NH₄
- Nitrate-leaching may occur when nitrification of ammonium-based fertilizer happens faster than plant uptake
- NKSB appeared to increase nitrification compared to N only

Final Summary: Ion Exchangers for detecting Harvesting and Site Preparation Effects

- Differences between harvesting methods were difficult to detect due to large site differences, too few sites, and a long time since activity
- Differences due to past burning may be detectable, though it would be nice to track these changes closer to the time of burning
- Ion-exchangers will likely be useful in detecting soil nutrient shifts due to harvesting and site preparation effects, but will require an adequate number of sites and repetitions
- B appeared to be more sensitive than other elements to harvesting removals and possibly fire