

# Comparing soil nutrients between an annual burned and patch burn grazing system

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## Background

The common technique grazing land management in mesic grassland used for cattle, annual burning and grazing (ABG), increases forage production for cattle at the expense of reducing habitat quality for native animals and plants by homogenizing vegetation and removing ground cover of dead plants. However, patch burn grazing (PBG), is a newer land management strategy that focuses on burning shifting patches of land. This leaves unaffected land while still providing recently burned areas that are beneficial for cattle foraging. PBG has been shown to still be just as beneficial for cattle as ABG, while promising to also be better for native wildlife, but evidence is limited for potential benefit of PBG to small animals, microbes, and plantlife. As well, PBG's effect on the soil itself is largely unexplored.

To explore the effects of PBG on soil, researchers buried resin bags in various locations in landscapes undergoing ABG and PBG management strategies in order to examine the effects of these strategies on nitrate, ammonium, and phosphorus in the soil between May and August of 2021.

## Data Tidying

```
library(tidyverse)
```

```
rawPBG_N <- read.csv("PBG_N_compiled_raw_2021.csv", stringsAsFactors = TRUE)
rawPBG_P <- read.csv("PBG_P_compiled_raw_2021.csv", stringsAsFactors = TRUE)
rawPBG_trts <- read.csv("PBG_trts.csv", stringsAsFactors = TRUE)
```

```
pbgPN <- rbind(rawPBG_P, rawPBG_N)
```

```
FilteredUpgbPN <- pbgPN %>%
  filter(grepl('U', sample))
```

```
dim(FilteredUpgbPN)
```

```
## [1] 549 17
```

```
dim(unique(FilteredUpgbPN))
```

```
## [1] 549 17
```

```
maxDilutionPBG <- FilteredUpgbPN %>%
  group_by(Sample) %>%
  filter(dilution == max(dilution, na.rm = TRUE)) %>%
  ungroup()
```

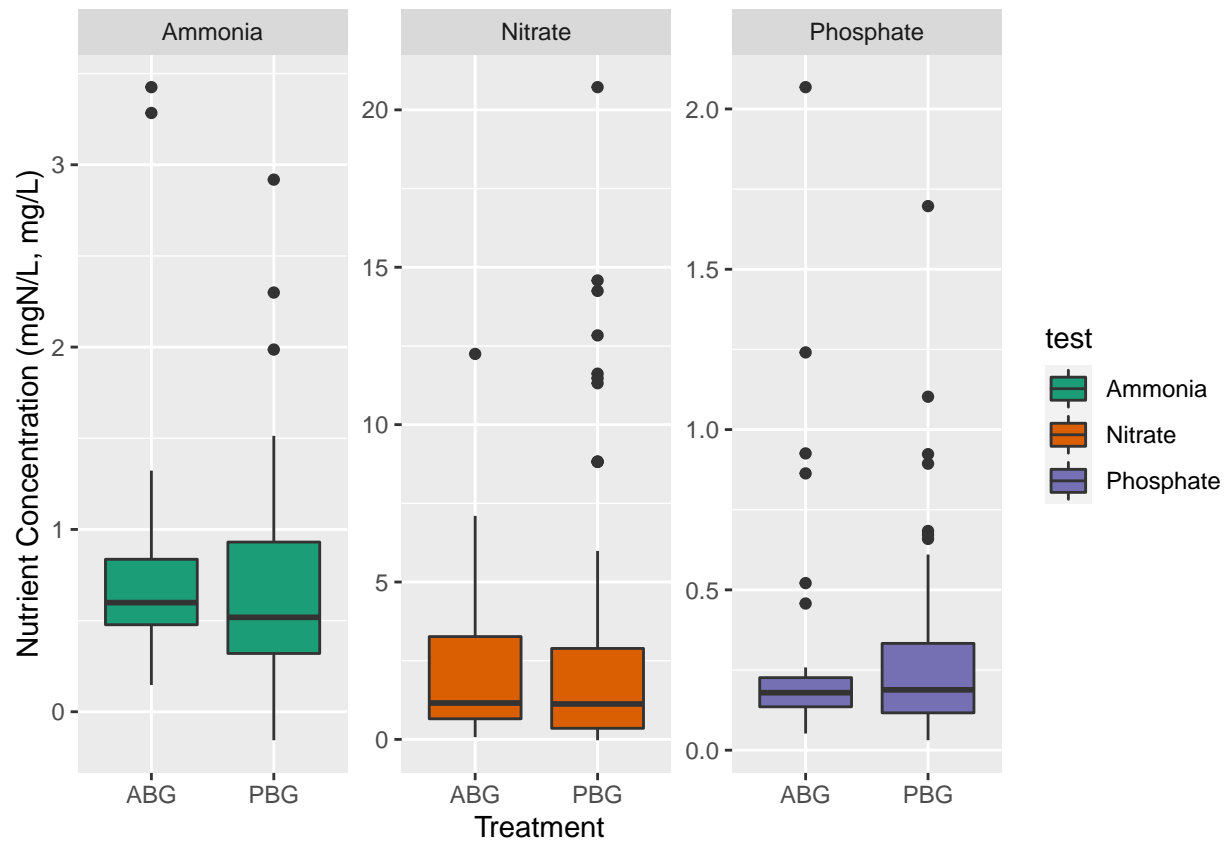
```
PNTreatment <- maxDilutionPBG %>%
  separate(col = Sample, into = c('watershed', 'transect', 'plot', 'elm'), sep = '-') %>%
  select(-c(elm)) %>%
  merge(rawPBGtrts) %>%
  select(c(treatment, watershed, transect, plot, concentration, units, test)) %>%
  rename(temp = test) %>%
  mutate(test = ifelse(temp=="HCl PO4_1",
    "Phosphate",ifelse(temp=="KCL NO3_NO2 2", "Nitrate", "Ammonia"
  )))
```

```
## Warning: Expected 4 pieces. Missing pieces filled with 'NA' in 70 rows [164,
## 165, 166, 169, 170, 191, 192, 195, 196, 218, 219, 222, 239, 240, 241, 242, 243,
## 244, 247, 248, ...].
```

```
PNTreatment <- PNTreatment %>%
  select(-c(temp)) %>%
  transform(concentration = as.numeric(concentration), plot = as.factor(plot), test = as.factor(test),
```

## Graphs

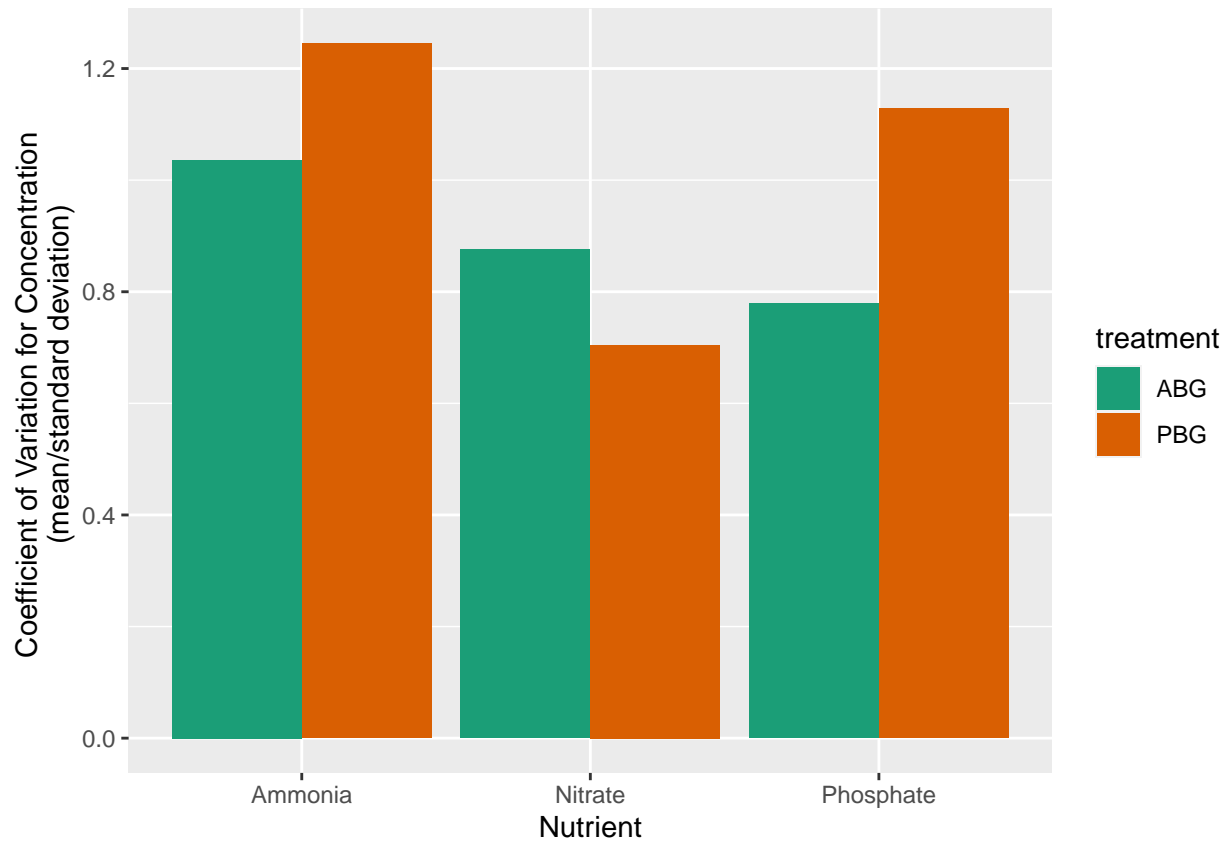
```
ggplot(PNTreatment, aes(x=treatment, y=concentration, fill=test), dpi = 500) +
  geom_boxplot(lwd = .5) +
  facet_wrap("test", scales = "free") +
  labs(
    y = "Nutrient Concentration (mgN/L, mg/L)",
    x = "Treatment"
  ) +
  scale_fill_brewer(palette = "Dark2")
```



```
CV <- PNTreatment %>%
  group_by(treatment, test) %>%
  summarise(cv=mean(concentration)/sd(concentration)) %>%
  ungroup() %>%
  mutate(nutrient = test) %>%
  select(-c(test))
```

## 'summarise()' has grouped output by 'treatment'. You can override using the  
## '.groups' argument.

```
ggplot(data = CV, aes(x=nutrient, y=cv, fill=treatment)) +
  geom_col(position = "dodge") +
  labs(
    y="Coefficient of Variation for Concentration  
(mean/standard deviation)",
    x="Nutrient"
  ) +
  scale_fill_brewer(palette = "Dark2")
```



## Summary

Based on the graphs above, PBG does not have a large impact on the median soil nutrient concentration compared to ABG, with the median concentration only different in soil ammonia where PBG had a lower median concentration. However, PBG sites did show a higher amount of variation in nutrient concentrations for both ammonia and phosphate. This greater variation may also be explained by the known higher plant biodiversity in PBG sites compared to ABG sites, so more study needs to be done. Either way, PBG does not seem to have an overall negative or positive impact on soil nutrient concentration.