Effects of Grazingland Fire on Root Biomass and Decomposition Rates

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Prairies- more than just grass

- 20% of the Earth’s land surface (15% North America)
- grazing land for wild game and livestock
- naturally and anthropogenically maintained with fire
Prairies- more than just grass
ARM SGP site Grazinglands Research Laboratory (GRL) in N Oklahoma

Lightly grazed tall grass prairie

2 year study

Major question: How does grazing land burning effect fluxes of CO$_2$, H$_2$O, and energy throughout the ecosystem?

Why is this important?
March 9, 2005
Roots!

- Tall grass prairie conventionally believed to contain deep roots which withstand fires and resist invasion by shallow rooted plants.
- What is the root biomass depth profile of this prairie?
- Does fire effect the decomposition rates of prairie roots and does it vary by depth?
- Does burning influence total root biomass? Does it vary over depth profile?
Root Biomass Comparison August 2006

Average Biomass (g/m²)

Core Depth (cm)

- Burned n=3
- Unburned n=4
Root Biomass Comparison March 2007 (n=7)

Biomass (g/m²)

Core Depth (cm)

- 0-10
- 10-20
- 20-30
- 30-40
- 40-50
- 50-75

- Burned
- Unburned
Hand-sorted Roots by Type March 2007

Biomass (g/m²)

Live <0.5mm  Dead <0.5mm  Live 0.5-2mm  Dead 0.5-2mm

Legend:
- N 0-10
- N 10-20
- N 20-30
- N 30-40
- N 40-50
- N 50-75
- S 0-10
- S 10-20
- S 20-30
- S 30-40
- S 40-50
- S 50-75
Average Live and Dead Root Totals (March 2007)

- **N live**
- **S live**
- **N dead**
- **S dead**

**Graph Details**
- **X-axis**: Depth (cm)
- **Y-axis**: Average Biomass (g/m²)
- **Legend**
  - **N live**: Yellow triangular markers
  - **S live**: Green circular markers
  - **N dead**: Green triangular markers
  - **S dead**: Green diamond markers
Live/dead ratio to determine decomposition rates

At steady lifetime and decomposition rates:

Stock Live = BNPP·τ_L

Stock Dead = BNPP·τ_D

BNPP is belowground net primary production

Live/Dead = Lifetime/Decay time = \( \frac{\tau_L}{\tau_D} \)
Conclusions

- More total biomass in shallow depths
- More dead roots than live roots
- Major differences take place in the top 20cm
- Burned field has increased belowground biomass 1.5 y post burn, but not 2 y post
- Burned field has more live roots (2 y post burn) though similar total roots
- More total dead roots in unburned fields (2 y post burn)

Is this indicative of a change in the decomposition rate???
Potential Sources of Error

- Natural variability of prairie ecosystem (not homogenous)
- Low sample size
- Personal bias in hand sorting
- Lack of pre-burn data for site comparison
Further Research

- C/N analysis in live and dead roots
- Pre-burn data
- Effects of fire on prairie species composition
- Long term annual burn versus no burn
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Questions????