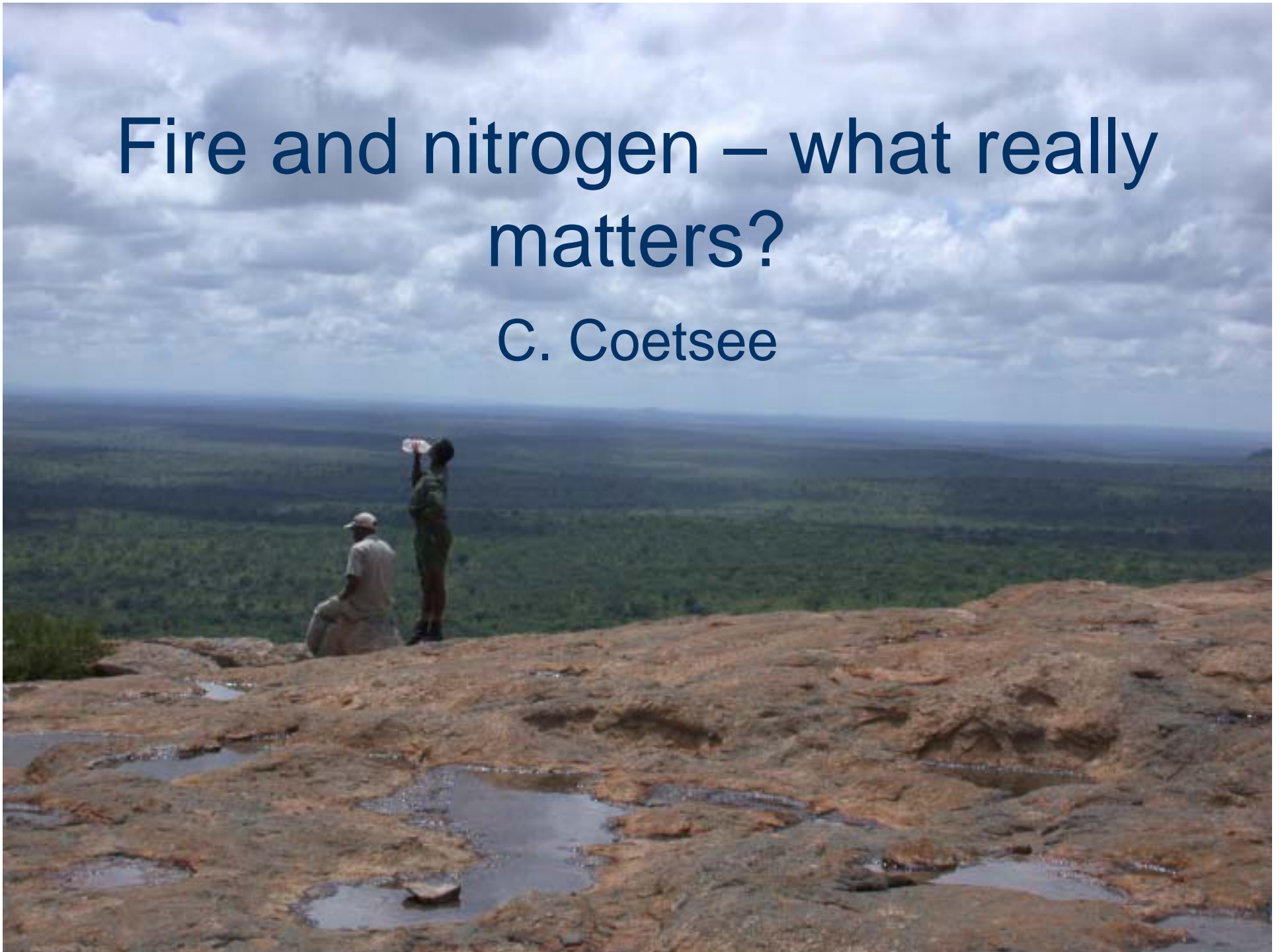


Fire and nitrogen – what really matters?

C. Coetsee



Frequent fire in savanna

- Many things decline, including:
- Total leaf area index (LAI)
- Annual litterfall N cycling
- Annual net N mineralization rates
- Total canopy [N]
- Fine root [N]
- Herbaceous [N]

Frequent fire in savanna, cont.

- While other things increase:
- N resorption
- Leaf litter [N]
- C:N ratios
- Nitrogen use efficiency (NUE)

Frequent fire in prairie

- Interactions with grazers
- Increased soil temperature and PAR
- Greater photosynthetic capacity and NUE
- Wide C:N ratios in plant material
- Greater immobilization
- Low [N] in soil promotes grasses with high NUE

But why is it important in savannas?

- Low fire frequency/
high tree dominance
- High rates of N
cycling
- High LAI
- High productivity
- High quality
- High fire frequency/
high grass dominance
- Low rates of N cycling
- Low LAI
- Low productivity –
woody + herbaceous
- Low quality

Or is it?

Questions?

1. Is productivity and N cycling rates negatively related to fire frequency and positively related to tree dominance?
2. Is the differences in ANPP between different fire frequencies (woody- and grass-dominated communities) a result of differences in N availability or NUE?

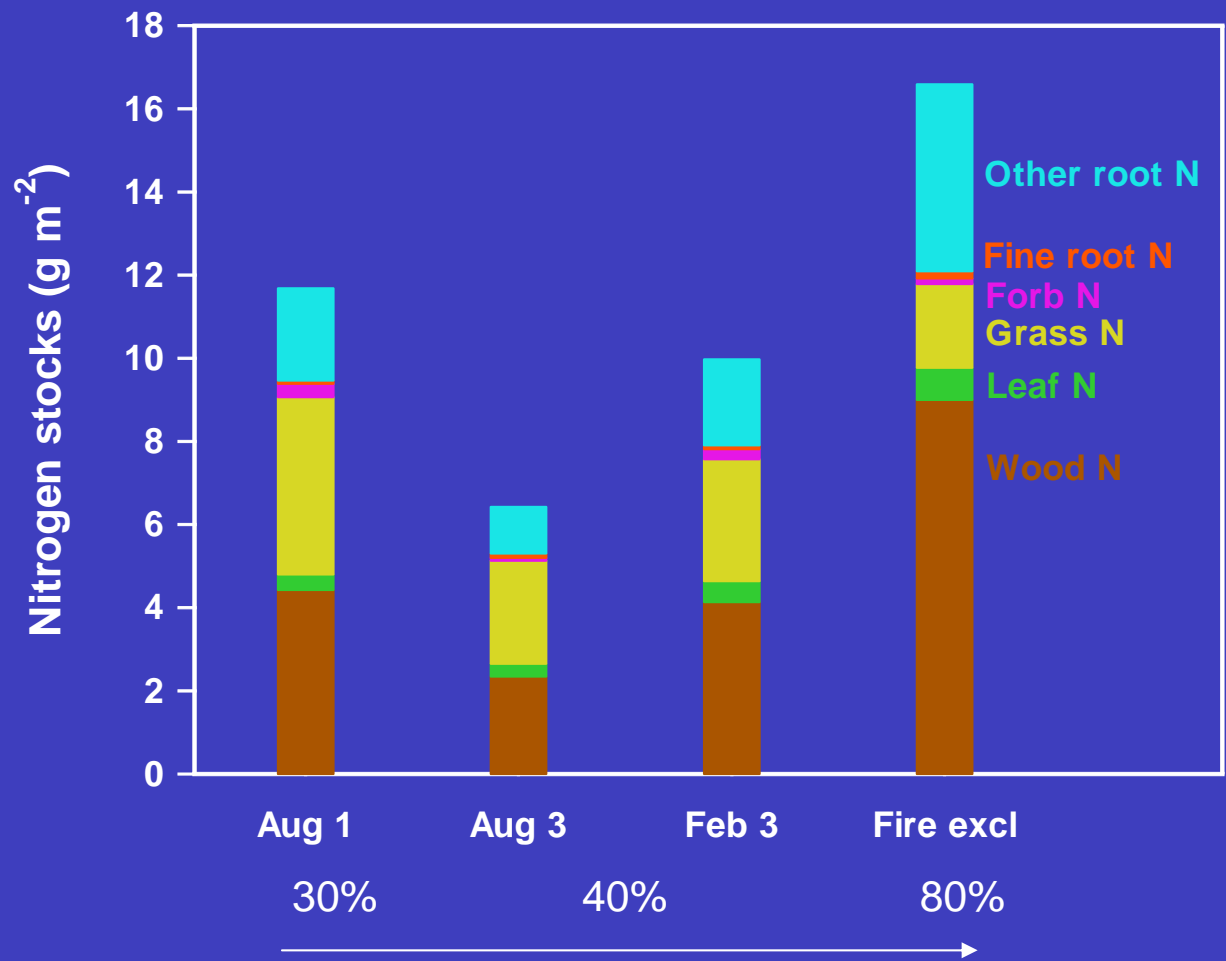
Basal area and LAI for four fire treatments in the Shabeni string

	Aug 1	Aug 3	Feb 3	Fire excl
Basal area (m ² .ha ⁻¹)	3.23	2.33	4.00	7.71
LAI (m ² .m ⁻²)	0.372	0.331	0.496	0.807

Aboveground biomass (kg ha⁻¹) for four fire treatments

Biomass		Aug 1	Aug 3	Feb 3	Fire excl
Herbaceous	Grass 2004	6284.95	5536.59	3785.02	4850.71
	Grass 2005	4273.75	2478.20	2933.97	2010.20
	Forb 2005	204.34	46.05	163.61	57.17
Tree	¹ Leaf	248.13	220.82	354.00	538.00
	Litter	357.56	202.94	491.82	596.39
1970	² Total (Enquist)	16985.4	9338.8	23250.1	na
1996	³ Total (Guy)	27390.8	10623.5	17944.5	70023.4
2000's	⁴ Total (Enquist)	38788.34	28012.71	51353.13	77381.82

Fine root biomass		143.13	200.33	147.08	202.83
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Questions?

1. Is productivity and N cycling rates negatively related to fire frequency and positively related to tree dominance?
2. Is the differences in ANPP between different fire frequencies (woody- and grass-dominated communities) a result of differences in N availability or NUE?

Nitrogen use efficiency

- The ratio of biomass produced per unit N lost (i.e. inverse of litter [N]) – N resorption
- The ratio of aboveground productivity and N loss in litterfall (ANPP/litterfall N)
- The productivity per annual N availability, uptake or N mineralization
- How NUE is the dominant plant species?

	Aug 1	Aug 3	Feb 3	Fire excl
N resorption	0.55	0.60	0.54	0.51
NUE (inverse litterfall N)	0.15 ^a	0.18 ^b	0.15 ^a	0.14 ^a

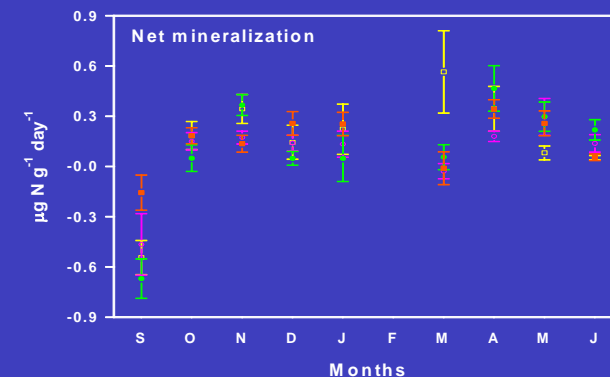
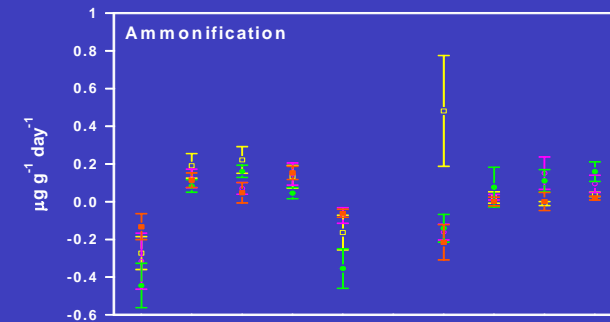
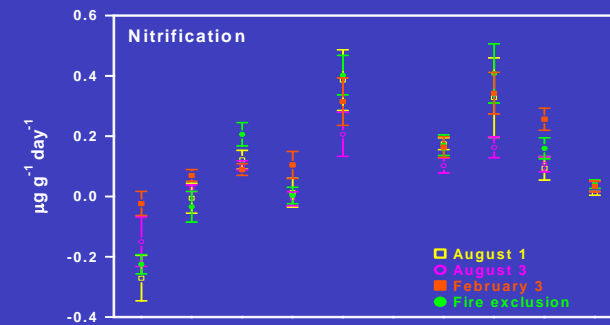
Monthly variation in the rates ($\mu\text{g g}^{-1}\text{soil day}^{-1}$) of N mineralization, ammonification and nitrification in soils from Shabeni:

August 1

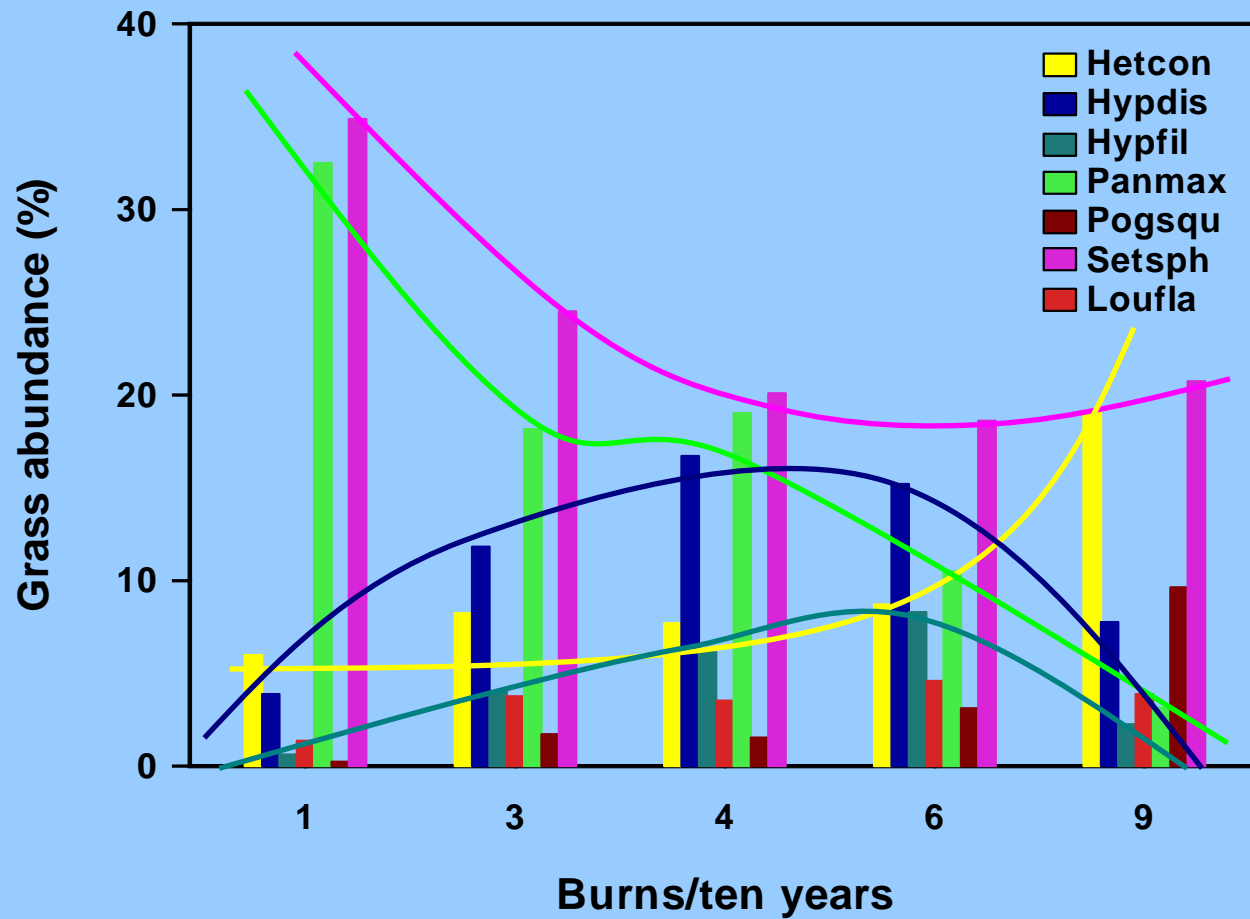
August 3

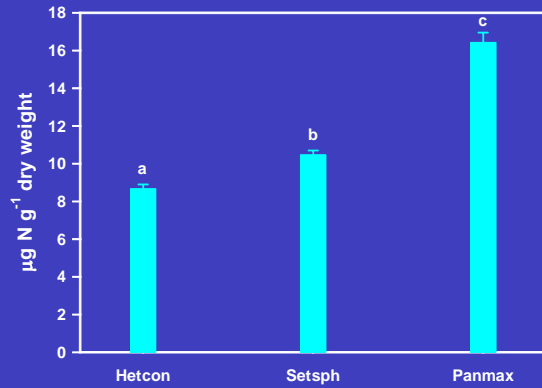
February 3

Fire exclusion



Abundance of the most dominant grass species – Pretoriuskop EBP's



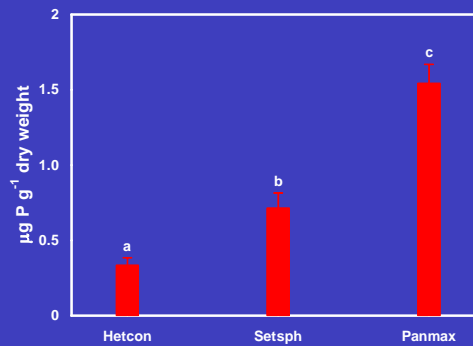


Foliar N concentration for three different grass species;

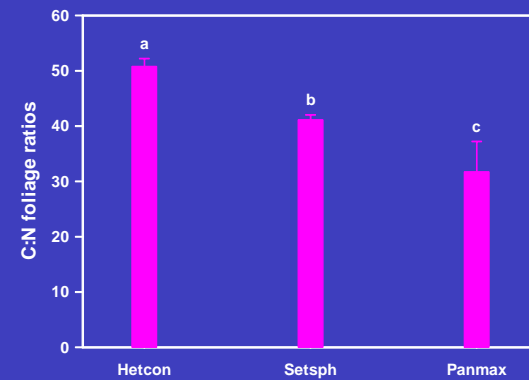
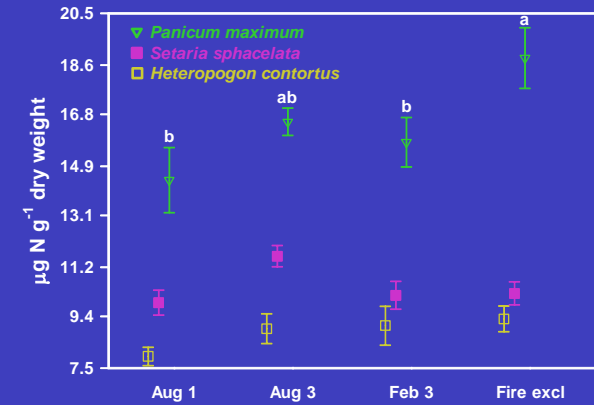
Heteropogon contortus

Setaria sphacelata

Panicum maximum



Foliar P concentrations



Foliar C:N ratios

Conclusion

1. Productivity and N cycling rates are not necessarily negatively related to fire frequency or positively related to tree dominance?
2. Possible greater NUE with frequent fire, but not lower N availability.
3. Species compositional gradient across fire gradient more important than litter chemistry within species.

Fire and N in broadleaved savanna - what really matters?

- High fire frequency/
high grass dominance
- Low rates of N cycling
- Low LAI
- Low productivity –
woody + herbaceous
- Low quality
- High fire frequency/
high grass dominance
- High rates of N cycling
- Intermediate LAI
- High productivity –
herbaceous > woody
- Low quality

Thank you

- W. Bond and E. February
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