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Comparative Litter Quality and Recalcitrance Among Native Grasses and the Invasive, Non-indigenous KR Bluestem (*Bothriochloa ischaemum*)

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Background

- Decomposition
  - Nutrient availability is altered following the change in litter quantity and quality due to invasion, causing a positive feedback for invasion (Evans et al. 2001, Allison & Vitousek 2004, Ehrenfeld 2003)
- Fire cycles
  - An increase in fire frequency and alteration in natural disturbance regimes has been observed in invasion studies (Evans et al. 2001, Vasquez et al. 2008, Gabbard & Fowler 2007)
- Competition for resources
  - Litter chemistry effects have been determined to be more influential for N cycling. Native grasses that have been determined to have diverse litter qualities would have a

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KR Bluestem (hereafter referred to as KR)

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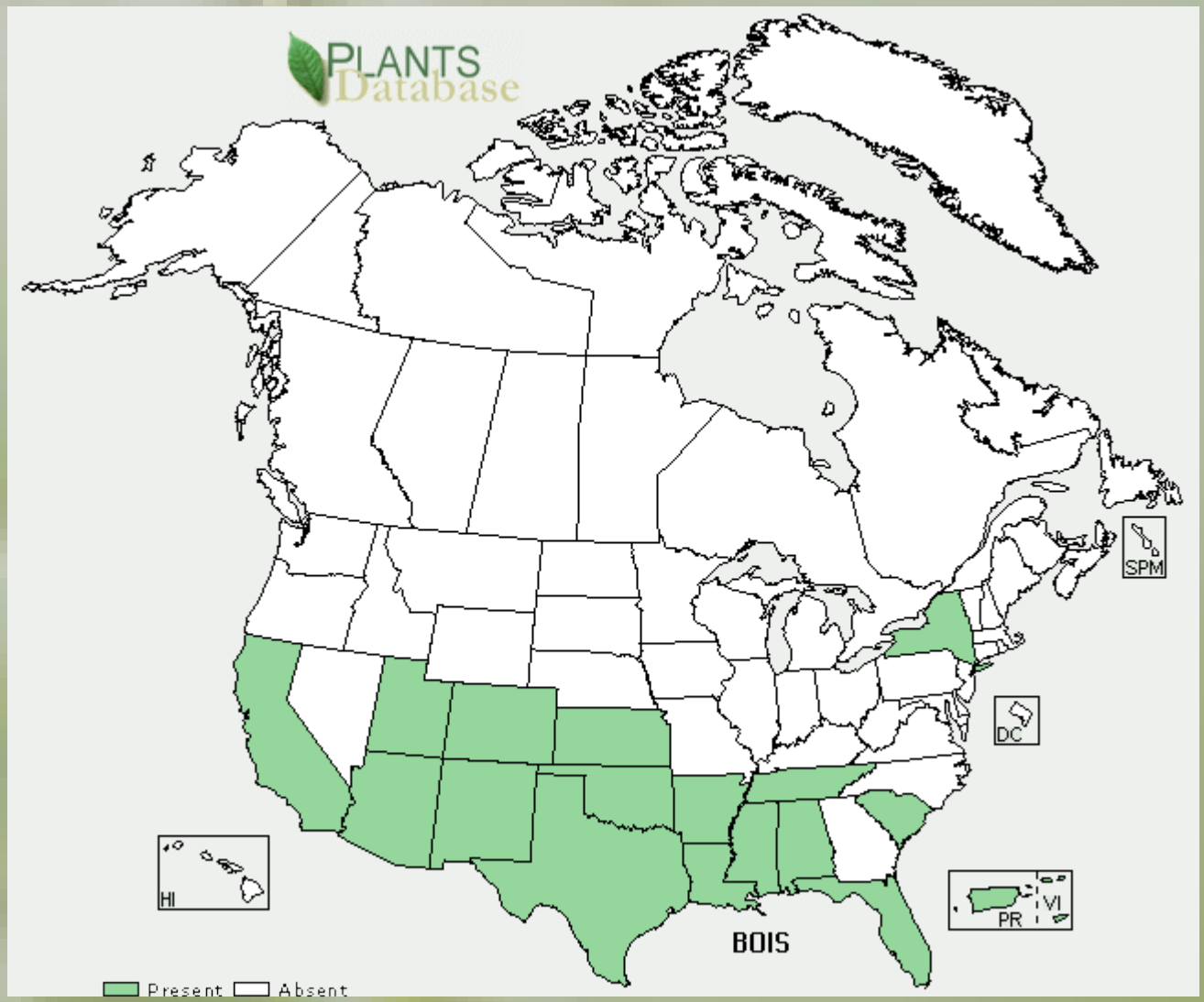
- Perennial, C4 bunchgrass
- Originated in southern Europe and Asia (Allred, 1983)
- Introduced in 1930's for rangeland improvement, erosion control, and revegetation (USDA, Gabbard & Fowler 2007)
- Observed to have a detrimental impact on native plant diversity and has a high probability of future spread (Gabbard & Fowler 2007)
- Impact on indicator species including rodents (Sammon 2006), and birds (Hickman et al. 2006)



KR Distribution in the U.S.



http://plants.usda.gov/java/profile?symbol=BOIS

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Observations – Texas Hill Country

- KR is commonly found in disturbed areas and open habitats with long history of grazing.
- Native species are predominately located in shaded areas
- KR generally found in monocultures in rangelands and appears to have increased litter quantity and, thus, fuelbad.

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Hypothesis

- Following invasion, the rate of decomposition and nutrient release is slower in KR dominated areas.
- Mechanism? – Lower quality litter, as measured by C and N and lignin.

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Experimental Design

- Species
  - KR Bluestem (*Bothriochba ischaemum*)
  - Little Bluestem (*Schizachyrium scoparium*)
  - Sideoats Grama (*Boutebua curtipendula*)
  - Switchgrass (*Panicum virgatum*)
- Litter collected from 3 roadside populations/species.
- Litter divided into leaves and culms
- 2g per bag: 1g leaves, 1g culms
- Fiberglass mesh bags
  - Highly resistant to UV
  - Small hole size (.01m x .02m) allows for microbes, excludes invertebrates.
  - Bag size: 10.16 cm x 15.24 cm

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Litterbag Method



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Experimental Design Using Litter Bags

Factorial Design:

- x 4 Species
- x 3 Sites
- x 2 Habitats per site (KR-vs. native-species dominated)
- x 5 Collection dates
- x 3 Replicate bags/date

Total # of bags = 360

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Sites

- Site
  - Allocated in Texas Hill County on similar soil types.
  - Protected so that bags could be left in place.
  - KR and native-dominated areas in open habitat to control for effects of canopy cover.

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Site Characteristics

Three sites



owndridge Natural Area (San Antonio, TX)

Davidson Ranch (Kendalia, TX





Luna Rosa Ranch (Medina,

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Site Characteristics – Soils







pH	Mg (lbs/A)	totalnitrate (%)
TotalNitrogen (lbs/A)	Fe (ppm)	totalammonium (%)
P (lbs/A)	Zn (ppm)	P-H2O
K (lbs/A)	B (ppm)	sand
SO4 (lbs/A)	Cu (ppm)	silt
Ca (lbs/A)	Organic Matter (%)	clay

Found NO significant differences among sites or between habitat for soil nutrient or texture analyses

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Response Variables

- Site and Habitat Characterization
  - Vegetation
  - Biomass
  - Soil Food Web
- Litter quality
  - Initial C, N, and lignin
- Biomass Loss with ash-free corrections

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KR Coverx Site x Habitat

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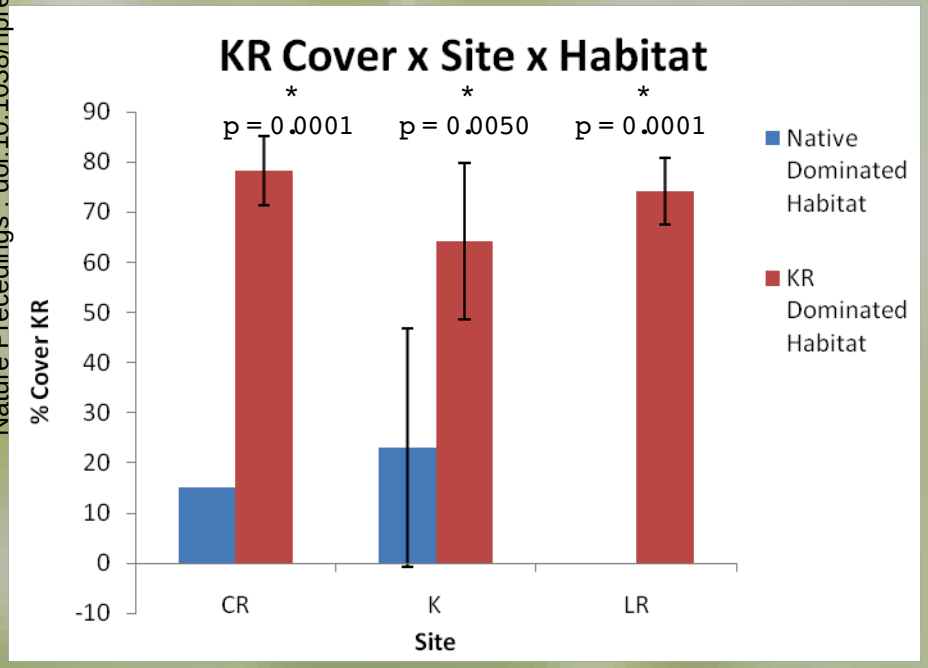
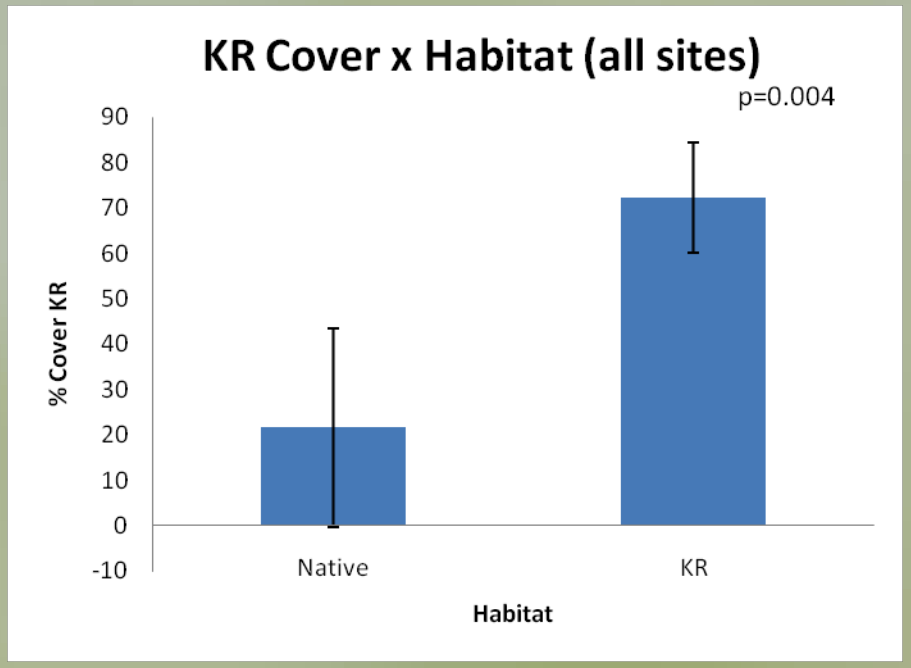
KR coverx site x habitat

Source	F	P
Model	43.7295	<.0001
Site	0.3685	0.6948
Habitat(Site)	72.6368	<.0001





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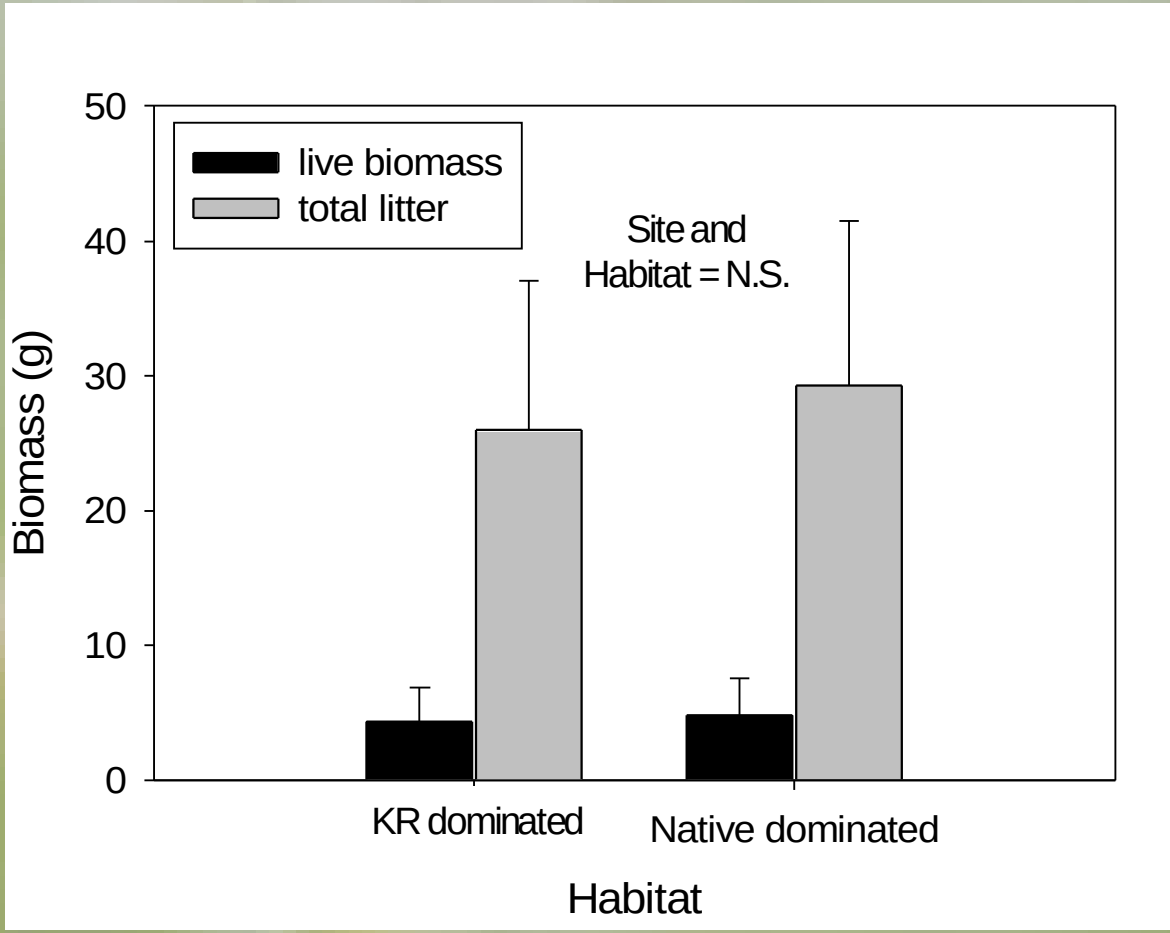
Biomass x Habitat



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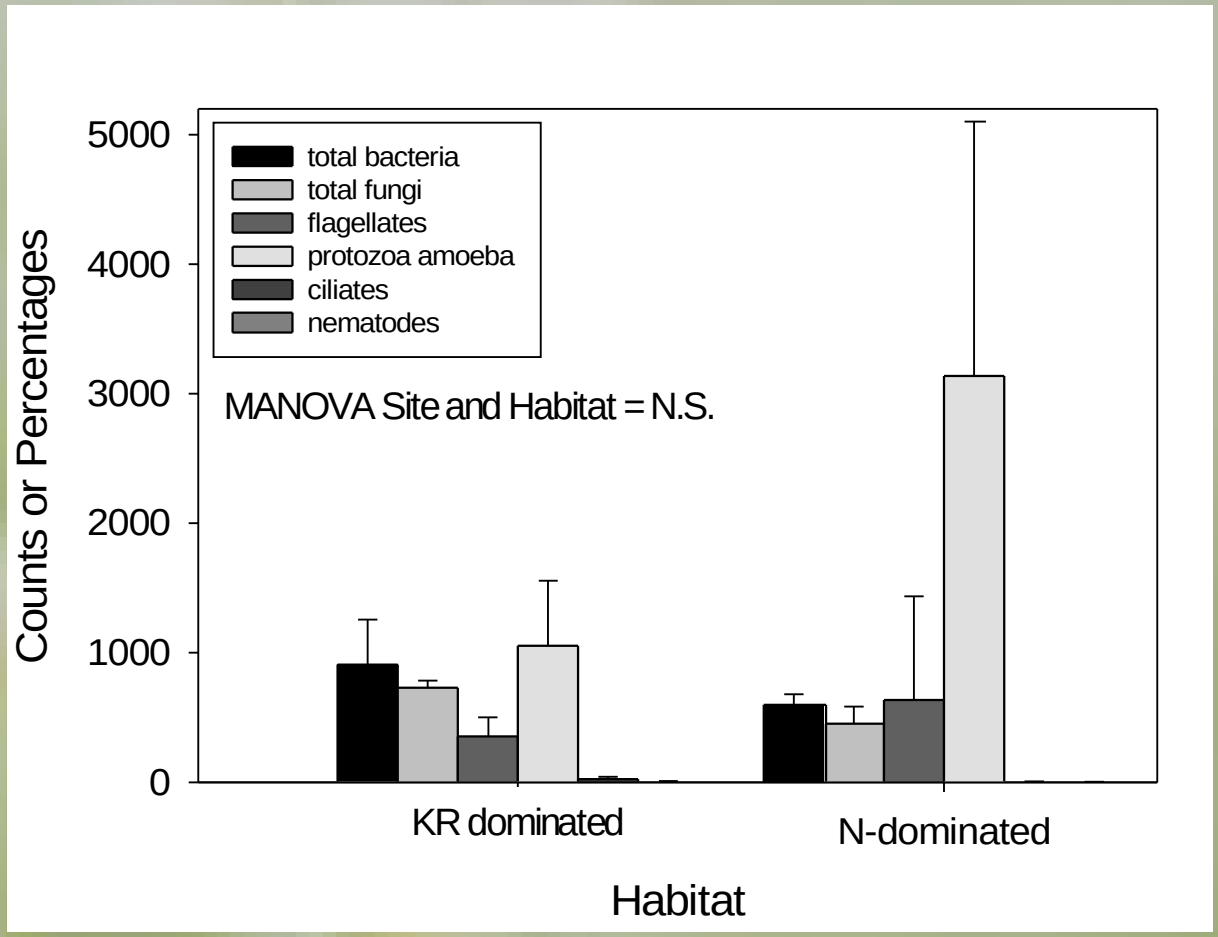
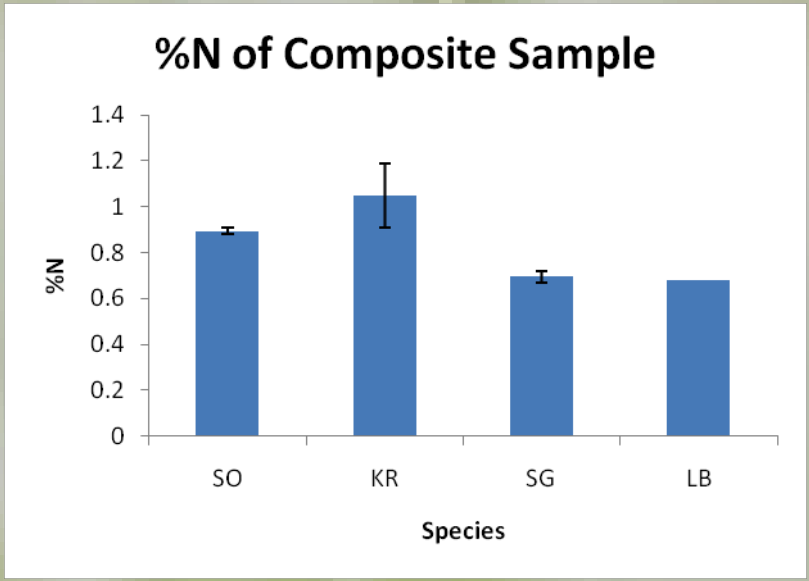
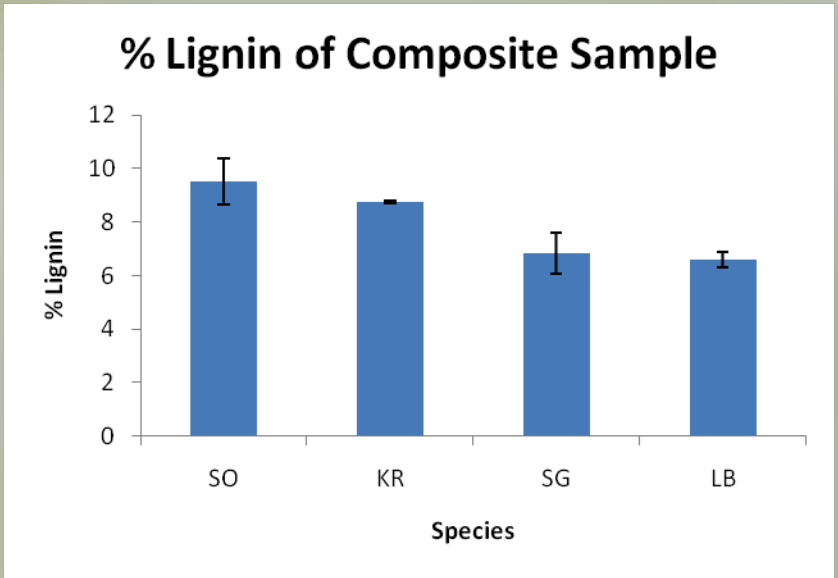
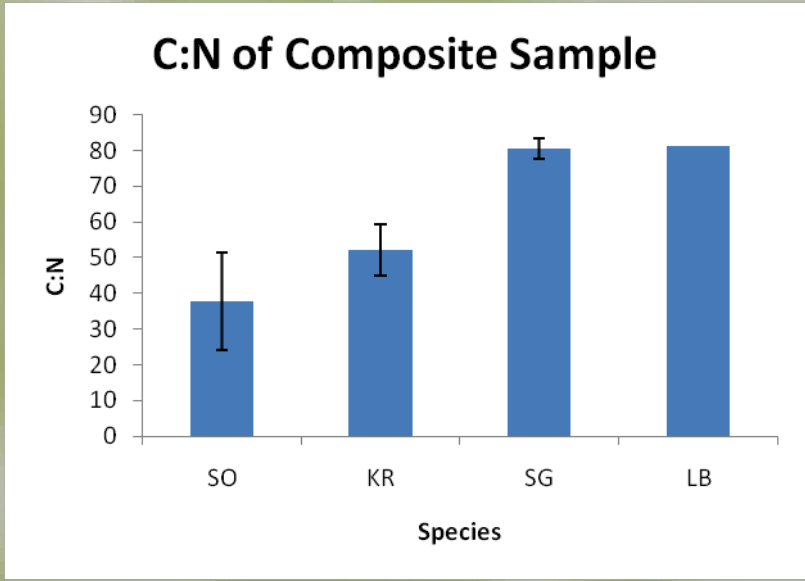
SoilFoodWeb Analysis x Habitat

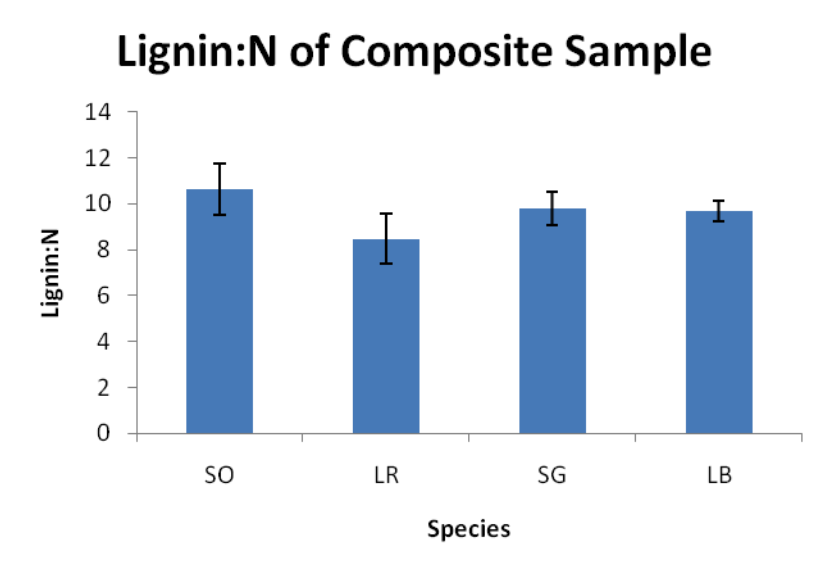


Litter Quality x Species









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Biomass Loss x Site x Habitat x Species

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MANOVA/Repeated Measures for Biomass Loss in Leaves, Culms and Total

Factor	percent remaining leaves			percent remaining culms			percent remaining combined biomass		
	F	*p*	x Time	*F*	*p*	x time	*F*	*p*	x time
Site	0.560	0.574	n.s.	0.920	0.406	n.s.	0.020	0.977	n.s.
Habitat	0.110	0.738	n.s.	0.120	0.732	n.s.	0.170	0.683	n.s.
Species	13.380	<0.0001	<0.0001	5.870	0.002	0.004	11.600	<0.0001	<0.0001
Site x Habitat	0.180	0.832	n.s.	0.100	0.909	n.s.	0.410	0.667	n.s.
Site x Species	1.410	0.232	n.s.	0.290	0.941	n.s.	0.430	0.856	n.s.
Habitat x Species	0.130	0.942	n.s.	0.440	0.728	n.s.	0.520	0.674	n.s.
Site x Habitat x Species	0.780	0.587	n.s.	1.370	0.245	n.s.	1.920	0.097	n.s.
Time	177.22	<0.0001	–	41.90	<0.0001	–	135.79	<0.0001	–

Wilks' Lambdas reported

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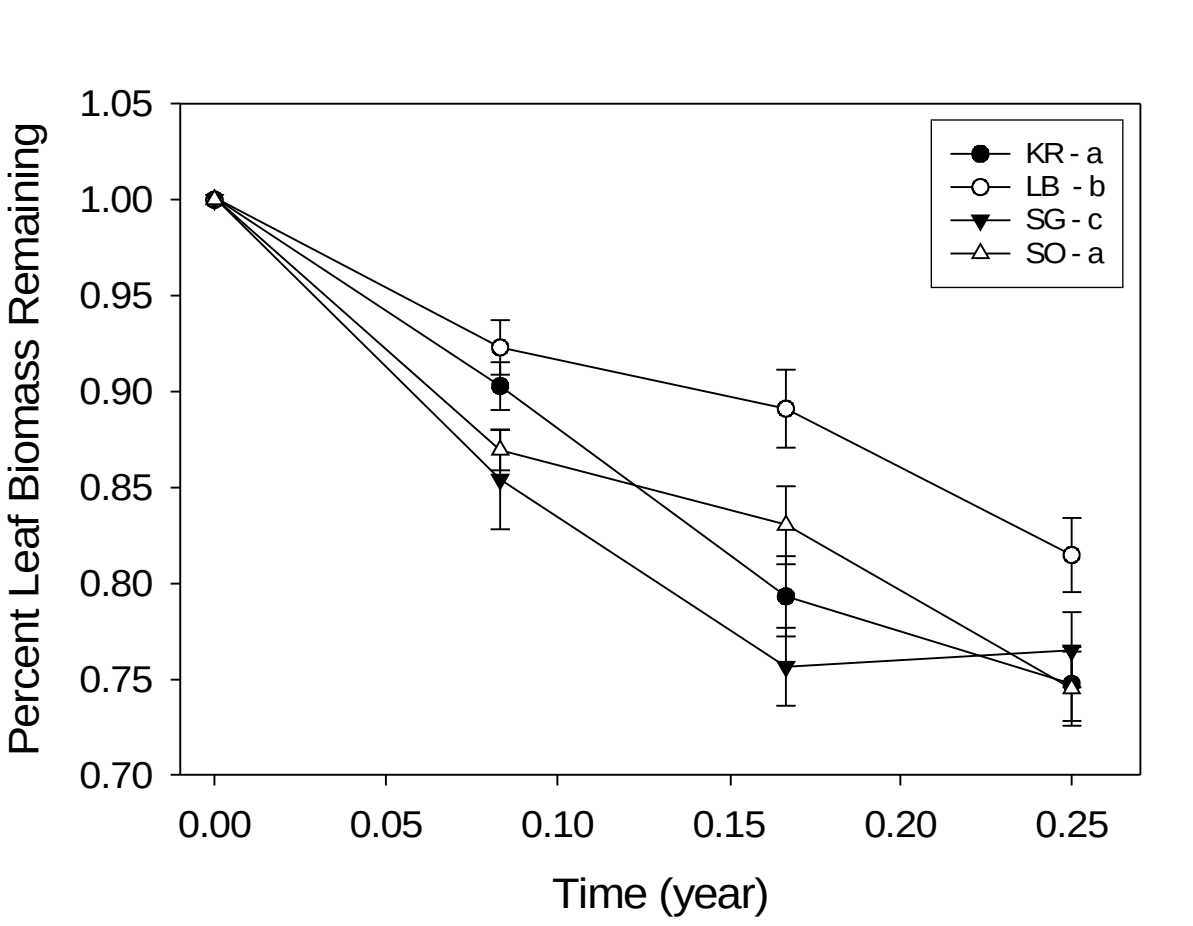
LEAF Biomass Loss x Species

Species Contrast Over Time



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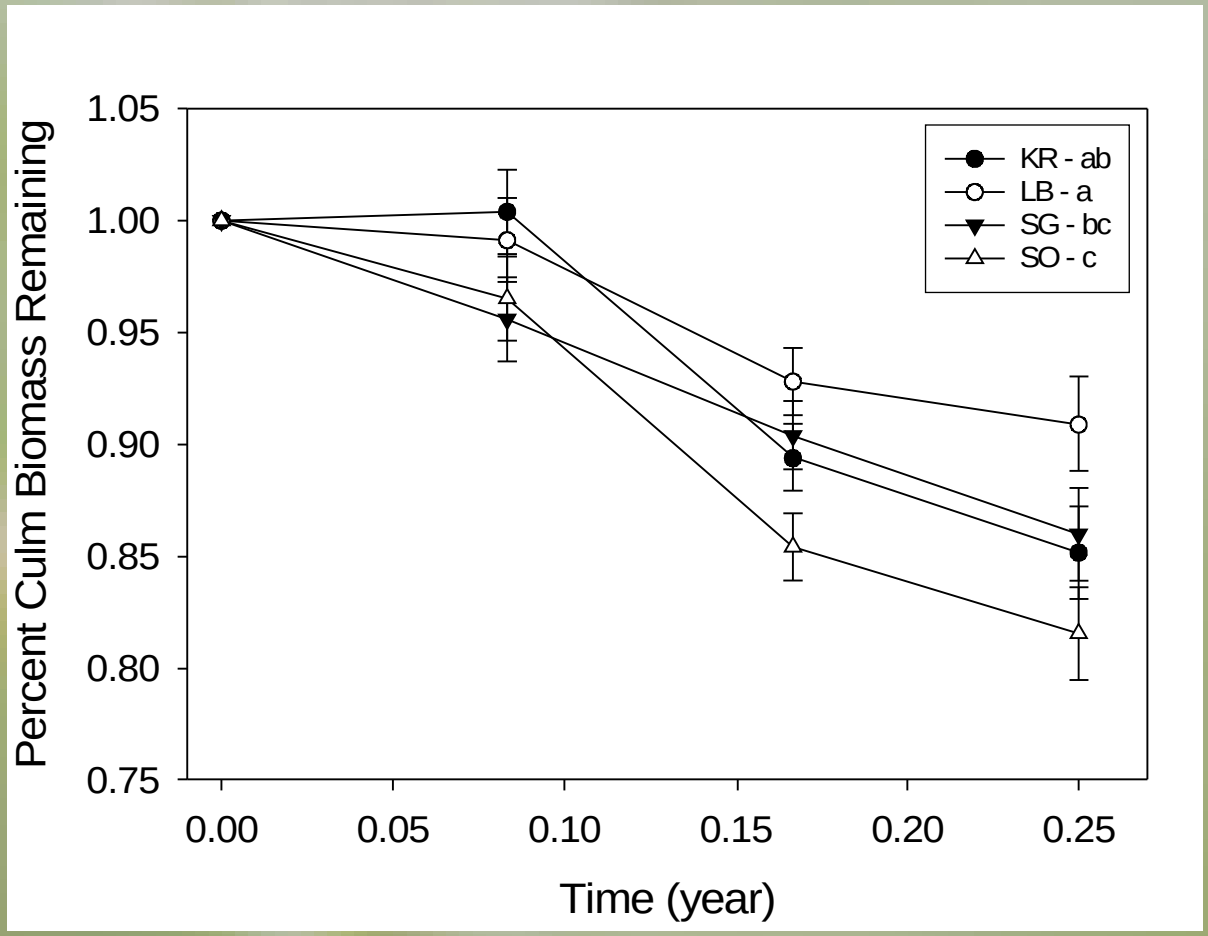
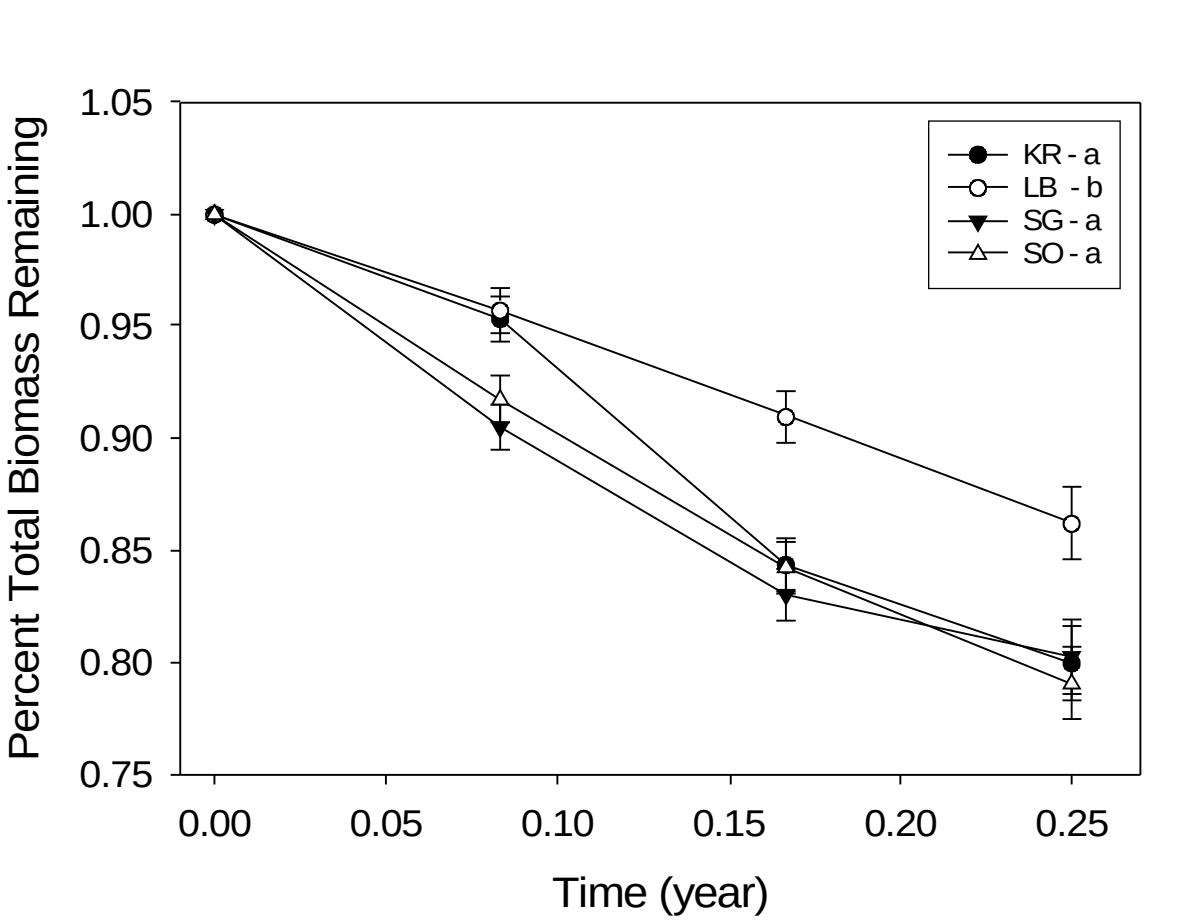
CULM Biomass Loss x Species

Species Contrast Over Time



TOTAL Biomass Loss x Species

Species Contrast Over Time



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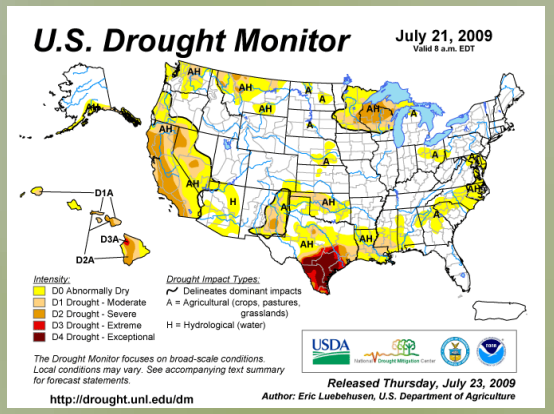
Conclusions

- No significant differences for the following:
  - Soil food web and nutrients and texture (sites or habitats).
  - Litter biomass accumulation (sites or habitats).
  - Initial C, N, or Lignin composition among species.
- Significant differences in KR cover between habitats.
  - KR Bluestem does not appear to be any more recalcitrant than the native species in this study.
- Little bluestem appears to have the highest recalcitrance. Perhaps useful for management where carbon (CO_2) sequestration is a goal.



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Further Study

- Observational study
  - Comparing litter accumulation in the present sites and habitats.
- Soil Microbial Community Analysis
  - Utilizing PCR techniques to identify the diversity of microbes present.

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