

Examining the role of burning and nitrogen in longleaf pine

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Introduction

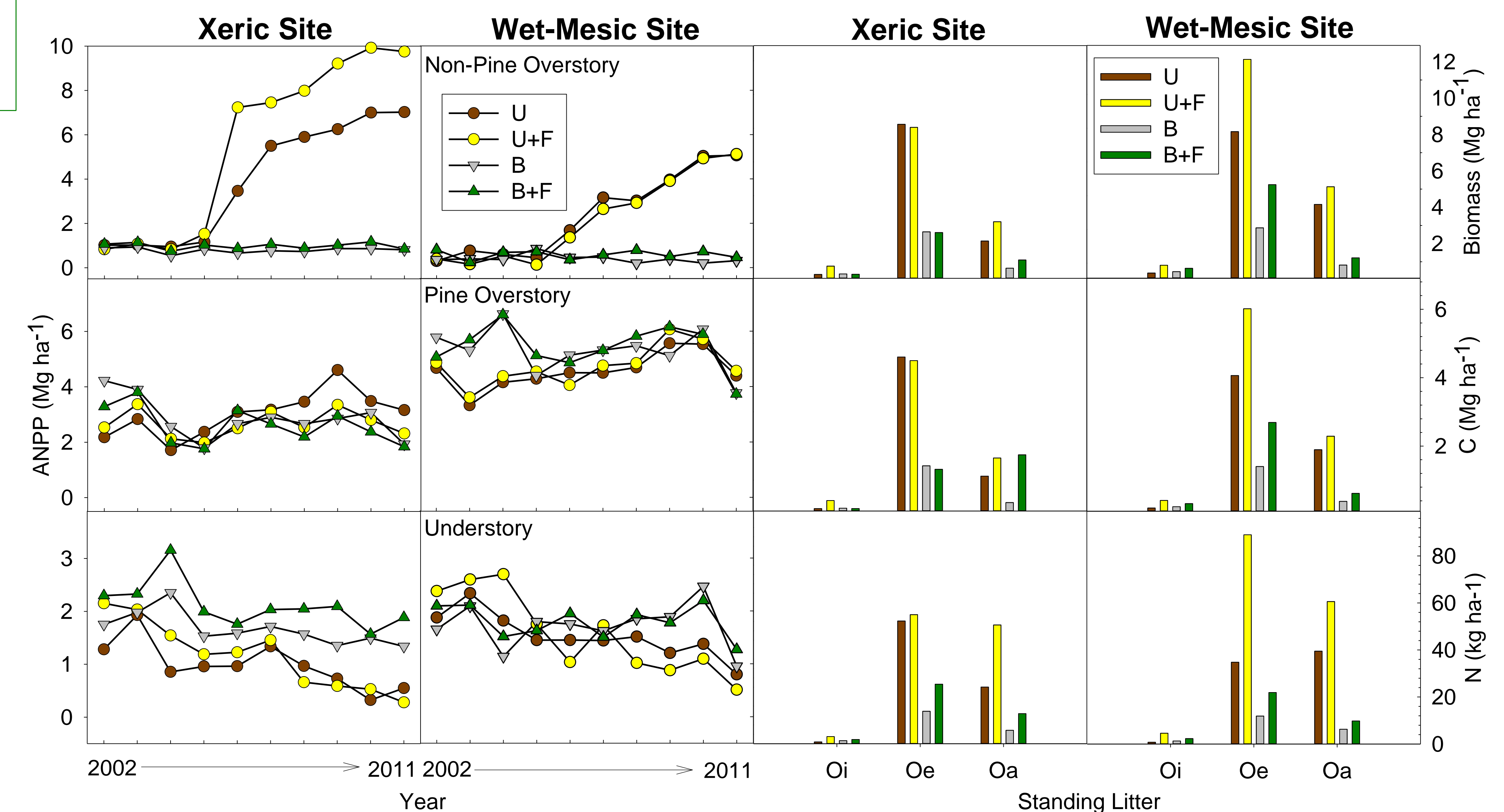
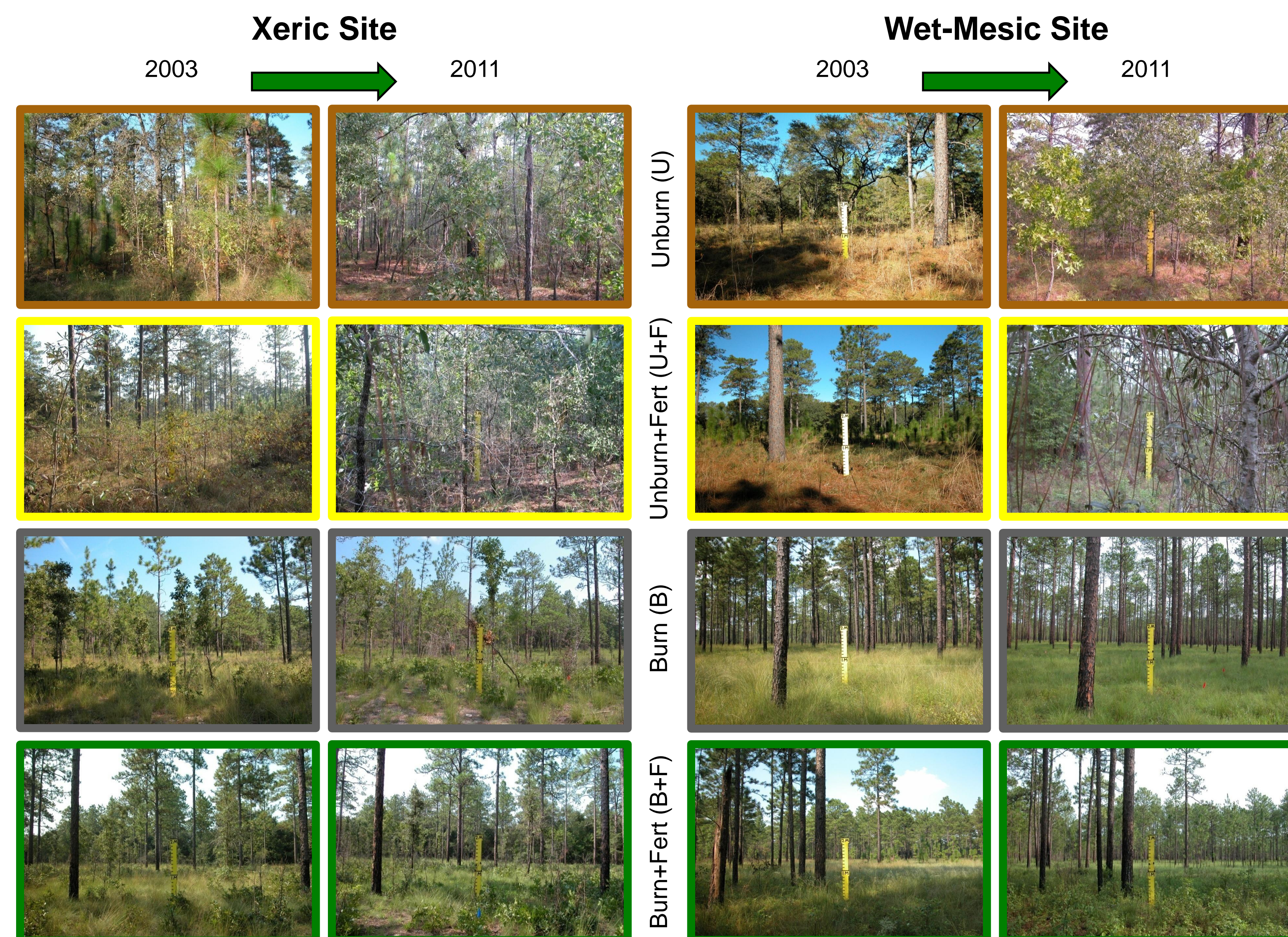
- Longleaf pine (*Pinus palustris* Miller) (LLP) savannas are regulated by low intensity natural or prescribed fires. These fires control hardwood development and dominance as well as maintain groundcover and food resources. Suppression of fires can lead to changes in structure and function of these savannas.
- Our objectives were to examine the extent that fire and nitrogen (N) influence productivity and nutrient cycling in a LLP-wiregrass (*Aristida stricta* Michx.) woodlands.

Methods

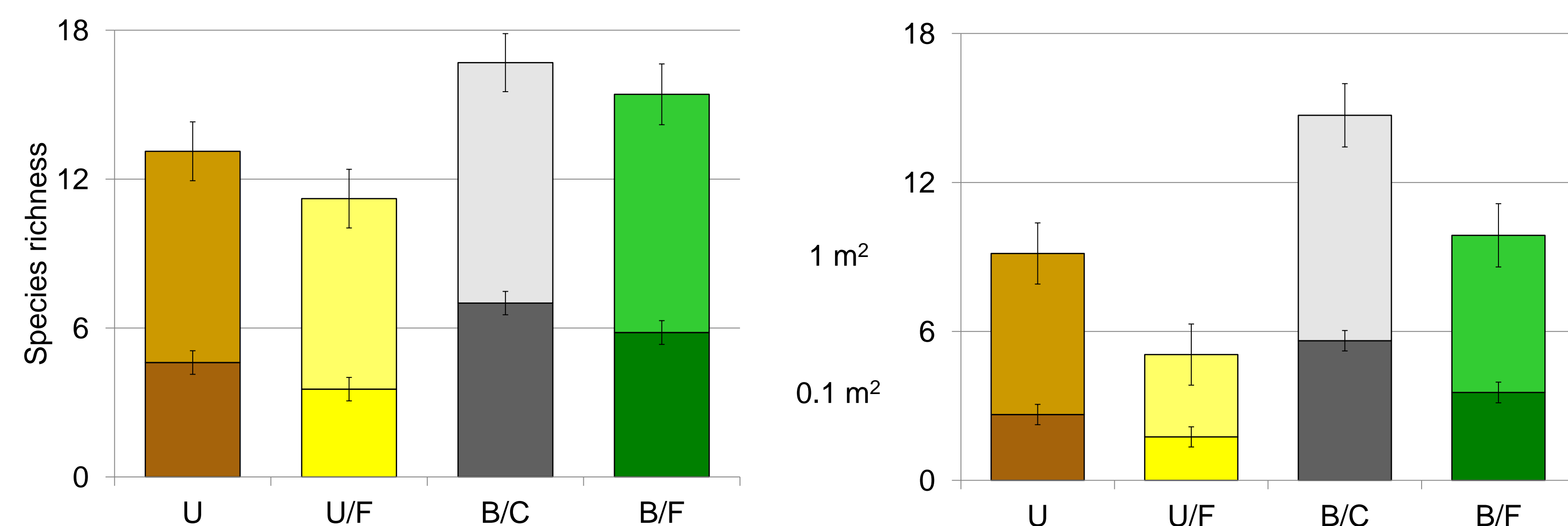
- Study site is located on the southeastern U.S. coastal plain at the Joseph W. Jones Ecological Research Center @ Ichauway (www.jonesctr.org) in southwest Georgia, USA.
- Forests are second-growth LLP stands with the average tree ages ranging from 70-90 yrs with wiregrass groundcover.
- Study is a multi-factorial experimental design with 4 combinations/4 replications of fire status and N addition (Unburned (U), Unburned w/ N added (U+F), Burned (B) and Burned w/ N added (B+F)) replicated on 2 sites (xeric and wet-mesic).
- Soils are Quartzipsament (Lakeland sand) at xeric site and Kandiuclut (Wagram) at wet-mesic site.
- 32 study plots (50 m x 50 m square) were established in 2000.
- Ammonium nitrate was applied 3 times/yr to coarsely mimic the natural distribution of N mineralization throughout the year for a total of 50 kg/ha/yr.
- All areas were burned in 2001 and burned areas were maintained with a 2 yr fire return interval.
- Soils were sampled in 2012 using a 2" split core sampler at 3 depths, 0-10, 10-20 and 20-30 cm.
- Vegetation was sampled in nested 20 m x 20 m sub-plots at scales of .1 and 1 m².
- Annual Net Primary Productivity (ANPP) for overstory was measured using annual DBH and for understory and standing litter using annual biomass clip plots of .75 m² from 5 locations/plot.
- Photo points were taken each summer at 7 m from the plot center in 4 cardinal directions at 2 m high.

Soil Depth (cm)	Treatment	Xeric Site				Wet-Mesic Site			
		Total C (Mg ha ⁻¹)	Total N (kg ha ⁻¹)	N-min (kg ha ⁻¹ yr ⁻¹)	pH	Total C (Mg ha ⁻¹)	Total N (kg ha ⁻¹)	N-min (kg ha ⁻¹ yr ⁻¹)	pH
0-10	U	8.5 ± 1.7	281 ± 60	29.3 ± 4.2	cd 4.51 ± 0.09	15.8 ± 2.1	508 ± 70	27.7 ± 5.4	abc 4.59 ± 0.05
	U+F	11.2 ± 1.7	438 ± 60	39.8 ± 4.2	ac 4.22 ± 0.09	21.0 ± 2.1	712 ± 70	35.3 ± 5.4	c 4.44 ± 0.05
	B	13.3 ± 1.7	494 ± 60	17.8 ± 4.2	bd 4.78 ± 0.09	16.7 ± 2.1	469 ± 70	14.1 ± 5.4	b 4.74 ± 0.05
	B+F	12.7 ± 1.7	490 ± 60	34.1 ± 4.2	a 4.14 ± 0.09	19.5 ± 2.1	635 ± 70	29.6 ± 5.4	ac 4.42 ± 0.05
10-20	U	5.5 ± 1.1	191 ± 38	Not est.	4.68 ± 0.05	8.3 ± 0.6	252 ± 23	Not est.	a 4.78 ± 0.04
	U+F	5.5 ± 1.1	236 ± 38	Not est.	4.76 ± 0.05	9.4 ± 0.6	292 ± 23	Not est.	b 4.97 ± 0.04
	B	7.5 ± 1.1	279 ± 38	Not est.	4.84 ± 0.05	7.9 ± 0.6	223 ± 23	Not est.	ab 4.84 ± 0.04
	B+F	6.3 ± 1.1	238 ± 38	Not est.	4.70 ± 0.05	8.9 ± 0.6	258 ± 23	Not est.	a 4.77 ± 0.04
20-30	U	a 3.4 ± 0.6	a 120 ± 21	Not est.	ac 4.68 ± 0.03	5.1 ± 0.5	168 ± 22	Not est.	c 4.91 ± 0.03
	U+F	ab 4.1 ± 0.6	ab 183 ± 26	Not est.	a 4.63 ± 0.03	5.5 ± 0.5	160 ± 19	Not est.	c 4.96 ± 0.03
	B	b 6.2 ± 0.6	b 257 ± 21	Not est.	b 4.82 ± 0.03	4.9 ± 0.5	145 ± 19	Not est.	b 4.62 ± 0.03
	B+F	ab 5.0 ± 0.6	a 168 ± 18	Not est.	bc 4.77 ± 0.03	5.8 ± 0.5	161 ± 19	Not est.	a 4.48 ± 0.03

- Xeric site total soil C and N decreased with fire exclusion at each depth and N increased with N addition at 0-10 and 10-20 cm. Significant decreases were seen between burned and unburned at 20-30 cm. Cumulative annual N-min at 0-10 cm increased in the absence of fire and with N addition. Soil pH became significantly more acidic with N addition and fire exclusion at 0-10 and 20-30 cm.
- Wet-Mesic site total N was slightly increased at 0-10 cm in the absence of fire and with N addition and total C was higher with N addition. Annual cumulative N-min at 0-10 cm was increased with fire suppression and N addition. Little variation was seen in C and N at deeper depth but each were higher with fire exclusion and N addition. Soils were significantly different in pH at all depths.



- Xeric and wet-mesic site ANPP for non-pine overstory increased in the absence of fire and with N addition at the xeric site. Understory ANPP was trending down with fire suppression at the xeric site.
- Standing litter biomass was higher for Oe and Oa layers with fire suppression and higher with N addition in the Oe layer at the wet-mesic site. Total C in the litter layers followed similar patterns. Increases in total N were evident with fire suppression particularly with N addition in the Oe layer at the wet-mesic site.



Burn exclusion led to a decrease in species richness regardless of spatial scale or site condition (xeric or wet-mesic), and N addition exacerbated these losses in 1 m² plots at xeric sites.

Conclusions

- Overstory ANPP and N cycling increased with fire exclusion and N addition.
- Increased litter inputs in quantity and quality affected nutrient cycling and species composition.
- Applied N and fire exclusion had a significant impact on midstory development.
- In the absence of fire understory species richness and productivity declined.
- Further analysis is planned and more questions are ready to be asked.