Title: **Benchmarking and developing demographic models with long-term shrub encroachment data in US tallgrass prairie**

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Project Abstract: Shrub encroachment in the US Great Plains will likely have strong impacts on various ecosystem services, such as wildlife habitat, food production, and carbon sequestration. One overall objective of our project is to develop ecosystem demographic models to improve projections of shrub encroachment under potential future global change scenarios, and to project impacts of shrub encroachment on ecosystem services. Using simulations in a tallgrass prairie in eastern Kansas, here we show (1) developments made to an ecosystem demographic model (BiomeE) to better represent grass-shrub dynamics, (2) patterns of shrub-grass dominance and co-existence under various fire regimes, and (3) comparisons between BiomeE and FATES. Long term empirical data from the Konza Prairie Biological Station show that grass and shrub plant functional types (PFTs) co-occur in tallgrass prairie when fire occurs once every three to four years. Using BiomeE simulations, we found that growth rate differences between grass (fast) and shrub (slow) PFTs may be a primary mechanism driving three-year fire frequency necessary for coexistence. This has implications for interactions with other global change factors that alter growth rates of one or both PFTs. Additionally, a positive feedback between grass coverage and ecosystem flammability may lead to rapid ecosystem state shifts. Similarities between BiomeE and FATES demographic models are such that understanding gained from BiomeE developments should be relatively transferrable to FATES. This will provide forecasting ability for PFT shifts and their impacts on ecosystem services under various future environmental scenarios.