Konza Prairie LTER

Photo credit: Jill Haukos

Konza Prairie (KNZ) LTER is focused on North American tallgrass prairie, specifically the Flint Hills ecoregion of northeast Kansas, which includes the largest tracts of unplowed tallgrass prairie in North America. Core KNZ LTER research has been based on a unique watershed-level fire and grazing experiment at the Konza Prairie Biological Station (KPBS) that began in 1972. Since then, complementary long term plot-level and stream reach experiments, and a network of sensors and sampling stations in both terrestrial and aquatic habitats have served as a foundation for the program.

Nearly four decades of KNZ LTER research has produced a rich, detailed, and evolving understanding of how fire, grazing, and climate interact to shape the structure and function of mesic grasslands. This has provided researchers with a unique opportunity to identify key drivers and mechanisms underlying ecosystem state change. Variations in fire frequency, grazing intensity, grassland restoration, nutrient input, and climate regimes have resulted in divergent ecosystem states with non-linear dynamics and strong legacy effects. By evaluating long term responses to these drivers, *(continued)*

Between 2008-2018:

66 investigators

11 institutions represented

72 graduate students

Mixed Landscape

Principal Investigator:

Jesse Nippert

Konza Prairie Biological Station

Est. 1980

Funding Cycle:

LTER VII

NSF Program:

Biological Sciences / Division of Environmental Biology

KNZ LTER researchers have identified thresholds, warning signs that precede state shifts, legacies, and hysteresis. These discoveries have deepened the body of knowledge on grassland dynamics, and KNZ LTER's experimental framework is being used to test and advance theories on non-equilibrium, community assembly, meta-population, resource limitation, and ecosystems.

Key Findings

A landscape that requires disturbance. Konza Prairie Biological Station features a replicated watershed-scale experiment with contrasting fire frequency and grazing treatments. Fire frequency affects plant composition and ecosystem state (i.e. whether an ecosystem is grassland, shrubland, or woodland). Fire also affects nutritional quality and quantity of vegetation, which influences foraging decisions by large herbivores at multiple scales. Herbivore choices cascade to impact grassland biodiversity via changes in dominance, a mechanism which KNZ LTER researchers found to be consistent with grasslands worldwide. [Products 1-3]

Variable resistance, but high resilience of tallgrass prairie to climate change. Climate change forecasts for mesic grasslands include increased climate variability and extremes. Experimental climate manipulations at Konza Prairie reveal a spectrum of responses to climate change, ranging from a lack of resistance to extreme drought, to great resilience to increased precipitation and heat wave variability. Although community composition changes with climate extremes, tallgrass prairie resilience is promoted by compensatory responses by dominant plant species. [4, 5]

Non-equilibrium dynamics are nearly ubiquitous and spatially complex. Experiments at KNZ LTER have identified significant time lags between treatment initiation and sustained community effects. At a minimum, these times lags are 3-6 years for water and nutrient manipulations, but can be decades according to fire suppression and woody plant expansion studies. Decreases in plant diversity evident in the first few years after water and nutrient enrichment did not necessarily persist long term due to stochastic influences on community assembly. In streams, communities reassembled and ecosystem processes recovered over weeks to months following flood or drought. These observations represent a paradigm shift in understanding grassland assembly and spatial and temporal responses to changing external drivers. [6-8]

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Synthesis

LTER cross-site synthesis working groups. Investigators from KNZ LTER have shared data and participated in several LTER synthesis working groups (2016-present) including: Ecosystem Sensitivity to Rainfall Experiment (EcoSeRE): design and synthesis, Long term experiments in the LTER Network: synthesis and hypothesis testing, and Integrating Plant Community and Ecosystem Responses to Chronic Global Change Drivers: Toward an Explanation of Patterns and Improved Global Predictions, which includes data from 7 LTER sites [9].

Framework for Stream Ecology. The stream biome gradient framework was created by KNZ LTER scientists to globally contextualize streams using surrounding terrestrial biomes to predict aspects of stream ecology (e.g. ecophysiology and ecosystems). Cross-site syntheses investigate nitrogen dynamics in food webs, leaf decomposition rates in response to climate change, and top-down control of stream consumers on stream ecosystem processes [10].

Photo credit: Jesse Nippert

Data Accessibility

The Information Management System (IMS) at KNZ LTER includes over 1,800 publications and 295 related datasets from 129 projects. All are available via the KNZ LTER website (using an interactive search interface), the Environmental Data Initiative Data Portal, and DataONE.

Partnerships

Konza Prairie Biological Station | The Nature Conservancy | Kansas State University | NEON Core Site | founding member of Nutrient Network (NutNet) | founding member of DroughtNet | Ameriflux Site

KONZA PRAIRIE BIOLOGICAL STATION

The Nature Conservancy

KANSAS STATE UNIVERSITY · FEBRUARY 16, 1863

Broader Impacts

Connecting science to K-12 education. The Konza Schoolyard LTER program engages local teachers and 800-1,000 students per year. Participants use KNZ LTER data, collect their own during site visits, and share findings in collaborative learning and research activities. The broader Konza Environmental Education Program (KEEP) facilitates science education and activities at KPBS for 2,500-3,000 schoolchildren annually.

Linking science and art. Konza Prairie LTER and KPBS collaborate with the local Prairie Studies Initiative, run by Kansas State University faculty, staff, students, and the public. The Initiative explores cultural and ecological dimensions of the prairie and challenges to sustaining grassland. This program connects scientists to poets, essayists, photographers, painters, and artists.

Conservation and stewardship. Scientists at KNZ LTER and KPBS have led tours for 3,000+ individuals associated with over 50 grassland-related professional groups. They have also worked closely with The Nature Conservancy to connect grassland science to best restoration and conservation practices. In 2017, KPBS hosted over 80 grassland practitioners at the annual Grassland Restoration Network workshop.

Top Products

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2. Koerner SE, et al. 2018. Changes in dominance determine herbivore effects on plant biodiversity. **Nature Ecology and Evolution.** doi: 10.1038/s41559-018-0696-y
3. Welti EAR, et al. 2019. Fire, grazing, and climate shape plant-grasshopper interactions in a tallgrass prairie. **Functional Ecology**. doi: 10.1111/1365-2435.13272
4. Hoover DL, et al. 2014. Resistance and resilience of a grassland ecosystem to climate extremes. **Ecology.** doi: 10.1890/13-2186.1
5. Knapp AK, et al. 2018. A reality check for climate change experiments: Do they reflect the real world? **Ecology**. doi: 10.1002/ecy.2474
6. Ratajczak Z, et al. 2014. Fire dynamics distinguish grasslands, shrublands, and woodlands as alternative attractors in the Central Great Plains of North America. **Journal of Ecology**. doi: 10.1111/1365-2745.12311
7. Avolio ML, et al. 2014. Changes in plant community composition, not diversity, during a decade of nitrogen and phosphorus additions drive above-ground productivity in a tallgrass prairie. **Journal of Ecology**. doi: 10.1111/1365-2745.12312
8. Baer SG, et al. 2016. Environmental heterogeneity has a weak effect on diversity during community assembly in tallgrass prairie. **Ecological Monographs**. doi: 10.1890/15-0888.1
9. Wilcox KR, et al. 2017. Asynchrony among local communities stabilises ecosystem function of metacommunities. **Ecology Letters**. doi: 10.1111/ele.12861
10. Dodds WK et al. 2015. The Stream Biome Gradient Concept: Factors controlling lotic systems across broad biogeographic scales. **Freshwater Science.** doi: 10.1002/ecs2.2786

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