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## Preview of Award 1440484 - Annual Project Report

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### Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	1440484
Project Title:	LTER: Long-Term Research on Grassland Dynamics- Assessing Mechanisms of Sensitivity and Resilience to Global Change
PD/PI Name:	John M Blair, Principal Investigator Sara G Baer, Co-Principal Investigator Walter K Dodds, Co-Principal Investigator Anthony Joern, Co-Principal Investigator Jesse B Nippert, Co-Principal Investigator
Recipient Organization:	Kansas State University
Project/Grant Period:	11/01/2014 - 10/31/2020
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Submitting Official (if other than PD\PI):	John M Blair Principal Investigator
Submission Date:	10/31/2016
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	John M Blair

### Accomplishments

#### \* What are the major goals of the project?

The Konza Prairie LTER Program (KNZ) is a comprehensive, interdisciplinary research program with the overarching goal of understanding the interactive effects of natural and anthropogenically-altered drivers on grassland ecological dynamics, and to advance ecological theory through synthesis and integration of long-term datasets. In the most recent iteration of

KNZ LTER funding (LTER VII), our focus is on assessing the mechanisms underlying sensitivity and resilience of this grassland ecosystem to a suite of critical forcing factors or 'drivers', by continuation of long-term manipulation of selected historically-important drivers, addition/alteration of novel drivers, and cessation of certain long-term experimental drivers to evaluate the strength of ecological legacies and feedbacks. KNZ will also continue to support numerous educational, training and outreach activities, contribute knowledge to address land-use and management issues in grasslands, and provide infrastructure and data in support of scientific pursuits across a broad range of disciplines.

Our core research site is the Konza Prairie Biological Station (KPBS), a 3487-ha area of native tallgrass prairie in the Flint Hills of NE Kansas. KPBS was established in 1971 and joined the LTER network in 1980. LTER funding supports collection of long-term data on processes such as hydrology, nutrient cycling, plant productivity and community composition. These long-term records continue to provide unique insights into the dynamics of tallgrass prairie ecosystems, serve as a critical baseline for identifying and interpreting ecological responses to environmental changes, and are made available as a resource for the broader scientific community. The KNZ program encompasses studies at, and across, multiple ecological levels and a variety of spatial and temporal scales. Our unifying conceptual framework focuses on *fire, grazing and climatic variability* as essential and interactive factors determining the structure and function of mesic grasslands. The interplay of these natural disturbances leads to the complex, non-linear behavior characteristic of these grasslands. Because grazing and fire regimes are managed in grasslands worldwide, KNZ data are relevant for understanding and managing grasslands globally, and for addressing broader ecological issues including disturbance and ecosystem stability and resilience, top down vs. bottom up controls, and the interplay of mutualistic and antagonistic biotic interactions. In addition, because human activities alter key ecological drivers in these grasslands, we can use KNZ studies and data to address critical issues related to global change, including land-use and land-cover change, the ecology of invasions and restoration, and the direct and indirect alteration of nutrient and water availability. Thus, the KNZ program, while initiated over 30 years ago to understand the effects of natural disturbances in this grassland, has sustained and immediate relevance for understanding and predicting the consequences of global change for grasslands around the world.

A major goal of the KNZ LTER VII project is the continuation of core watershed-level fire and grazing studies and associated long-term data collection to document both short-term and long-term dynamics in response to these treatments and a variable climate. The KNZ program is built around a long-term database on ecological patterns and processes derived from a fully replicated watershed-level experimental design, in place since 1977 with some modifications to accommodate new long-term studies initiated in LTER V and VI (e.g., watershed-level Fire Reversal and Season of Fire experiments, Riparian Woody Vegetation Removal experiment, Patch-Burn Grazing experiment). This unique experimental design includes replicate watersheds subject to different fire and grazing treatments. In addition to fire and grazing, climatic variability, climate extremes and directional climate change are key drivers of grassland dynamics, and important focal areas for KNZ activities. The collection of diverse data from common sampling locations facilitates integration among our research groups. Within core LTER watersheds, permanent sampling transects are replicated at various topographic positions, where ANPP, plant species composition, plant and consumer populations, soil properties, and key above- and belowground processes are measured. In addition, a number of long-term plot-level experiments allow us to address the mechanisms underlying responses to various fire and grazing regimes, including manipulations of fire and N availability (e.g. Belowground Plots Experiment, Chronic N Deposition experiment) and of climatic variables in both terrestrial (e.g. Irrigation Transect Study, Rainfall Manipulation Plots (RaMPs) Experiment, Climate Extremes Experiment (CEE)) and aquatic (Experimental Stream Studies) habitats. In total, the Konza LTER Program is a rigorous ecological research program designed to elucidate patterns and processes important in grasslands, and address the potential impacts of global change in these ecosystems. Towards this end, we currently maintain 106 datasets (many with multiple subsets) associated with our long-term research and use these to support numerous shorter-term experiments focused on specific drivers and mechanisms.

In the second year (2015-2016) of our current funding cycle (LTER VII, 2014-2020) we continued to address fundamental ecological questions within the framework of assessing the mechanisms of sensitivity and resilience to global change, a theme relevant to understanding, managing and conserving grasslands worldwide. We focus on the global changes most relevant to grasslands and grassland streams – *changes in land-use* (altered fire and grazing regimes) and *land-cover* (particularly increases in woody plant cover); *climate change* (altered precipitation patterns including response to extreme events) and *altered nutrient cycles* (changes in nutrient availability) in both terrestrial and aquatic environments; and *restoration ecology* (active management of the ecosystem state) – and we couple long-term observations with manipulative studies to evaluate the strength of biological legacies and feedbacks in conferring sensitivity or resilience of the ecosystem state to these drivers.

Overarching goals for the KNZ LTER VII funding cycle are to:

1. Build upon our core LTER experiments and expand datasets on fire, grazing and climate variability to deepen and refine our understanding of the abiotic and biotic factors and feedbacks affecting grassland structure and function;
2. Develop a mechanistic and predictive understanding of grassland dynamics and trajectories of change in response to selected natural and anthropogenic drivers using long-term experiments and datasets, coupled with complementary shorter-term studies;
3. Conduct new syntheses using KNZ data, alone and in combination with data from other sites, to advance ecological theory, and expand the inference of KNZ research to other grasslands and biomes;
4. Train the next generation of ecologists, educate the public, and provide outreach to increase the relevance of KNZ long-term research to society.

Consistent with our goals as a long-term ecological research program, many of the long-term experiments and datasets initiated in previous LTER grants are being continued throughout the current funding period, while several new experiments and datasets were, and are, being modified or initiated, as detailed in the KNZ LTER VII proposal. The value of these long-term experiments and datasets continues to increase with time. In addition, results from these long-term studies have new relevance as we move towards evaluating the ecological impacts of a suite of global change phenomena occurring at the Konza LTER site and in grasslands worldwide. Below we highlight a few selected activities and findings from our most recent funding period.

**\* What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities:

We continued watershed-level fire experiments, and associated data collection and synthesis efforts that are central to our “core” LTER studies. This includes maintaining watershed-level manipulations of fire frequencies (1, 2, 4 and 20 year fire return intervals) and seasonal timing of fires (spring, summer, autumn and winter), and experiments to assess the potential for altered fire regimes to reverse trajectories of land-cover change (the Fire Reversal experiment). Past and recent studies have highlighted critical threshold in fire return intervals that, when exceeded, can lead to rapid woody plant encroachment and loss of grassland habitat (Ratajczak et al. 2016). As a result, and in consultation with KPBS management, we modified some low-frequency fire return intervals on non-core LTER watersheds to better manage and conserve grassland habitat in areas not being used for current LTER research.

We continued to assess the interactive effects of fire and ungulate grazers (bison and cattle) on tallgrass prairie dynamics, using data from two large-scale grazing studies. Studies of native ungulate grazers includes 10 watersheds (approx 960 ha total) with different fire frequencies (1, 2, 4 and 20 year fire return intervals) grazed by a bison. Studies of ecological responses to alternative cattle grazing practices include traditional annual burning and season-long grazing, and an alternative patch-burn grazing system designed to enhance spatial and temporal heterogeneity for conservation goals. These whole watershed fire and grazing treatments are focal areas for a number of LTER data collection efforts (e.g., soil, water, plant and consumer sampling, remote sensing and GIS observations, flux tower and associated sensor network measurements, and groundwater and stream monitoring networks, and provide unique research opportunities for undergraduate and graduate students, as well as scientists from other institutions. Many core KNZ datasets are based on long-term responses to these watershed-level manipulations. Recent publications, highlighted in the "Findings" pdf, demonstrate important fire-grazer interactions that influence habitat heterogeneity, consumer diversity, and community networks.

Long-term KNZ datasets also capture interactions with the stochastically variable climate that characterizes the Central Plains. For example, measurements of plant

ANPP in response to natural climatic variable have been used to evaluate convergence and divergence of responses to natural climatic variability and to more controlled manipulations in climate experiments at the site (Wilcox et al. 2016, Knapp et al. in press). Other studies by KNZ investigators have compared long-term climate responses at Konza to other grassland sites with different climates (Hufkins et al. 2016, LaPirre et al. 2016, Wilcox et al. 2015). A recent drought followed by years with more average precipitation offered the opportunity to examine sensitivity and resilience of terrestrial and aquatic grassland ecosystems to drought. In addition, the template of watersheds with varied fire-grazing treatments and varied grassland ecosystem states provides a unique platform for many smaller-scale experiments, including nutrient manipulations, grazing exclosures, rainfall manipulations, and species removals. In 2015-2016, we continued to several climate-related experiments (EDGE, DroughtNet, RaMPs) and experiments to evaluate responses to changing nutrient availability (ChaNGE, Ghost Fire), and began new grazing lawns studies to assess mechanisms of formation and maintenance of this alternative grassland state in the grazed watersheds. Additional details are provided in the 'Activities' pdf.

Restoration research at Konza has expanded and become a significant component of the KNZ LTER program. Recent restoration activities include a fourth temporal iteration in the Sequential Prairie

Restoration experiment in 2016 and another planned for 2018, continued data collection associated with the riparian Woody Plant Removal experiment, as well as additional research on the roles of heterogeneity, invasive species and local plant adaptation for grassland restoration states. As specified in our LTER VII proposal, we also initiated a new project designed to evaluate ecological barriers to native species recovery following eradication of a regionally-important invasive C4 grass species. Further detail on recent restoration-based activities and findings are provided in the attached pdf files.

We continued to disseminate our results to the broader ecological science community, the general public, and local and regional land managers. KNZ data and case studies continued to be used in ecology courses and texts, and KNZ scientists were proactive in synthesis of KNZ data. The KNZ program and associated long-term experiments directly and indirectly support numerous post-doctoral, graduate and undergraduate researchers from across the country, including LTER- and site-based REU students. The KNZ SLTER and Konza Environmental Education Program (KEEP) provided on-site educational activities and outreach to K-12 students, and training via teachers' workshops. We also provided educational opportunities on for adults through a Master Naturalist program and by Konza Docent training. Jill Haukos, KEEP/SLTER Director of Education is co-chairs the LTER Education and Outreach Committee (EOC). Through our relationship with The Nature Conservancy, and interaction with the local Flint Hills Discovery Center, we hosted or enabled several public outreach events.

KNZ IM activities in 2015-16 focused on adopting/implementing/developing a Drupal Ecological Information Management System (DEIMS) for KNZ data, metadata, and other information products with a single web interface. Advantages of a DEIMS website are robust searching and data access, easier interfacing with the LTER data portal, and automatic generation of PASTA-compliant EML files. We migrated all current KNZ web and database content into a MySQL database on a development server. We continued to improve GIS metadata for core datasets. We improved the KNZ Biblio database by adding DOI, key words, and abstracts to each publication back to 1976, and improving import/export capabilities. We plan to launch the new DEIMS KNZ website within 6 months ([www2.konza.ksu.edu](http://www2.konza.ksu.edu)). In the interim, we continued upgrading and adding data to our current website at [www.konza.ksu.edu](http://www.konza.ksu.edu), which includes ca. 155 datasets. We continually update KNZ EML packages and

datasets on the LTER Data Portal (PASTA). There are 98 KNZ datasets in PASTA, many of which include multiple data packages (total of 250 datasets). We also host an up-to-date list of all KNZ LTER and LTER-related publications (1663 publications online, searchable by key word, author, year, and publication type). Publications are linked dynamically to personnel, allowing users to connect personnel and publications.

We created a LAMP *Ubuntu* sever on a virtual machine to support development of the DEIMS website. We added a new 2 terabyte external drive to our data server, which was installed off-site from the database, web and file server, and will extend KNZ database/data back-up and archival capabilities. We purchased and deployed new office and field devices for data collection and processing.

The KNZ IM (Yang XIA) continued to participate in all LTER IMC activities includes the IM annual meeting, IM water cooler, IM Executive committee, and maintaining /managing the LTER climate and hydrology database as volunteer administrator. In 2017, we will continue to add new projects and data sets; continue to develop and launch our DEIMS website; continue to update metadata and procedural protocols; continue to ensure data quality; perform data aggregation and synthesis to meet requirements for the LTER NIS; and provide up-to-date, accurate LTER data to KNZ investigators and to the broader scientific community as quickly and efficiently as possible.

Specific Objectives: These specific objectives are derived from goals and activities included in our original KNZ LTER VII proposal.

1. Maintain and expand core long-term experiments and data sets to better understand how natural and anthropogenic drivers (fire, grazing, climatic variability, nutrient availability and grassland restoration) affect grassland states and dynamics at multiple levels of ecological organization.
2. Evaluate the long-term rates, trajectories and underlying mechanisms/constraints of grassland response to altered drivers; with focus on drivers that past research has identified as most influential on ecological states.
3. Test complementary conceptual and theoretical models of ecosystem change over time, and identify mechanisms and feedbacks that support or differentiate directional, non-linear and threshold trajectories of change.
4. Measure grassland resilience to and recovery from altered drivers, identify feedbacks that support or constrain resilience and recovery, and understand whether recovery can be facilitated based on ecological principles.
5. Determine which abiotic and biotic factors regulate community assembly and ecosystem state changes in restored prairie.
6. Lead and participate in synthesis and cross-site research activities, to evaluate the fundamental controls on ecosystem resistance and resilience to changes in key drivers, both within and among different grasslands and biomes.
7. Continue to update KNZ LTER database to meet requirements for the LTER Network Information System. Provide up-to-date, accurate LTER data to KNZ investigators and to the broader scientific community as quickly and efficiently as possible.

8. Continue KNZ education and outreach activities to achieve our broader impact goals. Continue and expand on-site science activities and enlist new classes and students. Provide opportunities for undergraduate research experiences and continue to support graduate student research and training. Contribute LTER data to address relevant environmental issues (e.g., prescribed fires and air quality, land-use and water quality). Expand science and art interactions as a novel way of increasing awareness of and interest in grassland ecology and grassland conservation.

**Significant Results:** Please see the supporting pdf files, which provide detailed information on the activities and findings of individual research projects which have contributed to the overall progress of LTER VII in 2015-16.

**Key outcomes or Other achievements:** Please see the supporting pdf files, which provide detailed information on the activities and findings of individual research projects which have contributed to the overall progress of LTER VII in 2015-16.

#### **\* What opportunities for training and professional development has the project provided?**

The Konza LTER program provides training and professional development opportunities at many levels, including K-12 teachers, undergraduate and graduate students, post-doctoral scientists from a number of different institutions, junior tenure-earning faculty members, and professional research staff. Below we summarize some of the recent and continuing opportunities provided by the KNZ program.

The Konza Prairie Schoolyard LTER (SLTER) program is in its 18th year as a science education program for K-12 teachers and their students, built around the successful Konza Prairie LTER program. The Konza Prairie SLTER program aims to educate students about ecology and global change, with emphasis on regional grasslands, by engaging students and teachers in realistic and relevant science-based activities focused on long-term data collection at our LTER site. These activities were designed to give students an understanding of ecology, provide them the opportunity to collect and interpret their own data. K-12 teachers who wish to bring their classes to Konza Prairie and to experience the Schoolyard LTER activities must first participate in a Summer Teachers' Workshop. This week-long program introduces the teachers to each of the activities offered by KEEP and, at the completion of the workshop, allows them to tailor an educational experience specific to the needs of their students. The teachers who complete the program qualify to bring their classes to Konza for no charge and have their bus transportation costs paid. This agreement stands for the rest of the teachers' professional careers. These educators have become important partners in the Konza Environmental Education Program and many return annually. We have trained 96 area teachers since our program began in 1998. The number of SLTER student participants in 2015 (most recent year with complete data) was 1,480.

The Konza Environmental Education Program (KEEP) has partnered with the Manhattan/Ogden KS School District 383 to be a ready source of informal science education – specifically addressing core science concepts that are easily experienced during a Konza visit. To meet this need we train volunteer docents that assist in public education and outreach activities. New docents are added to the program annually and receive 40 hours of training on the history and ecology of the tallgrass prairie as well as an overview of research being conducted at Konza. Experienced docents are regularly apprised of new research programs and the progress of existing research and become ambassadors of science to the community. The KEEP program has trained over 300 docents (about 100 who are currently active). Additionally, KEEP offers training in ecological principles and the natural history of plants and animals of Kansas via the Kansas Master Naturalist program to area adults interested in volunteering as naturalists at over 50 sites around the state. Certification as a Kansas Master Naturalist requires 40 hrs. of training and 30 hrs. of volunteering. This program, run through KEEP with the participation of many Konza scientists, is offered every 3 yrs. and was offered in 2016. Additionally, we have another partnership with the Flint Hills Discovery Center (Manhattan, KS) to co-host visiting school groups. Last year we hosted 2,274 students who experienced the tallgrass prairie of KNZ through an activity other than an SLTER event.

The Konza LTER program continues to emphasize quality graduate student training. During the 2015-16 funding period, we provided stipends and other forms of non-financial support (vehicle use, site use, analytical laboratory use, attendance

at regional/national meetings) for > 20 students, including many non-KSU as well as KSU graduate students. We continue to foster graduate research involving students attending Colorado State University, University of Kansas, Southern Illinois University, Oklahoma State University, University of Nebraska, and others. In 2015-16, 10 theses/dissertations were completed that included data and research from the Konza Prairie (typically, as the primary data source), including 4 from non-KSU graduate students.

KNZ also offers research experiences for a large number of undergraduate students. In the summer of 2016, we supported 3 LTER REU students [mentored by Co-Is David Hartnett (KSU), Lydia Zeglin (KSU) and Nate Brunzell (KU), and contributed additional mentoring and logistical support to the KSU/Konza REU site program. Summer 2016 was the 21st year that Konza Prairie and the Division of Biology at K-State have offered a 10-week site-based summer REU program co-led by KNZ investigator Bruce Snyder. Participants in the site-based program included 12 students, including 6 that did KNZ LTER-related research and worked with KNZ researchers as mentors. In addition to these REU students, the Konza LTER program provides hands-on research opportunities for ~12-15 undergraduate research assistants each year. In addition to undergraduate students, KNZ supports and provides professional development opportunities for our professional research staff members, including training in the use of field and laboratory equipment, training in health and safety protocols, training in prescribed fire practices, and other relevant professional development

KNZ has a strong history of providing mentoring and research training for recent PhD's and junior faculty members. Several former PhD that students completed dissertation projects on Konza are now post-docs or junior faculty at other institutions but continue to participate in, and in many cases lead, KNZ research activities. This includes Sally Koerner (post-doc at FIU), Meghan Avolio (post-doc at SESYNC), Kevin Wilcox (post-doc at OSU), Kim LaPierre (post-doc at Berkeley), and Zak Ratajczak (U Virginia). The KNZ program also provides resources and mentoring to new tenure-earning faculty members. In our current funding cycle, this includes assistant professors in Biology (Lydia Zeglin, Michi Tobler, Andrew Hope) and Agronomy (Eduardo Santos).

#### **\* How have the results been disseminated to communities of interest?**

Konza LTER results are disseminated to the scientific community via publications in the peer-reviewed literature, through presentations at professional meetings and workshops, through seminars by KNZ scientists and students, through social media (Twitter, Facebook, Researchgate), and via the KNZ and KPBS web sites. In addition, KNZ scientists have participated in a broad range of activities that go beyond the scientific community. For example, KNZ data and findings are used in a number of undergraduate and graduate ecology courses at Kansas State University, the University of Kansas, University of Arizona, Colorado State University, and University of Oklahoma, among others. In addition, KNZ findings are increasingly utilized in undergraduate ecology texts and supplementary teaching materials. For example, KNZ long-term studies are used to demonstrate the role of fire and grazing in grasslands in 'General Ecology, 2nd edition' by D.T. Krohne, and as an example of the importance of long-term research in the 'Ecology' text by Cain et al. KNZ studies on top-down regulation of plant community structure are featured in an introductory undergraduate biology text ('Life. The Science of Biology. 7th edition' by Purves, Sadava, Orians and Heller) and KNZ data and findings are highlighted in several upper-level and graduate texts including 'Freshwater Ecology' (W.K. Dodds), 'The Ecology of Plants' (Gurevitch, Scheiner and Fox), and 'Biogeochemistry. An Analysis of Global Change' (W.H. Schlesinger).

Data and insight from the Konza LTER Program is being used by resource managers for effective land stewardship. Currently, our research concerning the role of seasonal burning and fire intensity on woody encroachment is being used to inform the Great Plains Fire Science Exchange (<http://www.gpfirescience.org/>) and the Tallgrass Prairie and Oak Savanna Fire Science Consortium (<http://www.tposfirescience.org/>). Both of these non-profit groups focus on conservation issues and land management of Midwestern grasslands. In addition, many of the Konza investigators (e.g., Blair, Briggs, Joern, Hartnett) serve as scientific consultants for a regional cultural and natural history center, the 'Flint Hills Discovery Center' in Manhattan, KS.

KNZ graduate students and PIs have also co-authored several educational publications, based on LTER data, for the peer-reviewed ESA-supported Teaching Issues and Experiments in Ecology (TIEE) and other education-based outlets.

In 2016, KNZ scientists and graduate students participated in numerous public outreach events designed to enhance understanding and LTER science and dissemination of important findings. Several KNZ researchers as Science Communication Fellows at Sunset Zoo. Sunset Zoo's Science Communication Fellowship (SCF) program supports a network of certified researchers, professionals, graduate students and post-graduate students working together to connect the community to science and elevate the understanding of research taking place in the region. SCF is part of the national

[Portal to the Public Network](#). In 2016, KNZ PhD students Rory O'Connor and Kent Connell presented results on topics including the role of fire in grasslands and importance of plant-microbe interactions. KNZ investigators also presented research findings at local Science Café meetings. KNZ scientists Briggs and Horn participated in LASER presentations designed to bring together scientists and artists to engage the public. Our local art museum (Beach Museum of Art) has a Prairie Studies Initiative (<http://beach.k-state.edu/praiiestudies/>). KNZ scientists Blair, Briggs, and Joern have acted as consultants, participants, and speakers in many Prairie Studies outreach events. In 2015, the museum screened a documentary focused on drought impacts on Flint Hills grasslands, followed by a panel discussion that included KNZ Co-PI Nippert. In 2016, KNZ investigator and KPBS Director John Briggs was part of a group that received funding from the KSU Academic Excellence Fund to support an Art-Science workshop at Konza Prairie that included participation by NSF personnel. Finally, Jill Haukos (director of the KEEP and KNZ SLTER programs) authored a 2016 KNZ contribution to the SLTER Children's Book Series (<http://www.lternet.edu/publications/Schoolyard>). Several other broader impacts and scientific extensions from the Konza LTER Program are discussed in further detail in the 'Broader Impacts' section of this annual report.

### \* What do you plan to do during the next reporting period to accomplish the goals?

During the next year of our funding (Year 3 of LTER VII: 2016-17), we will: 1) complete the collection, processing, and online data integration of samples collected in 2016; 2) continue data processing, data error checking and the entry of data into the KNZ LTER database and the LTER Network Information System; 3) launch the new DEIMS-based KNZ website and database; 4) continue to publish novel scientific results based on KNZ LTER data and experiments; 5) continue to support the educational development and training of graduate and undergraduate students; 6) initiate new treatment structures, as specified in the LTER VII proposal, in the Irrigation Transect and Belowground plot experiments in summer 2017, and 7) participate in our scheduled mid-cycle NSF review (summer 2017).

### Supporting Files

Filename	Description	Uploaded By	Uploaded On
KNZ LTER Activities 2016.pdf	Selected KNZ LTER activities for the 2015-16 reporting period	John Blair	10/31/2016
KNZ LTER Findings 2016.pdf	Selected KNZ LTER research accomplishments and findings for the 2015-16 reporting period	John Blair	10/31/2016

## Products

### Books

### Book Chapters

### Inventions

### Journals or Juried Conference Papers

Alfaro, M., B.K. Sandercock, L. Liguori, and M. Arim (2015). The diet of Upland Sandpipers (*Bartramia longicauda*) in managed farmland in their Neotropical non-breeding grounds. *Ornithología Neotropical*. 26 (4), 337-347. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Baer, S.G., J.M. Blair, and S.L. Collins (2016). Environmental heterogeneity has a weak effect on diversity during community assembly in tallgrass prairie. *Ecological Monographs*. 86 94 - 106. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/15-0888.1

Borer, E.T, E.W. Seabloom, D.S. Gruner, W.S. Harpole, H. Hillebrand, E.M. Lind, P.B. Adler, J. Alberti, T.M. Anderson, J.D. Bakker, L. Biederman, D. Blumenthal, C.S. Brown, L.A. Brudvig, Y.M. Buckley, M. Cadotte, C. Chu, E.E. Cleland, M.J. Crawley, P. Daleo, E.I. Damschen, K.F. Davies, N.M. DeCrappeo, G. Du, J. Firn, Y. Hautier, Q.W. Heckman, A. Hector, J. HilleRisLambers, O. Iribarne, J.A. Klein, J.M.H. Knops, K.J. La Pierre, A.D.B. Leakey, W. Li, A.S. MacDougall, R.L.



McCulley, B.A. Melbourne, C.E. Mitchell, J.L. Moore, B. Mortensen, L.R. O'Halloran, J.L. Orrock, J. Pascual, S.M. Prober, D.A. Pyke, A.C. Risch, M. Schuetz, M.D. Smith, C.J. Stevens, L.L. Sullivan, R.J. Williams, J.P. Wragg, Wright, and L.H. Yang (2014). Herbivores and nutrients control grassland plant diversity via light limitation. *Nature*. 508 517 - 520. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1038/nature13144

Breshears, D.D., A.K. Knapp, D.J. Law, M.D. Smith, D. Twidwell, and C.L. Wonkka (2016). Rangeland responses to predicted increases in drought extremity. *Rangelands*. 38 191-196. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Briggs, J.M., J. Blair, and E.A. Horne (2016). Ecohydrological and climate change studies at the Konza Prairie Biological Station. *Transactions of the Kansas Academy of Science*. 119 5 - 11. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1660/062.119.0103

Brookfield, A., G.L. Macpherson, and M. Covington (). Effects of changing meteoric precipitation patterns on groundwater temperature in karst environments. *Groundwater*. . Status = ACCEPTED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Brown, S.P., A.M. Veach, A.R. Rigdon-Huss, K. Grond, S.K. Lickteig, K. Lothamer, A.K. Oliver, and A. Jumpponen (2015). Scraping the bottom of the barrel: are rare high throughput sequences artifacts?. *Fungal Ecology*. 13 221 -225. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1016/j.funeco.2014.08.006

Caudle, K.L., L.C. Johnson, S.G. Baer, and B.R. Maricle (2014). Comparing nondestructive and destructive methods of measuring leaf chlorophyll content: tracking changes in foliar chlorophyll of five *Andropogon gerardii* ecotypes (Poaceae). *Photosynthetica*. 52 511-518. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; OTHER: KNZ001638

Cochran, F. V., N. A. Brunsell, and A. Sukyer (2016). Thermodynamic entropy production as a measure of agroecosystem sustainability. *Ecological Indicators*. 67 204-214. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Commerford, J.L., K.K. McLauchlan, and T.A. Minckley (2016). High dissimilarity within a multiyear annual record of pollen assemblages from a North American tallgrass prairie. *Ecology and Evolution*. 6 5273 - 5289. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1002/ece3.2259

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Winder, V.L., K.M. Carrlson, A.J. Gregory, C.A. Hagen, D.A. Haukos, D.C. Kesler, L.C. Larsson, T.W. Matthews, L.B. McNew, M.A. Patten, J.C. Pitman, L.A. Powell, J.A. Smith, T. Thompson, D.H. Wolfe, and B.K. Sandercock (2015). Factors affecting female space use in ten populations of prairie chickens. *Ecosphere*. 6 art166. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/ES14-00536.1

Wolf, S., T.F. Keenan, J.B. Fisher, D.D. Baldocchi, A.R. Desai, A.D. Richardson, R.L. Scott, B.E. Law, M.E. Litvak, N.A. Brunzell, W. Peters, and I.T. van der Laan-Luijckx (2016). Warm spring reduced carbon cycle impact of the 2012 US summer drought. *Proceedings of the National Academy of Sciences*. 201519620. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1073/pnas.1519620113

Young, A., B. Chappell, M. William, and L. Margaret (2016). Tardigrades of the Tree Canopy: *Milnesium swansoni* sp.nov. (Eutardigrada: Apochela: Milnesiidae) a new species from Kansas, U.S.A.. *Zootaxa*. 4072 559-568. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.11646/zootaxa.4072.5.3

Yu, Q., K.R. Wilcox, K.J. La Pierre, A.K. Knapp, X. Han, and M.D. Smith (2015). Stoichiometric homeostasis predicts plant species dominance, temporal stability, and responses to global change. *Ecology*. 96 (9), 2328–2335. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: 10.1890/14-1897.1

## Licenses

### Other Conference Presentations / Papers

Jacquín, A., J.M.S. Hutchinson, M. Goulard, S.L. Hutchinson (2015). *A statistical approach for predicting grassland degradation in disturbance-driven landscapes*. 2015 8th International Workshop on the Analysis of Multitemporal Remote Sensing Images (Multi-Temp)2015 8th International Workshop on the Analysis of Multitemporal Remote Sensing Images (Multi-Temp). Annecy, France. Status = PUBLISHED; Acknowledgement of Federal Support = Yes

### Other Products

### Other Publications

### Patents

### Technologies or Techniques

### Thesis/Dissertations

Troia, M.J.. *A mechanistic framework for understanding prairie stream fish distributions*. (2014). Kansas State University. Acknowledgement of Federal Support = Yes

Wilcox, K.R. .. *Assessing Grassland sensitivity to global change*. (2015). Colorado State University. Acknowledgement of Federal Support = Yes

Grischkowsky, S.A.. *Did selective breeding of a non-native grass promote invasiveness?*. (2014). Oklahoma State University. Acknowledgement of Federal Support = Yes

Veach, A.M.. *Dynamics of microbial community structure and function in a tallgrass prairie ecosystem*. (2015). Kansas State University. Acknowledgement of Federal Support = Yes

Raynor, E.J.. *Ecological hierarchy of foraging in a large herbivore: the plains bison perspective in tallgrass prairie*. (2015). Kansas State University. Acknowledgement of Federal Support = Yes

Ott, J.P.. *Ecological implications of grass bud bank and tiller dynamics in mixed-grass prairie*. (2014). Kansas State University. Acknowledgement of Federal Support = Yes

Ratajczak, Z.. *Ecological thresholds and abrupt transitions of tallgrass prairie to shrublands and woodlands*. (2014). Kansas State University. Acknowledgement of Federal Support = Yes

Duell, E.B.. *Elevated temperatures and drought favor invasive grasses over native species*. (2015). Oklahoma State University. Acknowledgement of Federal Support = Yes

- Williams, E.J. *Grasshopper sparrows on the move: patterns and causes of within-season breeding dispersal in a declining grassland songbird*. (2016). Kansas State University. Acknowledgement of Federal Support = Yes
- Stanton, N.L.. *How does your prairie (re)grow?: Interactions of seed additions with resource availability, heterogeneity, and disturbance on recruitment and diversity in a restored tallgrass prairie*. (2014). Kansas State University. Acknowledgement of Federal Support = Yes
- Jackson, K.E.. *Influence of patch-burn grazing and riparian protection on the ecological integrity of headwater prairie streams*. (2014). Southern Illinois University. Acknowledgement of Federal Support = Yes
- Liu, Huan.. *Inorganic and organic carbon variations in surface water, Konza Prairie LTER Site, USA, and Maolan Karst Experimental Site, China*. (2014). University of Kansas. Acknowledgement of Federal Support = Yes
- Commerford, J.L. *Investigating North American grassland biogeography throughout the Holocene*. (2016). Kansas State University. Acknowledgement of Federal Support = Yes
- Soong, J.. *Moving beyond mass loss: Advancing understanding about the fate of decomposing leaf litter and pyrogenic organic matter in the mineral soil*. (2014). Colorado State University. Acknowledgement of Federal Support = Yes
- Ricketts, A.M. *Of mice and coyotes: Mammalian Responses to Rangeland Management Practices in Tallgrass Prairie*. (2016). Kansas State University. Acknowledgement of Federal Support = Yes
- Martin, E.C.. *Ontogenetic shifts, habitat USE and community structure: how fishes use and influence protected tallgrass prairie streams*. (2014). Kansas State University. Acknowledgement of Federal Support = Yes
- Zahner, A.. *Plant Responses to Grazer-Mediated Habitat Alterations in Tallgrass Prairie*. (2015). Kansas State University. Acknowledgement of Federal Support = Yes
- Scott, D.A.. *Recovery of whole soil conditions through restoration from agriculture and its role in mediating plant-plant competition*. (2015). Southern Illinois University Carbondale. Acknowledgement of Federal Support = Yes
- Rawitch, M. J.. *Stream CO2 degassing: Review of methods and laboratory validation of floating chambers*. (2016). University of Kansas. Acknowledgement of Federal Support = Yes
- Larson, D. M.. *The influence of fire and grazing on tallgrass prairie streams and herpetofauna*. (2014). Kansas State University. Acknowledgement of Federal Support = Yes
- Harris, P.T.. *The role of deer browsing on plant community development and ecosystem functioning during tallgrass prairie restoration*. (2014). Southern Illinois University. Acknowledgement of Federal Support = Yes
- Denton, E.. *When a drought is not a drought: Timing determines productivity responses to drought in a mesic grassland*. (2014). Colorado State University. Acknowledgement of Federal Support = Yes

## Websites

Konza LTER project web site

<http://www.konza.ksu.edu>

This is the main website for the KNZ LTER program, and includes links to the KNZ documents, databases, and publications.

## Participants/Organizations

### What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Blair, John	PD/PI	4



<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Baer, Sara	Co PD/PI	2
Dodds, Walter	Co PD/PI	2
Joern, Anthony	Co PD/PI	2
Nippert, Jesse	Co PD/PI	2
Boyle, Alice	Co-Investigator	1
Briggs, John	Co-Investigator	1
Brunsell, Nathaniel	Co-Investigator	1
Collins, Scott	Co-Investigator	1
Gido, Keith	Co-Investigator	1
Harrington Jr., John	Co-Investigator	1
Hartnett, David	Co-Investigator	2
Horne, Eva	Co-Investigator	1
Hutchinson, Stacy	Co-Investigator	1
Jensen, William	Co-Investigator	1
Johnson, Loretta	Co-Investigator	1
Jumponnen, Ari	Co-Investigator	1
Knapp, Alan	Co-Investigator	2
Macpherson, Gwendolyn	Co-Investigator	2
Olson, KC	Co-Investigator	1
Rice, Charles	Co-Investigator	1
Sandercock, Brett	Co-Investigator	1
Santos, Eduardo	Co-Investigator	1
Smith, Melinda	Co-Investigator	2

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Snyder, Bruce	Co-Investigator	1
Whiles, Matt	Co-Investigator	1
Wilson, Gail	Co-Investigator	1
Zeglin, Lydia	Co-Investigator	1
Zolnerowich, Gregory	Co-Investigator	1
Ferguson, Carolyn	Faculty	1
Gibson, David	Faculty	1
Goodin, Douglas	Faculty	1
Greer, Mitch	Faculty	1
Hope, Andrew	Faculty	1
Kaufman, Donald	Faculty	1
Mather, Martha	Faculty	1
Mayfield, Mark	Faculty	1
Moore, Trisha	Faculty	1
Ocheltree, Troy	Faculty	1
Ransom, Michel	Faculty	1
Todd, Timothy	Faculty	1
Avolio, Meghan	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Koerner, Sally	Postdoctoral (scholar, fellow or other postdoctoral position)	1
LaPierre, Kimberly	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Laws, Angela	Postdoctoral (scholar, fellow or other postdoctoral position)	1

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Lemoine, Nate	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Ratajczak, Zak	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Veach, Allison	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Wilcox, Kevin	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Yu, Qiang	Postdoctoral (scholar, fellow or other postdoctoral position)	1
Haukos, Jill	Other Professional	12
Xia, Yang	Other Professional	9
Ackerfield, Jennifer	Graduate Student (research assistant)	1
Bachle, Seton	Graduate Student (research assistant)	6
Bergsten, Ross	Graduate Student (research assistant)	12
Bonjour, Sophia	Graduate Student (research assistant)	1
Chaves Rodriguez, Francis	Graduate Student (research assistant)	12
Choppick, Parker	Graduate Student (research assistant)	1
Connell, Kent	Graduate Student (research assistant)	12
Dietrich, John	Graduate Student (research assistant)	1
Felton, Andrew	Graduate Student (research assistant)	12
Forrestel, Elisabeth	Graduate Student (research assistant)	2
Frenette, Bryan	Graduate Student (research assistant)	12
Gomez, Jesus	Graduate Student (research assistant)	12
Gray, Jess	Graduate Student (research assistant)	1
Griffin-Nolan, Robert	Graduate Student (research assistant)	1

<b>Name</b>	<b>Most Senior Project Role</b>	<b>Nearest Person Month Worked</b>
Gunnip, James	Graduate Student (research assistant)	12
Higgs, Sophie	Graduate Student (research assistant)	12
Hoffman, Ava	Graduate Student (research assistant)	1
Horton, AJ	Graduate Student (research assistant)	1
Ling, Bohua	Graduate Student (research assistant)	1
Liu, Huan	Graduate Student (research assistant)	2
Manning, George	Graduate Student (research assistant)	1
Mino, Laura	Graduate Student (research assistant)	1
Morse, Nathan	Graduate Student (research assistant)	1
Notenbaert, Noortje	Graduate Student (research assistant)	12
O'Conner, Rory	Graduate Student (research assistant)	12
O'Keefe, Kim	Graduate Student (research assistant)	12
Rawitch, Michael	Graduate Student (research assistant)	1
Raynor, Edward	Graduate Student (research assistant)	12
Ricketts, Drew	Graduate Student (research assistant)	12
Scott, Drew	Graduate Student (research assistant)	4
Shoup, Logan	Graduate Student (research assistant)	1
Slette, Ingrid	Graduate Student (research assistant)	1
Verheijen, Bram	Graduate Student (research assistant)	12
Welti, Ellen	Graduate Student (research assistant)	12
Wiggam-Ricketts, Shelly	Graduate Student (research assistant)	12
Williams, Emily	Graduate Student (research assistant)	12
Winnicki, Sarah	Graduate Student (research assistant)	12

Name	Most Senior Project Role	Nearest Person Month Worked
Kuhl, Amanda	Non-Student Research Assistant	12
O'Neal, Patrick	Non-Student Research Assistant	12
Ramundo, Rosemary	Non-Student Research Assistant	12
Taylor, Jeff	Non-Student Research Assistant	12
Ensley-Field, Mira	Research Experience for Undergraduates (REU) Participant	2
Krupa, Paige	Research Experience for Undergraduates (REU) Participant	2
Mueller, Sarah	Research Experience for Undergraduates (REU) Participant	2
Mueller, Emmi	Research Experience for Undergraduates (REU) Participant	2
Renner, Elizabeth	Research Experience for Undergraduates (REU) Participant	2
Spahr, Lauren	Research Experience for Undergraduates (REU) Participant	2

#### Full details of individuals who have worked on the project:

##### John M Blair

Email: [jblair@ksu.edu](mailto:jblair@ksu.edu)

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 4

**Contribution to the Project:** Dr. Blair is the Konza Prairie LTER lead PI and project director. Provides overall LTER project leadership and coordination. Research expertise in ecosystem ecology and terrestrial biogeochemistry; soil ecology, including decomposition, soil nutrient cycling, litter/soil/plant nutrient dynamics; effects of climate change and other disturbances on ecosystem processes; ecology of soil invertebrates; and restoration ecology.

**Funding Support:** None

**International Collaboration:** No

**International Travel:** No

##### Sara G Baer

Email: [sgbaer@siu.edu](mailto:sgbaer@siu.edu)

Most Senior Project Role: Co PD/PI

Nearest Person Month Worked: 2

**Contribution to the Project:** Dr. Baer is a project co-PI and provides expertise on grassland restoration, particularly

with respect to plant community dynamics and long-term changes in ecosystem properties and processes. She is responsible for directing research on grassland restoration ecology at the Konza site, including recovery of ecosystem properties in restored grasslands, and the influence of genotypic differences in cultivars and native vegetation on ecological processes in restored grasslands. Dr. Baer oversees the new Restoration Chronosequence study as part of the LTER VII project. Supported with a subcontract to Southern Illinois University.

**Funding Support:** NSF LTREB: The role of ecological heterogeneity in a long-term grassland restoration experiment. Provides partial support for a related restoration experiment initiated with non-LTER funds.

**International Collaboration:** No

**International Travel:** No

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### **Walter K Dodds**

**Email:** wkdodds@ksu.edu

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Konza LTER VII Co-PI. Dr. Dodds provides leadership for the Konza LTER aquatic research group. Research expertise in aquatic ecology; phycology; nutrient cycling and retention in streams; groundwater chemistry; watershed-level hydrologic export; water quality. Dr. Dodds is also leading the riparian vegetation removal study as part of the LTER VII funding cycle. This study will assess the impacts of riparian land-cover change on grassland streams.

**Funding Support:** None

**International Collaboration:** Yes, Brazil

**International Travel:** No

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### **Anthony Joern**

**Email:** ajoern@ksu.edu

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Konza LTER VI Co-PI. Provides expertise on insect population and community studies; plant-herbivore-predator interactions; long-term consumer population dynamics; responses of insect herbivores to fire and grazing; temporal dynamics in ecological studies. Oversees the Konza LTER long-term grasshopper abundance dataset, and studies on the role of insect herbivores and climate change in mesic grasslands. Is co-leading the patch-burning grazing study, and assessing impacts of fire-grazing interactions on spatial patterning. Co-Director of the KSU Institute for Grassland Studies (with D. Hartnett).

**Funding Support:** None

**International Collaboration:** No

**International Travel:** No

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### **Jesse B Nippert**

**Email:** nippert@ksu.edu

**Most Senior Project Role:** Co PD/PI

**Nearest Person Month Worked:** 2

**Contribution to the Project:** Dr. Nippert is a co-PI on the Konza LTER VII project, and contributes expertise in plant ecology and ecophysiology, and plant responses to environmental variability and change. Dr. Nippert oversees the application of environmental sensor networks to assess spatial variability in microclimate, and plant responses on core

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ILTER watersheds at the Konza Prairie LTER site. He is responsible for woody plant encroachment studies, and also directs the KSU Stable Isotope Mass Spectroscopy Laboratory, and provides expertise on the application of stable isotopes to ecological studies.

**Funding Support:** NSF-IOS:MEETING: PhysFest: Advancing the Field of Plant Physiological Ecology; Konza Prairie, June 6-10, 2016

**International Collaboration:** Yes, South Africa

**International Travel:** No

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**Alice Boyle**

**Email:** aboyle@ksu.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Expertise in bird ecology and physiology; particular interest in reproduction, dispersal and energetics.

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** No

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**John M Briggs**

**Email:** jbriggs1@k-state.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Konza LTER investigator and Director of the Konza Prairie Biological Station (the primary research site for the Konza LTER program). Dr. Briggs oversees studies of grass-shrub interactions and the causes and consequences of woody plant encroachment into grasslands. Directs research into patterns and controls of ANPP in grasslands, as well as studies of the relationship between ANPP and species richness. Also provides expertise in database management, GIS and remote sensing studies.

**Funding Support:** NSF: Impacts of Spatially Heterogeneous Nitrogen to Grazer Distribution and Activity: Effects on Ecosystem Function in Tallgrass Prairie

**International Collaboration:** No

**International Travel:** No

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**Nathaniel Brunsell**

**Email:** brunsell@ku.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Expertise in ecosystem and global C and water flux measurement and modeling; coordinates collection and analysis of data from the Ameriflux towers located on Konza Prairie.

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** No

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**Scott Collins****Email:** scollins@sevilleta.unm.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1

**Contribution to the Project:** Expertise in grassland ecology and plant community ecology; ecological analyses of spatial and temporal dynamics; ecological responses to disturbance; analysis of species distribution and abundance; local-regional interactions; productivity-diversity relationships.

**Funding Support:** NSF Savannah Convergence Project

**International Collaboration:** Yes, South Africa

**International Travel:** No

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**Keith Gido****Email:** kgido@ksu.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1

**Contribution to the Project:** Provides expertise in aquatic ecology; stream communities and ecosystems; the effects of fish on stream ecosystem properties such as primary productivity, nutrient cycling, community structure (species richness and diversity), decomposition and transport of particulate organic matter (POM); impacts of altered hydrologic regimes on stream ecosystems. Oversees the LTER experimental stream facility. Coordinates regional assessments of stream fish communities.

**Funding Support:** NSF Macrosystem Project: Scale, Consumers, and Lotic Ecosystem Rates (SCALER): from decimeters to continents NSF Dissertation Research: Forecasting Global Warming Effects on Developmental Performance of Prairie Stream Fishes along the River Continuum.

**International Collaboration:** Yes, Australia

**International Travel:** No

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**John Harrington Jr.****Email:** jharrin@ksu.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Harrington is a Professor of Geography with expertise in climatology and climate change, land-use/land-cover change, and natural resource applications of remote sensing and GIS. Dr. Harrington is leading many of the new social science related initiatives within our LTER program, and has been representing the KNZ LTER program at numerous LTER Network social science planning and cross-site activities (valuation of ecosystem services, impacts of land-cover change, etc.).

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** No

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**David C Hartnett****Email:** dchart@ksu.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2



**Contribution to the Project:** Expertise in grassland plant population ecology; the role of belowground bud banks in grassland communities; plant mycorrhizal interactions in grasslands; plant-herbivore interactions; fire ecology. Also involved in ILTER activities, and Co-Director of the Institute for Grassland Studies.

**Funding Support:** None.

**International Collaboration:** Yes, Botswana

**International Travel:** No

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**Eva Horne**

**Email:** ehorne@ksu.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Research in behavioral ecology of grassland reptiles; responses of reptile and amphibian populations to fire and grazing. Dr. Horne also assists with administration of the Konza Prairie Biological Station, and coordination of research permits and projects at the site.

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** No

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**Stacy Hutchinson**

**Email:** slhutch@ksu.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Hutchinson is a Professor of Biological and Agricultural Engineering, and has assumed responsibility for overseeing the water addition treatments and soil moisture monitoring in the long-term Irrigation Transect Experiment at the Konza site. This was previously the responsibility of Dr. Jim Koelliker until his retirement in 2010

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** No

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**William Jensen**

**Email:** wjensen1@emporia.edu

**Most Senior Project Role:** Co-Investigator

**Nearest Person Month Worked:** 1

**Contribution to the Project:** Dr. Jensen is an Associate Professor at Emporia State University. He is studying the effects of patch-burn grazing on brood parasitism of Dickcissel nests in the Flint Hills tallgrass prairie, and is responsible for collecting data on avian consumer responses to the patch-burn grazing experiment..

**Funding Support:** None.

**International Collaboration:** No

**International Travel:** No

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**Loretta Johnson****Email:** johnson@k-state.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1

**Contribution to the Project:** Provides research expertise in plant ecology, plant-soil interactions, and ecological genomics. Oversees a long-term water x N amendment experiment at Konza Prairie, and a cross-site study of the impacts of climate on success of local vs. non-local ecotypes of dominant grasses.

**Funding Support:** None.**International Collaboration:** No**International Travel:** No**Ari Jumponnen****Email:** ari@ksu.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 1

**Contribution to the Project:** Expertise on fungal ecology, particularly mycorrhizae and other endophytic fungi; diversity of soil microbial communities; application of molecular methods to characterize soil microbial communities.

**Funding Support:** None.**International Collaboration:** No**International Travel:** No**Alan Knapp****Email:** alan.knapp@colostate.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2

**Contribution to the Project:** Provides research expertise in grassland ecology, plant ecology, physiological ecology, global change studies, plants-herbivore interactions, invasive species ecology. Dr. Knapp also provides leadership for LTER studies of plant productivity and responses to climatic variability and climate change, and conducts multi-site research involving SGS and KNZ LTER sites. Supported by a subcontract to Colorado State University.

**Funding Support:** NSF Savannah Convergence Project**International Collaboration:** Yes, South Africa**International Travel:** No**Gwendolyn Macpherson****Email:** glmac@ku.edu**Most Senior Project Role:** Co-Investigator**Nearest Person Month Worked:** 2

**Contribution to the Project:** Expertise in hydrogeology; subsurface hydrology; long-term studies of groundwater flux and biogeochemistry at Konza LTER site. Supported by a subcontract to the University of Kansas.

**Funding Support:** None.**International Collaboration:** No**International Travel:** No

**What other organizations have been involved as partners?**

Name	Type of Partner Organization	Location
Colorado State University	Academic Institution	Fort Collins, CO
Department of Energy	Other Organizations (foreign or domestic)	USA
University of Kansas	Academic Institution	Lawrence, KS
Kansas State University	Academic Institution	Manhattan, KS
NOAA	Other Organizations (foreign or domestic)	USA
Oklahoma State University	Academic Institution	Stillwater, OK
Southern Illinois University at Carbondale	Academic Institution	Carbondale, IL
State of Kansas	State or Local Government	Kansas
The Nature Conservancy	Other Nonprofits	Kansas
US EPA	Other Organizations (foreign or domestic)	USA
USGS	Other Organizations (foreign or domestic)	USA

**Full details of organizations that have been involved as partners:****Colorado State University****Organization Type:** Academic Institution**Organization Location:** Fort Collins, CO**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Dr. Alan Knapp (Biology Department, Colorado State University) collaborates on many aspects of the Konza LTER program. His research includes studies of grassland ecology, responses to climatic variability and climate change, and the ecology of plant invasions. Knapp's LTER research is supported by a subcontract to Colorado State University, which also provides support for students participating in cross-site research that utilizes the Konza Prairie LTER site and database. Dr. Melinda Smith is an LTER collaborator and participates in several aspects of Konza LTER research, including studies of plant community dynamics, the ecology of plant invasions, genomic responses of plants to climate change, and comparisons of the ecology of North American and South African grasslands. Dr. Smith and her students also oversee the NutNet project at Konza as a part of a multi-site study of the effects of nutrient amendments and herbivory on herbaceous community and ecosystem dynamics. The Konza LTER program provides a subcontract to CSU and logistical support for these studies.

**Department of Energy****Organization Type:** Other Organizations (foreign or domestic)**Organization Location:** USA**Partner's Contribution to the Project:**

Financial support  
In-Kind Support  
Collaborative Research

**More Detail on Partner and Contribution:** The Konza LTER program provides partial support for two CO2 flux towers, which are part of the Ameriflux network of net C exchange measurement sites. DOE provides some financial and logistical support for tower operations and data processing.

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### Kansas State University

**Organization Type:** Academic Institution  
**Organization Location:** Manhattan, KS

**Partner's Contribution to the Project:**  
In-Kind Support  
Facilities

**More Detail on Partner and Contribution:** KSU owns a portion of the Konza Prairie Biological Station, and provides access and use of the field site and associated on-site facilities. KSU also provide campus lab facilities, and computer server and network support through a partnership between the KNZ LTER program and the KSU Physics Computer Support Center, where KNZ network servers are housed. KSU provides support for operation of the Environmental Chemistry Laboratory in Bushnell Hall, which is used for LTER water sample analyses. KSU also provides support in the form of available assistantships for graduate students conducting KNZ research.

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### NOAA

**Organization Type:** Other Organizations (foreign or domestic)  
**Organization Location:** USA

**Partner's Contribution to the Project:**  
Facilities  
Collaborative Research

**More Detail on Partner and Contribution:** Konza Prairie is part of the U.S. Climate Reference Network (USCRN). USCRN is a network of climate stations developed as part of a National Oceanic and Atmospheric Administration (NOAA) initiative. Its primary goal is to provide future long-term homogeneous observations of temperature and precipitation that can be coupled to long-term historical observations for the detection and attribution of present and future climate change.

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### Oklahoma State University

**Organization Type:** Academic Institution  
**Organization Location:** Stillwater, OK

**Partner's Contribution to the Project:**  
Collaborative Research

**More Detail on Partner and Contribution:** The Konza LTER program provides a subcontract to Oklahoma State University to support collaborative research with Dr. Gail Wilson. Dr. Wilson's research focuses primarily on the role of mycorrhizae in grasslands, and the the ecology of *Bothriochloa bladhii* (Caucasian bluestem), an important invasive grass species.

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## Southern Illinois University at Carbondale

**Organization Type:** Academic Institution

**Organization Location:** Carbondale, IL

**Partner's Contribution to the Project:**

Collaborative Research

**More Detail on Partner and Contribution:** Collaborative Konza LTER research is supported by subcontracts to SIU collaborators: (1) Dr. Matt Whiles and students to support research on stream invertebrate ecology and soil macroinvertebrate ecology; (2) Dr. Sara Baer and students to support research on grassland restoration ecology.

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## State of Kansas

**Organization Type:** State or Local Government

**Organization Location:** Kansas

**Partner's Contribution to the Project:**

Financial support

Facilities

**More Detail on Partner and Contribution:** The state of Kansas provides an operating budget for Konza Prairie Biological Station personnel and general site maintenance.

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## The Nature Conservancy

**Organization Type:** Other Nonprofits

**Organization Location:** Kansas

**Partner's Contribution to the Project:**

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** Konza Prairie Biological Station is a Nature Conservancy site, established on land purchased by The Nature Conservancy and managed by the Division of Biology at KSU. Konza LTER scientists interact with TNC scientists and officers on a broad range of management-related issues, including grassland conservation, restoration ecology, and grazing management.

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## US EPA

**Organization Type:** Other Organizations (foreign or domestic)

**Organization Location:** USA

**Partner's Contribution to the Project:**

Facilities

Collaborative Research

**More Detail on Partner and Contribution:** The US EPA jointly operates a CASTNet (Clean Air Standards and Trends Network) and AMoN (ammonia monitoring) site located at the Konza Prairie LTER site. The Konza Prairie LTER program provides site support and the EPA provides analytical services and compiles data on atmospheric nutrient concentrations and dry deposition rates, and tropospheric ozone concentrations. The EPA Region 7 office also supports a collaborative modeling project, which is using Konza LTER data to build linked models of hydrology and biogeochemistry that can be used to assess the effects of alternate land-use scenarios in the Flint Hills region. This project is led by Dr. Bob McKane (EPA) in collaboration with KNZ scientists.

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## What other collaborators or contacts have been involved?

Nothing to report

## Impacts

### What is the impact on the development of the principal discipline(s) of the project?

The Konza Prairie LTER Program is a comprehensive, interdisciplinary research program designed to contribute to synthetic activities and conceptual and theoretical advances in ecology, and to further an understanding of ecological processes in grasslands. Examples of specific recent contributions to the discipline of ecology are provided in the attached 'Konza LTER Findings' file. Here, we summarize in more general terms the contributions of the Konza LTER program to the advancement of ecology. Konza LTER scientific findings continue to be published in a broad range of high-quality journals.

In the 2015-16 funding period, the KNZ program produced or contributed to 106 publications: 95 refereed journal articles (including 12 currently in press), 1 conference proceeding, and 10 dissertations and theses. These publications cover topics ranging from the ecophysiology of individual organisms to regional patterns of productivity to consequences of global change in grasslands. Within the past year, Konza LTER scientists continued to publish high-quality articles in disciplinarily focused areas (e.g., *Freshwater Science*, *Global Change Biology*, and *New Phytologist*), general ecology (*Ecology*, *Ecological Monographs*, *Journal of Ecology*, *Global Change Biology*) and high-impact general science journals (e.g., *BioScience*, *Nature Climate Change*, *Nature Geoscience*, *PNAS*). Several syntheses of long-term KNZ research were published in 2016, including an *Ecological Monographs* article based on a multi-decadal test of the role of heterogeneity in grassland community reassembly (Baer et al. 2016), an analysis of how 12-years of nutrient enrichment leads to divergence of tallgrass plant communities and decreased ecosystem stability (Koerner et al. 2016).

In addition to site-based science, KNZ scientists made substantial contributions to multi-site, collaborative ecological research, and the widespread use of KNZ LTER data and resources by the broader ecology community. For example, KNZ LTER data were used in several recent multi-site or synthetic efforts, including: a comparison of drivers of variation in ANPP and plant community composition across a broad precipitation gradient (LaPierre et al. 2016. *Ecosystems*); a multi-site assessment of how sensitivity of carbon exchanges in Great Plains grasslands responds to precipitation variability (Petrie et al. 2016. *Biogeosciences*); a synthetic analysis of similarities and divergence in ecological responses to fire and grazing in grasslands in North America and South Africa (Smith et al. 2016. *BioScience*); and a multi-site assessment of changes in spatial variance during grassland to shrubland state transitions (Ratajczak et al. in press. *Journal of Ecology*). Konza Prairie is also an active node in the NutNet Nutrient Network, and KNZ scientists have contributed to several NutNet publications in the 2015-16 funding period.

### What is the impact on other disciplines?

The Konza Prairie LTER program and our core research experiments attract numerous scientists from a broad spectrum of scientific disciplines beyond ecology. For example, KNZ supports long-term collaborations with several physical scientists from the University of Kansas: Gwen Macpherson (Geology, KU) is a hydrogeochemist whose research includes long-term studies of groundwater chemistry sampled via permanent wells located on Konza Prairie. Dr. Pamela Sullivan (Geography, KU) began additional subsurface geochemistry research at Konza. Sullivan's work focuses on the interface of freshwater resources – changing climate – vegetation dynamics, and she is collaborating with Macpherson, Blair, and Nippert. Dr. Andrea Brookfield (Kansas Geological Survey) is a geohydrologist with an emphasis on groundwater modeling. Brookfield has begun collecting data at Konza, attending annual meetings, and making regular contributions. In 2016, we also collaborated with Steve Holbrook (U Wyoming) to facilitate NSF-supported work on Konza to use geophysical tools to image the subsurface across different lithologies in the US. An atmospheric scientist from the University of Kansas (Nate Brunzell, Geography) oversees KNZ flux tower research, uses Konza sites to study the effects of surface heterogeneity on land atmosphere interactions, and is employing a Large Aperture Scintillometer (LAS) to measure sensible heat fluxes over longer path lengths that span Konza watersheds with ongoing C flux measurements. A recent hire at K-State includes Dr. Eduardo Santos (Agronomy), whose research is also focused on land-atmosphere interactions. KNZ is supporting Santo's use of stable isotopes to partition C fluxes on grazed and ungrazed watersheds. The work by Brunzell and Santos compares plot-based vegetation measurements with data from eddy covariance stations and satellite-derived estimates of surface energy fluxes. Two hydrologists from Biological and Agricultural Engineering (Dr. Stacy Hutchinson and Dr. Tricia

Moore) maintain and contribute to the 'Irrigation Transect Experiment'. Contributions by Hutchinson and Moore have provided numerous training opportunities for Biological and Agricultural Engineering and Hydrology students.

Konza Prairie and KNZ research areas are increasingly used for geophysical studies of soil and subsurface processes. In 2016, a USGS team visited Konza to initiate a long-term study of soil properties and processes as part of a national USGS Reference Watershed Soil-Monitoring Initiative, which includes all Hydrologic Benchmark Network (HBN) watersheds (e.g., Konza's Kings Creek and associated watersheds). Soil sampling is being conducted once every 7 years at each of the 37 HBN watersheds and 19 NAWQA reference watersheds. The seven-year sampling rotation is based on results of previous soil resampling studies that have shown key measurements such as exchangeable cations, pH, and organic carbon change during periods of 5 to 10 years. Also in 2016, a KSU Geology post-doc (Sara Vero) installed a series of sensors near KNZ research plots to gather data for a proposal titled "Developing Geophysical Methods for Elucidating the Hydrodynamics of an Epikarst System".

Konza Prairie has also become a research platform for several collaborative teams of ecologists and molecular biologists that are part of the KSU Ecological Genomics Initiative. Many of these interdisciplinary teams are using the Konza LTER site and associated long-term experiments to address questions related to the genetic mechanisms underlying plant and animal responses to environmental constraints. The KNZ LTER patch-burn grazing experiment is being done in collaboration with

Dr. KC Olson, a grazing animal nutritionist that is using the experiment to assess the impacts of alternate grassland management practices on animal nutrition and animal health. Other contributions to disciplines outside the traditional realm of ecology include the operation of flux towers at the Konza site, which has provided data used by micrometeorologists, climatologists, remote sensing scientists and modelers. We also collaborate with atmospheric chemists and modelers from the EPA CASTNet program in sampling concentrations of selected airborne particles and using these to model dry deposition rates, and in 2006, two new seismographs were installed on the site to facilitate ongoing geologic research by USGS scientists and their collaborators.

An unusual collaboration in 2016 was a visit from a group of mathematicians and math graduate students. Blair provided a seminar and Brunsell provided a field tour to the group to discuss the LTER program, KNZ research, and potential future math-science collaborations.

### **What is the impact on the development of human resources?**

The Konza Prairie LTER VII program makes significant contributions to human resource development in science, engineering and technology. Our program has a long history of undergraduate training and exposure to scientific research for local KSU students. Amanda Kuhl (KNZ Research Assistant) mentors > 10 students year-round that assist in the collection and measurement of the long-term productivity plots on KNZ. In addition, training of undergraduates includes support of the local REU program (details provided in the 'Accomplishments' section of this report). Indirectly, we support the development of undergraduates via the use of Konza LTER data in ecology classes and text books. As documented elsewhere in this report, we also train numerous graduate students and provide valuable experience in interdisciplinary research and the synthetic use of long-term datasets. In addition to supporting KSU graduate students, the Konza Prairie LTER site is widely utilized by graduate students from other institutions. During the 2015-16 funding period, the site was used by graduate students from the University of Kansas, University of California-Santa Cruz, Southern Illinois University, Colorado State University, Oklahoma State University, University of Nebraska, and the University of Missouri. We also hosted field trips for students from many regional colleges and universities, and in the last year we hosted a summer student training field trip organized by Haskell Indian Nations University. The Konza Environmental Education program, and the Konza Prairie Schoolyard LTER Program, provide formal and informal research experiences and science education to public groups, children and K-12 teachers. Finally, the Konza LTER site continues to be used in conjunction with the NSF-funded Girls Researching Our World (GROW) program ([www.ksu.edu/grow/](http://www.ksu.edu/grow/)), with several KSU scientists and students leading educational activities for 7th and 8th grade girls.

### **What is the impact on physical resources that form infrastructure?**

The Konza LTER program provides a research platform for scientists and students from around the world. The 3,487-ha Konza Prairie Biological Station (KPBS), located in the Flint Hills of NE Kansas, is the core research site for the KNZ program. In addition to providing the watershed-level fire and grazing treatments, agricultural fields, restored prairie, stream network and weirs, KPBS includes several buildings in the headquarters area that support LTER research. The on-site Ecology Laboratory (2,400 ft<sup>2</sup>) includes (1) a wet/dry lab with

sinks, fume hood, refrigerators, balances, etc., (2) two large multi-purpose work rooms with bench space and sinks for processing samples, drying ovens, refrigerators and freezers, and equipment storage, and (3) and a large researchers' shop equipped with a variety of tools and field supplies. Other station buildings include a fire station and maintenance building, a large storage building for equipment, and a residence occupied by the site foreman year round. The 4,650-ft<sup>2</sup> Hulbert Center houses a library/conference room, administrative offices, classroom and teaching laboratory (used primarily for K-12 activities), reference herbarium and animal collections, and a kitchen and dormitory-style housing for 15 visitors. Two small guest cottages (each with 2-bedrooms living room, bath, kitchen, and laundry facilities), can accommodate up to 5 persons/cottage. A larger cottage, built in 2012, can accommodate up to 12 guests, expanding the capacity of on-site accommodations to 37 visiting researchers.

With support from an NSF Field Stations and Marine Laboratories (FSML) grant, Kansas NSF EPSCoR, the Kansas Agricultural Experiment Station, KSU, and private foundations, major site improvements and building renovations have ensured that KNZ remains a modern biological station. These include new housing for visiting students and scientists (included above), an on-site meeting and conference center, and improved Internet capabilities. With funding from an NSF-FSML grant and additional support from KSU and a private donor, an historic limestone barn at the KPBS headquarters was

transformed into a multipurpose meeting facility for on-site conferences, workshops, and educational programs. The historic stone barn was renovated in 2008 and has the Cortelyou Lecture Hall (1,750 ft<sup>2</sup>) with a seating capacity of ~100 persons fully equipped with A/V equipment and wireless internet. An additional large multi-purpose room (1,850 ft<sup>2</sup>) is designed as flexible space for varied uses including additional meeting space, workshops, scientific posters and other research displays, social gatherings, and education programs for large groups. All lab and office buildings at KPBS have T1 Internet connectivity to the KSU campus. In addition, there is a wireless link to KPBS from campus with multiple wireless access points (802.11abg) that provide coverage to >60% of the 3,487-ha site.

Other LTER infrastructure, maintained by KPBS, includes the outside perimeter fence (29.8 km), the interior bison management area enclosed by 16.4 km of "New Zealand" fence, 98 small (25-m<sup>2</sup>) grazing exclosures, 11.7 km of fence for cattle research, 26.4 km of access roads and 61 km of fireguards separating the experimental watershed units. KPBS maintains several general-purpose vehicles on-site, as well as specialized equipment (tractors, fire trucks, mowers, soil augers, etc.). KPBS makes staff and equipment available to assist with KNZ research activities, including mowing fireguards, installing equipment, soil coring, etc. KPBS staff also coordinates the fire management plan and implementation of prescribed burning of watersheds and experimental plots, and the management of bison and cattle herds for KNZ grazing treatments. The headquarters area include a corral and handling facilities for managing the bison herd (hydraulic chute, electronic scales, etc.), which is essential for LTER grazing studies. Other field equipment and instrumentation on site includes the main KNZ weather station, a network of 11 rain gauges, two eddy flux towers for quantifying ecosystem-level C and water vapor flux, four weirs and associated stream gauging equipment (updated in 2012 to Sutron Constant Flow Accubar® bubble gages and recorders with wireless connectivity), 46 wells for measuring groundwater levels and chemistry, numerous TDR probes, neutron access tubes and tension lysimeters for soil water measurements. Related equipment co-supported by other programs includes a USGS stream monitoring station, 2 seismometers (USGS), an aerosol and ozone monitoring facility (CASTNet), and a NOAA Climate Reference Network (CRN) weather station. These facilities add significantly to data for LTER research and education programs, and for regional and cross-site studies. KPBS is also a core site for National Ecological Observatory Network (NEON), which is now fully built-out and operational (completed during the 2014-15 cycle). NEON will provide additional unique measurement capabilities and data at KPBS, which will complement many KNZ LTER studies.

In addition to facilities at KPBS, a wide-range of modern laboratory facilities are available on the nearby KSU campus approximately 15 km from KPBS (e.g., Analytical Chemistry Labs, Stable Isotope Lab, Center for Ecological Genomics, Core Sequencing and Genotyping Facility, Lipodomics Center, Gene Expression and Microarray Facility, a BioSafety Level 3 Facility for invasive species and infectious disease studies, etc.). The majority of core LTER laboratory space and analytical equipment are located in Bushnell Hall (Biology), including space and equipment for preparing plant, soil and water samples for analysis (drying ovens, grinders, shaker tables, block digestors, vacuum filtration systems). Bushnell Hall also houses an extensive collection of prairie plant specimens in the KSU Herbarium, and these specimens are now electronically databased and georeferenced. Some specific equipment and facilities available for LTER research are located within other Departments (Agronomy, Biological and Agricultural Engineering, Plant Pathology, Geography), reflecting the interdisciplinary nature of our research. Some major analytical instruments available for KNZ investigators include: 2 Alpkem autoanalyzers (FlowSolution IV) for liquid samples, Carlo-Erba 1500 automated C/N analyzer for solid samples, Shimadzu TOC 500 analyzer for dissolved C, a Hitachi U2900 automated dual-beam spectrophotometer, several gas chromatographs with electron capture, flame ionization and thermal conductivity detectors, a Nikon compound



microscope with epifluorescence and video imaging capabilities, 4 LiCor 6400 Portable Photosynthetic Systems, 2 LiCor 8100 systems dedicated for soil CO<sub>2</sub> flux measurements, a LiCor 1600 null-balance porometer for stomatal conductance, and 3 pressure chambers (PMS model 1000) for measuring plant water potential, 4 Tektronix cable testers (model 1502B) coupled to Campbell CR10 data loggers for TDR soil moisture measurements, 2 Troxler (model 3221) neutron probe gauges for soil moisture determinations, and several Trimble GPS units. Eight multi-parameter sondes (YSI 6000) are used for monitoring oxygen and temperature in 3 watersheds. Cold storage facilities for holding samples are available, as are sample preparation rooms for drying and grinding plant and soil samples. Climate controlled greenhouse space is available on the KSU campus. In addition, other "typical" laboratory instruments (balances, microscopes, etc.) are available in individual investigator laboratories.

### **What is the impact on institutional resources that form infrastructure?**

KNZ investigators continue to support grassland research through the local (KSU) Grasslands Institute and through hosting relevant society meetings (e.g., the Second America's Grasslands Conference).

### **What is the impact on information resources that form infrastructure?**

KNZ resources are used to support the hardware and software associated with the KNZ web site and data portal. In the upcoming year, we will continue to add new projects and data sets to the KNZ database; we will continue to develop our new DEIMS-based website and launch it as soon as possible; continue to update a variety of metadata and procedural protocols to ensure any changes in technique or structure of our datasets are accounted for; continue to ensure data quality, perform data aggregation and synthesis to meet requirements for the LTER Network Information System; provide up-to-date, accurate LTER data to KNZ investigators and to the broader scientific community as quickly and efficiently as possible.

### **What is the impact on technology transfer?**

Nothing to report.

### **What is the impact on society beyond science and technology?**

The KNZ LTER program contributes to increased public awareness of ecological and environmental issues (e.g., biodiversity conservation, habitat loss, ecosystem services, restoration ecology, etc.) through outreach and public education activities, such as the Konza Prairie biennial Visitors' Day. In June 2015, KNZ hosted the 'Grasslands of the World' conference, organized by The Nature Conservancy and attended by over 200 (non-academic) participants. This event raised conservation awareness of global grasslands (e.g., savanna, steppe, prairie, etc.) and included presentations by KNZ investigators. KNZ investigators also participate in national and international conferences with emphases on sustainability and conservation. For example, Dr. Sara Baer was a featured speaker at the June 2016 North American Prairie Conference, which attracts a significant number of non-scientists.

In addition, the Konza LTER Program is increasingly called upon to provide data relevant to resource management and regulatory policy. In 2016, a group from Midwest Energy toured KNZ to learn about climate change issues and how it may affect their company in the future. Because of the widespread use of prescribed fire for both grassland conservation and agricultural goals, KNZ research on ecological responses to contrasting long-term fire regimes and different seasons of fire has taken on new importance. At the regional level, KNZ scientists have advised EPA Region 7 staff and scientists on the ecological benefits of fire in maintaining native tallgrass prairie habitat and diversity and contributed important long-term data to guide the development of the Flint Hills regional smoke management plan. The issue of smoke management coupled with concerns about woody plant expansion have provided KNZ investigators an opportunity to interact with land managers, producers, and private organizations in linking basic research with management goals. The KNZ Season of Fire Experiment provides 22-years of data from watersheds burned at different times of the year (Spring, Summer, Fall and Winter). Most prescribed burning in the Flint Hills takes place during a small window in April. We now have data showing that burning can be done other times of year in ungrazed watersheds with little adverse effect on plant productivity or desirable species. KNZ investigators have interacted and advised groups, including the EPA, Natural Resources Conservation Service, the Kansas Farm Bureau, The Nature Conservancy Grassland Committee, and others. In 2016, we participated in a regional meeting focused on the timing of prescribed fires, sponsored by the Kansas Prescribed Fire Council, Kansas Grazing Land Coalition, Kansas Society for Range Management, Kansas Native Plant Society and Great Plains Fire Science Exchange. The Kansas Chapter of The Nature Conservancy and The National Park Service hosted

the meeting at the Tallgrass Prairie National Preserve. Practitioners interacted with research scientist to learn more about alternative fire timing, and data from the season of year burning experiment on KPBS supported by KNZ was highlighted during this meeting.

Locally, Konza scientists continue to serve as consultants for the Flint Hills Discover Center, and we participate in Kansas Agricultural Experiment Station public education events by providing information on the ecological consequences of various grassland management practices (e.g., fire frequency and grazing). KNZ scientists have been instrumental in the development of a management plan for the Nachusa Grasslands Nature Conservancy Site in Illinois. Baer, Blair, and Scott Collins have met with Nachusa staff and provided input on the development of a science and management plan. In the international arena, Konza Scientists have provided information on grassland management to scientists and park resource managers from South Africa, Botswana, China, Australia, and Hungary, with many of these visits focusing on resource management issues of public concern. The Konza Prairie LTER database is also being used to address other issues relevant to regulatory policy. Long-term data on Konza Prairie streamwater quality provides a baseline for regional water quality in the absence of agricultural practices or other disturbances. LTER data on soil chemistry is also being incorporated into ongoing studies to evaluate the potential of grassland management practices to increase soil C sequestration to offset atmospheric CO<sub>2</sub> loading.

In 2016, KNZ scientists and graduate students participated in numerous public outreach events designed to enhance understanding and LTER science and dissemination of important findings. Several KNZ researchers as Science Communication Fellows at Sunset Zoo. Sunset Zoo's Science Communication Fellowship (SCF) program supports a network of certified researchers, professionals, graduate students and post-graduate students working together to connect the community to science and elevate the understanding of research taking place in the region. SCF is part of the national [Portal to the Public Network](#). In 2016, KNZ PhD students Rory O'Connor and Kent Connell presented results on topics including the role of fire in grasslands and importance of plant-microbe interactions. KNZ investigators also presented research findings at local Science Café meetings. KNZ scientists Briggs and Horn participated in LASER presentations designed to bring together scientists and artists to engage the public.

The Konza Prairie LTER site, and the unique watershed fire and grazing treatments, have been the focus of several art and humanities-related activities. For example, the Konza Prairie Biological Station continues to provide on-site housing for a Visiting Writers series, in conjunction with the KSU English Department, as part of KNZ's contribution to the LTER Ecological Reflections program. In 2016, KPBS and KNZ hosted writer Julian Hoffman (<https://julianhoffman.wordpress.com>). His writings explore the relationship between wildlife, places and human connections. His book "The Small Heart of Things: Being at Home in a Beckoning World" was chosen by Terry Tempest Williams as the winner of the 2012 AWP Award Series for Nonfiction. In 2014, it won a National Outdoor Book Award for Natural History Literature. While at KPBS, he interacted with KNZ investigators to learn more about the tallgrass prairie and provided a reading for the public at KSU. KNZ scientists Briggs and Horn also participated in LASER presentations designed to bring together scientists and artists to engage the public.

KPBS and KNZ also hosted a workshop for artists and scientist on KPBS July 15, 2016. It was titled "Cross-Disciplinary Workshop and Engagement: An Art-Science Workshop". Over 40 individuals including local/regional scientists and artists along with personal from NSF attended or participated in the workshop. Matthew Coolidge, Founder and Director of the Center for Land Use Interpretation in Los Angeles was the keynote speaker. It was sponsored by a Kansas State University Academic Excellence Award and University of Kansas Spenser Museum. This workshop was a result of KNZ investigators interacting with the KSU Beach Art Museum over the past couple of year in developing the Prairie State Initiative. The Prairie Studies Initiative at Kansas State University is a collaborative network of faculty, staff, and university departments interested in the past, present, and future of the prairie, especially the tallgrass prairies of Kansas. The Initiative is working to develop programs to raise awareness at Kansas State University about the value, importance, and challenges of the prairie, as well as to spur innovative scholarship related to the prairie among faculty, staff, and students at K-State.

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## Changes/Problems

### Changes in approach and reason for change

Nothing to report.

**Actual or Anticipated problems or delays and actions or plans to resolve them**

Nothing to report.

**Changes that have a significant impact on expenditures**

Nothing to report.

**Significant changes in use or care of human subjects**

Nothing to report.

**Significant changes in use or care of vertebrate animals**

Nothing to report.

**Significant changes in use or care of biohazards**

Nothing to report.