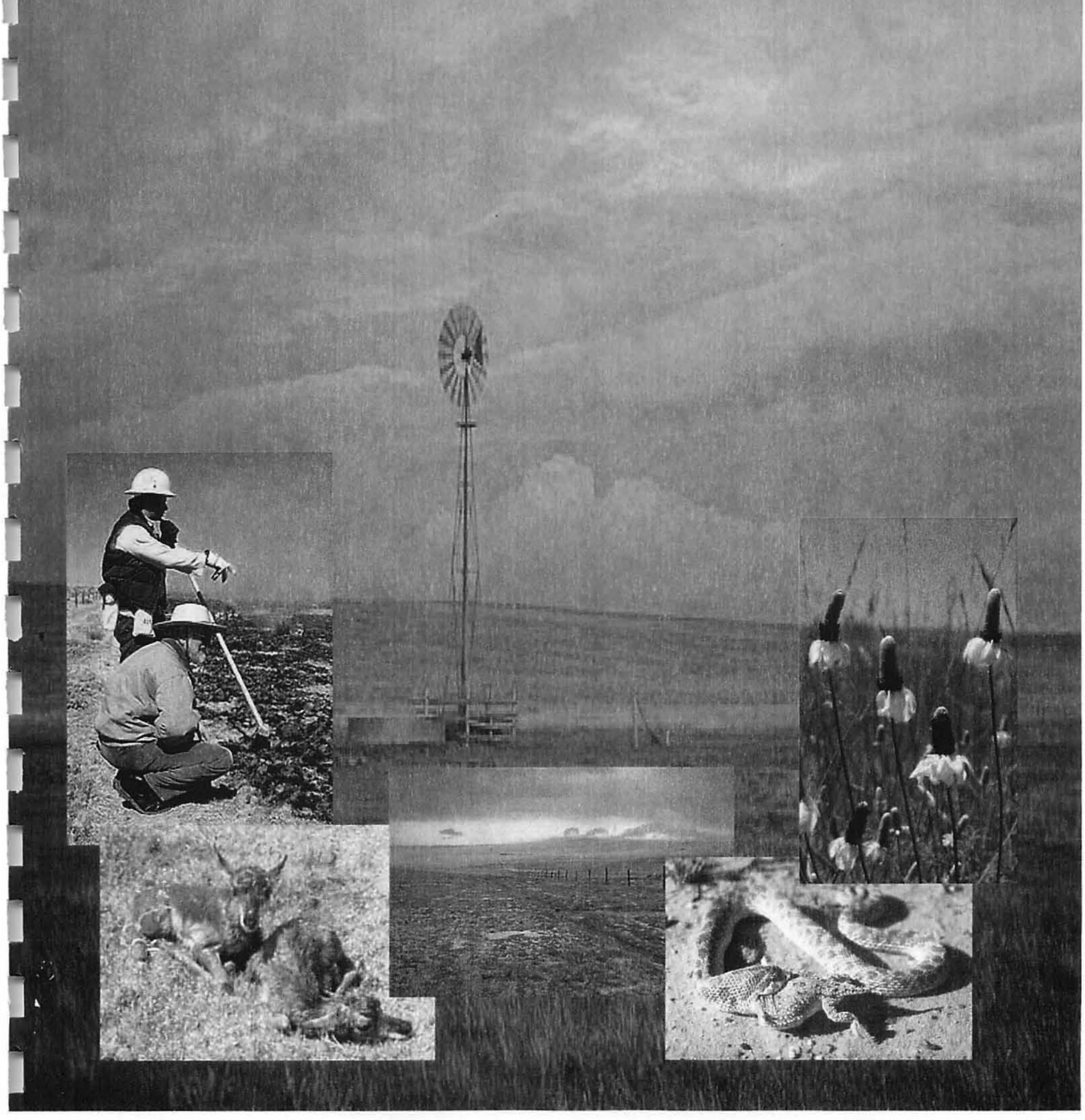
Shortgrass Steppe Symposium

January 14, 2005



2005 Shortgrass Steppe Symposium

*Many people and organizations have helped make this symposium possible.
We extend our thanks to all of them for their contributions.
Special thanks are due to those below.*

USDA Forest Service, Pawnee National Grassland for the National Grassland pins

Rocky Mountain Bird Observatory for the *Pocket Guide to Prairie Birds*

Judy and Wade Hendryx for the artwork for the SGS LTER logo used on the Symposium mugs

Dana Blumenthal, Indy Burke, Bob Flynn, Mark Lindquist, Jack Morgan and Maureen O'Mara for musical entertainment

Bob Flynn, Judy Hendryx, Nicole Kaplan, Mark Lindquist, Jeri Morgan, Sallie Sprague, and Caroline Yonker for their dedication and hard work putting together this Symposium

The cover for the 2005 Shortgrass Steppe Symposium shows the winning photos from the contest held during the 2003 Symposium. Thank you to all the photographers for giving us permission to use their photos for SGS LTER projects and activities.

Photo Credits

Background:
Paul Stapp "Summer Sunset on the Pawnee with Windmill"

Insets, left to right:
Nicole Kaplan "Don't Touch, It's Hot"
Dave Smith "Pronghorn Fawns Minutes after Delivery"
Mark Lindquist "Holy Hail Fell from the Sky in Spring"
Amy Yackel Adams "Hognose Snake Eating Short Horned Lizard"
Amy Yackel Adams "Prairie Cornflower"

Poster Number: **#23**
Location: *224 – 226 (am)*

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Morgan, N.K., P. Newman, and G.N. Wallace. (Natural Resource Recreation and Tourism).
Recreational Shooting on the Pawnee National Grassland: A Qualitative Case Study

Population growth along Colorado's Front-Range has resulted in increasing use levels on the Pawnee National Grassland (PNG) in general and recreational target shooting in particular. Front Range urbanization has also led to the closure of a number of the areas previously used by recreational shooters. PNG managers have seen an increase in the intensity and spatial distribution of recreational shooting as well as a number of associated impacts. For managers to respond effectively to the challenges associated with increased use, and make appropriate management decisions, it is imperative that they understand the breadth and depth of stakeholder views of recreational shooting across all stakeholder groups. This case study explores the social setting on the PNG by describing the stakeholder groups, relationships between groups, and the views of individual users. Semi-structured interviews with 24 informants across multiple stakeholder groups were conducted. The transcribed interviews were coded, identifying common themes across all interviews. These identified themes, such as safety, ecological integrity, vandalism, and place attachment, highlight issues and views that allow managers to see beyond the labels of protected area stakeholders, and better understand their diversity of users. Shooters have many reasons for using the PNG, including the absence of use fees or time restrictions. Many feel that with private ranges in the area increasing their fees and capping memberships, they have no where else to go. Most other users do not have a problem shooting in particular, but rather some of the impacts associated with this increased use, such as property damage, unsafe shooting practices, trampled vegetation, and litter. This case study tells the story of recreational shooting on the Pawnee National Grassland today in the interest of giving managers better information from which to make decisions.

Results Table 1

Stakeholder Group	Ranchers	Researchers	Birders	Horseback Riders	Recreational Shooters	Managers
Identified Themes	• Have no problem with shooting, but with irresponsible behavior • Major complaint is vandalism/ damage to stocktanks, windmills, fences • Concern for personal safety when working cattle near shooting	• Find doing research within sound of shooting unnerving • Have had close calls when shooters have not seen them in the field • Concerned about the effects of shooting on the organisms they study	• See shooting as highly disruptive to their recreation and enjoyment of the place • Concerned about effects to the land and wildlife populations from shooting.	• Dislike seeing trash from shooter use • Safety and disturbance issues for humans and horses make them wary of riding at PNG, and avoid areas where shooting is occurring if they can	• Very broad spectrum of people • Reasons for using PNG: have few other options for shooting in northern Colorado, enjoy the open space, no use fees, long ranges • Also dislike visual impacts: trash	• As shooting numbers increase, spend more of their time managing shooting • See increasing impacts to other users, wildlife, and the land as shooting increases

Additional 2005 Shortgrass Steppe Symposium Participants

Chrissy Alba	SGS-LTER/CSU, Department of Biology
Tom Baur	Crow Valley Grazing Association, Board Vice-President
John Bradford	U.S.F.S. Rocky Mountin Research Station
Reesa Conrey	CSU, Department of Biology
Mauricio Cotera	Universidad De Nuevo Leon
Jim Curtis	Crow Valley Grazing Association, Board Secretary
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Kim Obele	CSU, Department of Forest, Rangeland and Watershed Stewardship
Bruce Rittenhouse	National Park Service
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Jason Stevens	SGS-LTER
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Aryn Wilder	CSU, Department of Biology

2005 Shortgrass Steppe Symposium
Lory Student Center (LSC) @ Colorado State University
January 14, 2005
Key Issues for Management, Research, and Conservation

8:15 – 8:45 **LSC 227**	**Registration, poster set-up and coffee**
8:45 – 9:00 **LSC 228**	**Overview: Management needs and challenges for the Shortgrass Steppe** **Gene Kelly, Colorado State University**
9:00 – 9:30 **LSC 228**	**Issues of grazing** **Justin Derner, Agricultural Research Service**
9:30 – 9:50 **LSC 228**	**Discussion**
9:50 – 10:05 **LSC 224-226**	**Break (refreshments)**
10:05 – 10:35 **LSC 228**	**Issues of drought** **Nolan Doeskin, Colorado State University**
10:35 – 10:55 **LSC 228**	**Discussion**
11:00 – 12:00 **LSC 224-226**	**Poster session**
12:00 – 1:00 **Cherokee Park**	**Lunch with entertainment**
1:00 – 1:30 **LSC 228**	**Issues of weeds and invasive species** **Dana Blumenthal, Agricultural Research Service**
1:30 – 1:50 **LSC 228**	**Discussion**
1:50 – 2:20 **LSC 228**	**Issues of prairie dogs and faunal diversity** **Mike Antolin, Colorado State University**
2:20 – 2:40 **LSC 228**	**Discussion**
2:40 – 3:00 **LSC 228**	**Synthesis: What would we like to know and where do we go to meet new challenges in management, research, and conservation?** **Alan Knapp, Colorado State University**
3:00 – 4:00 **LSC 220-222**	**Poster session (refreshments)**

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2005 Shortgrass Steppe Symposium
Acronym Definitions

AES	Agricultural Experiment Station
AIDL	Athropod-Borne and Infectious Disease Laboratory
ARS	Agricultural Research Service
CDOW	Colorado Division of Wildlife
CNHP	Colorado Natural Heritage Program
CPER	Central Plains Experimental Range
CSU	Colorado State University
CU	University of Colorado
DU	University of Denver
FS	Forest Service
GDPE	Graduate Degree Program in Ecology
GIS	Geographic Information Systems
GPS	Global Positioning System
MAST	Math and Science Teaching
NRCS	Natural Resources Conservation Service
NREL	Natural Resource Ecology Laboratory
NSF	National Science Foundation
PNG	Pawnee National Grassland
RMBO	Rocky Mountain Bird Observatory
RRRU	Rangeland Resources Research Unit
SGS-LTER	Shortgrass Steppe Long Term Ecological Research
TNC	The Nature Conservancy
UNC	University of Northern Colorado
USDA	United States Department of Agriculture
USGS	United States Geological Survey

2005 Shortgrass Steppe Symposium
Poster Presentations

First Author	*Title*	*Location*
(1) Alfieri, Joseph	A Comparison of the Bowen Ratio Energy Balance and Eddy Covariance Methods for Determining Surface Fluxes over Shortgrass Steppe	*220-222 (am)*
(2) Beltrán-Przekurat, Adriana	Land-Atmosphere Interactions in Semiarid Areas: Examples from Shortgrass Steppe and Jornada LTER Sites	*220-222 (am)*
(3) Blecker, Steve	The Role of Plants in Regulating the Biogeochemistry of Silica in Temperate Grassland Ecosystems of the Mid-Continent of North America	*220-222 (am)*
(4) Darden, Safi-Kirstine	Mediation of Spatial Organization in the Swift Fox: Preliminary Observations	*224-226 (am)*
(5) Dye, James	Historical and Current Trapping Records for Heteromyid Rodents in Northern Colorado	*224-226 (am)*
(6) Flynn, Robert	GIS Data and Tools Available at the SGS LTER	*224-226 (am)*
(7) Grant, Doug	Drought and Grazing Interaction and Recovery in Shortgrass Steppe: A DAYCENT Modeling Analysis	220-222 *(pm)*
(8) Hanan, Niall	Land-Use Impacts on Carbon and Water Flux on the Shortgrass Steppe in Eastern Colorado – Preliminary Results	*220-222 (pm)*
(9) Hardwicke, Kelly	Species Interactions across Three Trophic Levels: *Cynomys ludovicianus* Colonies Increase Floral Visitation by Insects	*224-226 (am)*
(10) Heisler, Jana	Ecosystem Response to Climate Change: Sensitivity of Grassland Ecosystems across the Great Plains to Variability in Precipitation	*220-222 (am)*

2005 Shortgrass Steppe Symposium
Poster Presentations

First Author	*Title*	*Location*
(11) Kelly, Gene	LTER: Long Term Ecological Research Network	*220-222 (am)*
(12) Kelly, Gene	Shortgrass Steppe Long Term Ecological Research	*220-222 (am)*
(13) LeCain, Dan	Gradient FACE: a New Free Air CO_2 Enrichment (FACE) System on Native Prairie	*220-222 (pm)*
(14) Moore, John	Environmental Education and Outreach for Secondary Native American Educators and Students	*224-226 (pm)*
(15) Munson, Seth M.	Long-Term Response of Shortgrass Steppe Vegetation to Removal of *Bouteloua gracilis*	*224-226 (am)*
(16) Quirk, Meghan H.	Colorado Front Range GK-12 Connecting Kids and Ecology – Teachers and Researchers	*224-226 (pm)*
(17) Rondeau, Renee	Longevity of Cow Fecal Pats	*224-226 (pm)*
(18) Sherry, Jennifer	Mapping Grassland Vegetation in the Urban/Wildland Interface - Ecological Information for Integrating Management Goals	*224-226 (pm)*
(19) Smith, David	Shortgrass Steppe Ecosystem Productivity	*220-222 (pm)*
(20) Stapp, Paul	Patterns of Small Mammal Abundance in Prairie Dog Colonies in Shortgrass Steppe: Effects of Plague	*224-226 (pm)*
(21) Wolchansky, Jen	Effect of Grazing on Soil Temperature and Moisture on the Shortgrass Steppe	*220-222 (pm)*
(22) Yackel Adams, Amy A.	Modeling Post-Fledging Survival of a Grassland Bird in Response to Drought	*224-226 (pm)*

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PD Blanken[1], J. Morgan[2], D Smith[2], D LeCain[2], J. Wolchansky[1], RL Grossman[3] ([1]Geography, U. Colorado, Boulder, [2]USDA-ARS, [3]Colorado Research Associates). A Comparison of the Bowen Ratio Energy Balance and Eddy Covariance Methods for Determining Surface Fluxes Over Shortgrass Steppe.

Due to the differences inherent to the Bowen Ratio Energy Balance (BREB) and Eddy Covariance (EC) methods of measuring surface fluxes, each can yield substantially different measures of the same flux. This research sought to quantify the magnitude and scope of these differences by analyzing data collected at the CPER during the spring of 2004. By elucidating the relationships between the various fluxes as measured by the two methods, this research was able to generate techniques that could be used to reconcile the data collected by each of these methods. Specific emphasis was placed on the latent heat flux (λE) and the carbon dioxide flux (F_c) as they demonstrated the greatest differences.

When measured via the BREB method, λE was consistently greater than the same flux measured with the sensor systems associated with the EC method. This difference was as great as 40% during the daytime period. However, using the polynomial relationship developed in this research, it was possible to reduce the differences to less than 10%.

Similarly, F_c measured via the BREB method was 0.04 mg $s^{-1}m^{-2}$ or nearly 2.5 times greater than the same flux measured via the EC method. Given that measures associated with the EC method were more consistent with other estimates of the carbon budget at the research site, a family of curves were derived to correct F_c measured via the BREB method to those from the EC method. As can be seen in the figure, the measure of F_c by the BREB method, when corrected, is quite similar to the measure via the EC method. Again, the agreement is within 10%. This correction, along with the one associated with λE, can be used to generate a consistent long term data set.

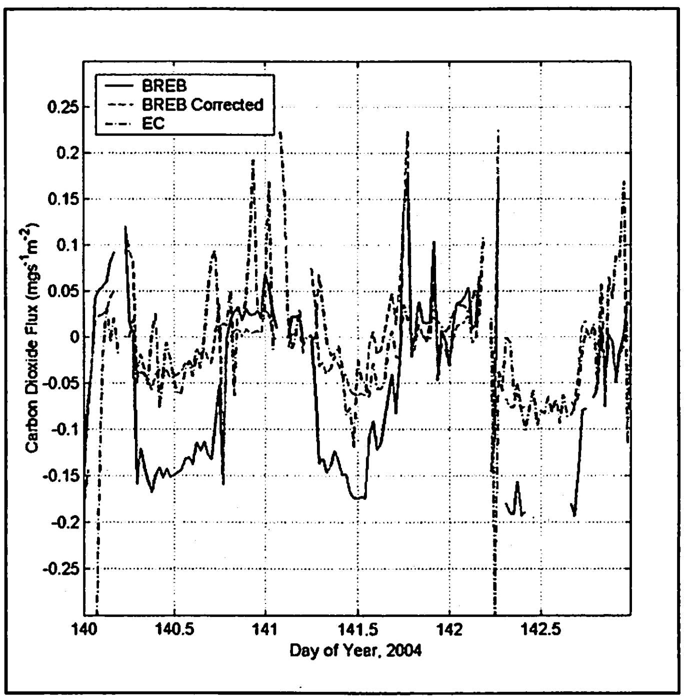

Figure 1: As evidenced by the typical three day period shown, the correction of F_c measured via the BREB method using the relationships developed in this research yielded a flux consistent with the measurements obtained with the EC method.

Overall, while many components of the surface energy budget were quite similar regardless of the measurement method employed, both λE and F_c required some correction to yield a consistent long-term data set. The resulting data set, however, could then be used with confidence as the foundation for further research into the linkages between the land surface and the atmosphere over grassland environments.

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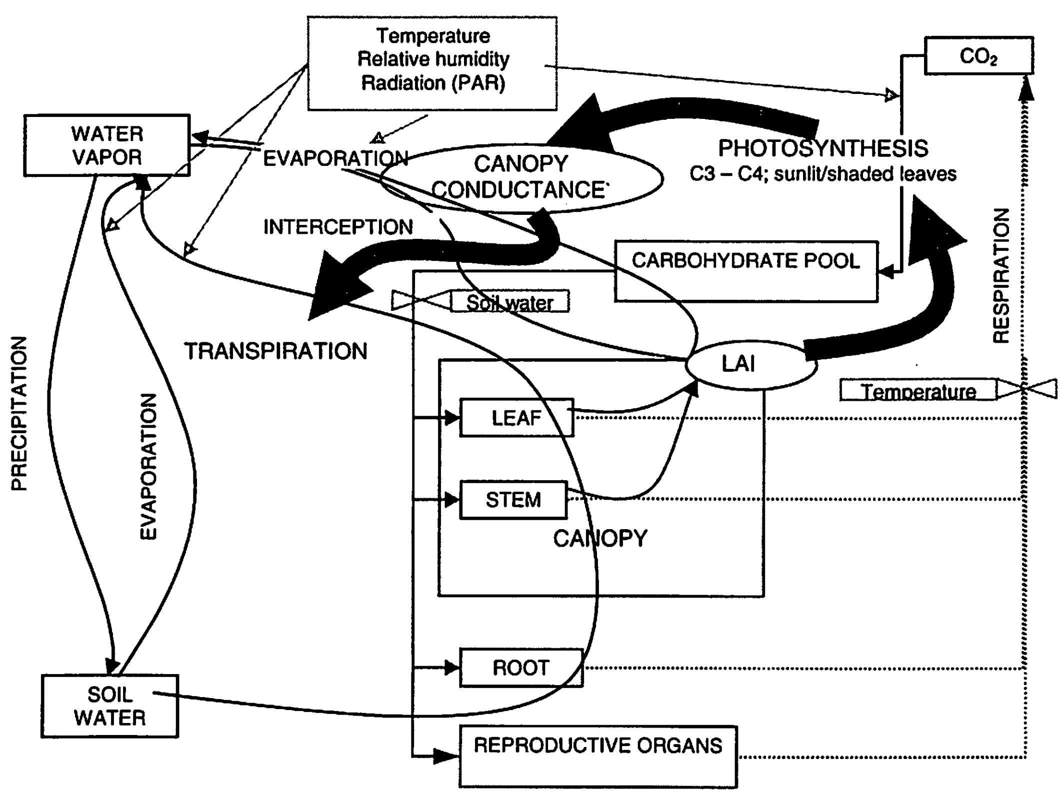
Beltrán-Przekurat[1], A, RA Pielke[1] Sr., JA Morgan[2], D Le Cain[2] and D Smith[2]
[1] Atmospheric Science, [2]USDA-ARS. Land-atmosphere interactions in semiarid areas: examples from Shortgrass Steppe and Jornada LTER sites.

Observations and modeling results have shown that land use practices have affected regional climate in the Shortgrass Steppe (SGS) region through their influence on energy partitioning and balance. A coupled atmospheric-vegetation model constitutes an appropriate tool to study the interactions and feedbacks between the vegetation, soil and the atmosphere. The Regional Atmospheric Modeling System coupled with a plant-scale model GEMRAMS is used to quantify the potential impact of these land use practices on mesoscale climatic patterns at the SGS LTER site. At the Jornada LTER, the conversion from the natural landscape of grasses to the current landscape of shrubs has been shown with the high resolution model version of GEMRAMS to result in significant changes in surface heat and moisture fluxes. The same modeling approach will be used in the SGS LTER site. Measurements of CO_2 and water fluxes will be used to validate the performance of the coupled modeling system GEMRAMS.



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S.W. Blecker, S.E. Melzer-Drinnen, C.M. Yonker, and E.F Kelly. (Soil and Crop Sciences, Colorado State University). The role of plants in regulating the biogeochemistry of silica in temperate grassland ecosystems of the mid-continent of North America.

There is a substantial body of evidence that suggests that plants may transform silica into more stable or labile forms, thus acting as potential sources or sinks of silica. Estimates of soil weathering rates need to include the influence of biogenic silica on primary silicate weathering, which in turn influence evaluations of paleoclimate. To further quantify biological cycling of silica, we present the initial results of state factor (bioclimo- and chronosequences), constituent mass balance, and geochemical analyses of soil and biogenic silica to quantify the role of plants in regulating the biogeochemistry of silica in temperate grassland ecosystems of the mid-continent of North America. Isotopic analyses of soils and biogenic minerals in tropical ecosystems have shown that $\delta^{30}Si$ values within the soil profiles exhibit a strong differentiation between a more biologically influenced surface layer, and the less biologically active deeper layer. Of the grassland ecosystems we studied, shortgrass steppe ecosystems have the greatest accumulations of biogenic silica in soil and the lowest silica storage in biomass, whereas the tallgrass systems have greatest biomass silica and lowest biogenic silica accumulation in soil. Our paper will integrate pedological and geochemical characterization to provide a synthetic treatment of the potential role of grassland ecosystems in the mobilization and storage of silica worldwide.

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Darden, S. K. & Dabelsteen, T. (Institute of Biology, University of Copenhagen) Mediation of Spatial Organization in the Swift Fox: Preliminary Observations

Animals communicate in a network of individuals (McGregor and Dabelsteen 1996). Acoustic, chemical, and visual signals can operate in this network to convey information about a signaller's identity, behaviour, physiological state and location. The communication of these types of information can function in maintaining social distances, attracting mates, and defending or announcing territories. Signal transmission properties determine signal value at different temporal and geographical distances from the signaller and a signal's transmission distance may influence social spacing and individual movement patterns, which themselves may influence signal modality.

Canid species are often nocturnal, have large home ranges and use auditory and olfactory cues in intra- and inter-social group communication. In grey wolves (Canis lupus), for example, where the social group (pack) is usually comprised of several related and unrelated individuals that collectively defend a territory from neighbouring packs, scent marking and howling function in maintaining inter-pack distances and in defending territory boundaries (Rothman and Mech 1979, Harrington and Mech 1983). These two signalling modalities also function in maintaining contact between group members as they move about the territory (Schassburger 1993). In the large canids, scent-marking and howling seem to be most intense during dispersal and mating when territorial intrusions are most prevalent and contact is important for the coordination of mating (e.g., Wells and Bekoff 1981, Asa and Valdespino 1998, Jaeger et al. 1996). In the small canids, these types of signals are thought to be important in understanding population dynamics and social interactions (e.g., White et al. 2000), but have only been briefly addressed (e.g., Macdonald 1979).

The swift fox (Vulpes velox) is a small, socially monogamous North American canid that has been found to occupy large home ranges that overlap up to 40% with those of neighbouring individuals and up to 100% with pair-mates (Pechacek et al. 2000). The overlapping home ranges create a dynamic spatial context in which long-range and static signals should have important functions in regulating intra-specific spatial separation and mated pair contact. Preliminary results from observations of 19 individuals (10 males and 9 females) monitored during the mating and pup-rearing seasons suggest that acoustic and chemical signals play an important role in information transfer, not only within pairs, but also between neighbours. We have found that long-ranging vocalizations are used frequently during the mating season and may convey individual identity as well as gender information. We have also found that the foxes may be using faecal latrines as information centrals for mates and neighbouring foxes. From information on the potential for both static and instantaneous interactions (degree of home range overlap and animal movement, respectively) we are now planning experiments further investigating aspects of swift fox olfactory and acoustic communication in a network context.

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Dye, J.L. and M.R. Banta (Dept. of Biological Sciences, Univ. Northern Colorado). Historical and current trapping records for heteromyid rodents in northern Colorado.

As part of a larger project examining aspects of torpor and winter metabolism in the silky pocket mouse (*Perognathus flavus*), we attempted to trap several individuals of *P. flavus* at various sites on the Central Plains Experimental range (CPER) during summer 2004. Historical trapping records for this area include this species as well as other heteromyid rodents (*Perognathus hispidus* and *Dipodomys ordii*). For the same project we also trapped a short-grass region 15 km east of Greeley, CO. This area is on State of Colorado Public Land that is leased to a local rancher and grazed periodically by cattle and horse.

On the LTER we accumulated a total of 1580 trap nights between June-August 2004 spanning seven different sections. This resulted in the capture of eight individuals: 3 Ord's kangaroo rats (*D. ordii*), 3 deer mice (*Peromyscus maniculatus*), 1 northern grasshopper mouse (*Onychomys leucogaster*) and one juvenile cottontail rabbit (*Sylvilagus* spp.). This represents an overall trapping success rate of 0.5%, with no captures of the target species.

On the east Greeley site we accumulated 1591 trap nights between September-November 2004 all within a single section (Sec6 T5N R63W). This resulted in the capture of 228 individuals: 91 Ord's kangaroo rats (*D. ordii*), 33 deer mice (*P. maniculatus*), 33 northern grasshopper mice (*O. leucogaster*), 19 plains pocket mice (*Perognathus flavescens*), and 53 silky pocket mice (*P. flavus*) which was the target species. This capture represents an overall trapping success rate of 14.3 %, with a 3.3 % capture of the target species.

The east Greeley site appears to have a greater abundance of vegetation for an increase of ground cover and food availability. The sandy soil at the east Greeley site may also prove to be more favorable for burrowing by many individuals. Lastly, with the strain imposed by several years of drought, individuals at the east Greeley site may have been affected less by the drought than individuals on the LTER.

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Flynn, RL, NE Kaplan (Soil and Crop Sciences). GIS Data and Tools Available at the SGS LTER.

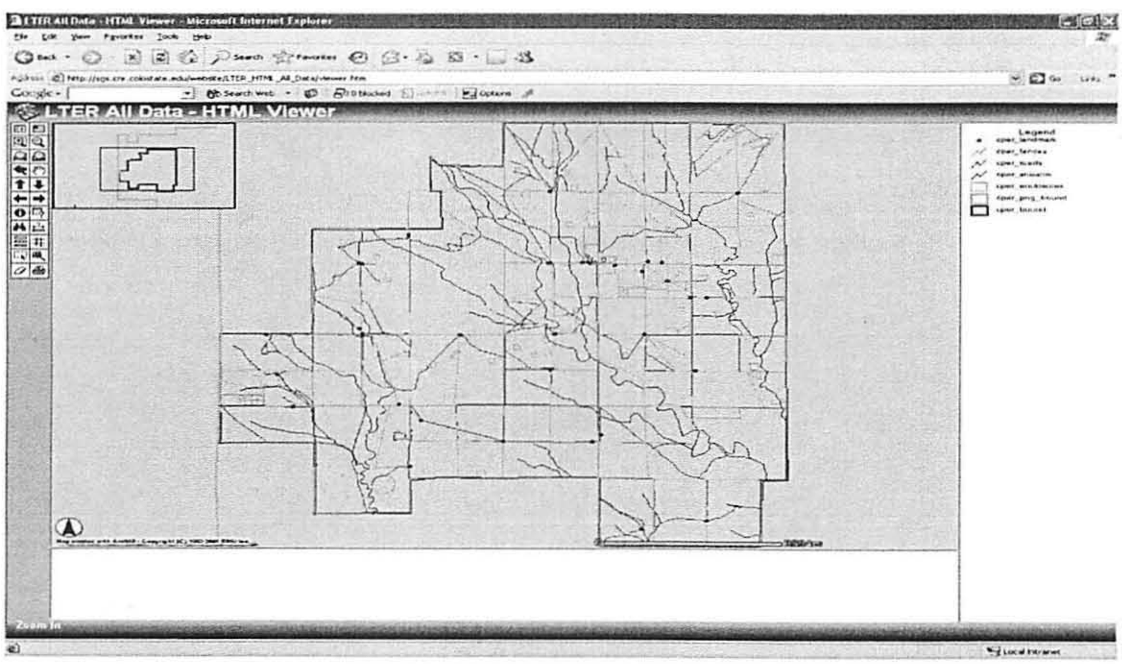
Tools for gather and viewing GIS data in the field. Handheld PC's now provide a means for gathering spatial data for LTER experiments. With these devices, field workers can navigate to and record research site information.

Tools on the SGS website for viewing and obtaining GIS data. The SGS Map Viewing Tool is available on the SGS Website for viewing, printing and capturing images of GIS data. The basic version only requires an internet browser, while the advanced version uses a freely downloadable tool for customized maps.

Tools for Analysis of SGS spatial data GIS data. Analysis and modeling of data using GIS software is being performed extensively at the SGS LTER. Examples include generation of random sample points, proximity analysis, interpolation of sample data, spatial change over time, spatial correlation of physical factors (soil, water, vegetation, etc), species population and interaction modeling, and climate modeling.

GIS data layers. Various GIS data layers are available to researches at the SGS LTER. These include static physical data (boundaries, elevation, water, pastures, roads, soils, etc.), dynamic data (prairie dog towns, burn areas, exclosures), experiment site data, and multispectral imagery.

Map Viewing Tool on SGS LTER Website



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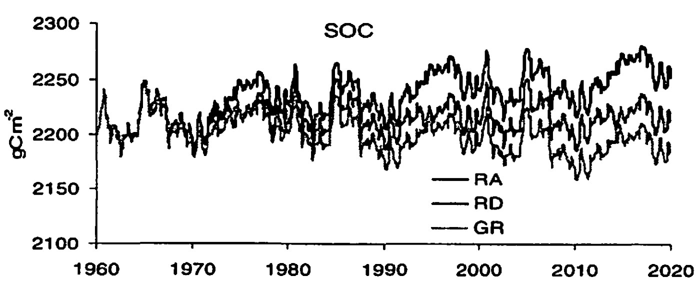
Grant, DW[1], SJ Del Grosso[1,2], WJ Parton[2], JD Reeder[1], JA Morgan[1] ([1]USDA, Agricultural Research Service, Ft. Collins, CO, [2]Natural Resources Ecology Laboratory (NREL), Colorado State University, Ft. Collins, CO). Drought and grazing interaction and recovery in shortgrass steppe: a DAYCENT modeling analysis.

Global climate change may result in a warmer drier climate with more frequent drought episodes in the Great Plains region of North America. Plant productivity decreases during drought conditions, reducing OM inputs from grasses and decreasing forage production. We used the DAYCENT biogeochemical model to examine the potential responses of SOM to increased drought frequency and the interaction between drought and rest from cattle grazing. Weather data from 1950 through 2002 at the CPER were categorized as drought or non-drought years based on three criteria: 1) early-season precipitation (April-June), 2) total annual precipitation, and 3) early-season actual evapotranspiration (AET). Using the early season AET or precipitation criteria, drought occurred in one out of six years (9 of 53 years) when drought was defined as one standard deviation below the mean climatic variable. We selected a subset of the weather data (1955 to 1974) to analyze how SOM dynamics would be affected if drought frequency increased to one out of four years and this weather cycle was repeated to drive 60 years of simulations. Grazing during drought years followed by a year of rest (RA) was compared to rest during the year of drought (RD) and continuous season-long grazing (GR) to look at the interaction between drought and rest from grazing. This analysis revealed that rest during the year of drought (RD) did not significantly enhance C sequestration potential of the soil over continuous grazing (GR), while rest the year after drought (RA) did slightly improve soil C sequestration or at least offset the increase of SOM losses associated with increased drought frequency. This response was largely attributable to the rareness of consecutive drought years and increased potential for C sequestration from rest in non-drought years resulting from increased plant inputs.



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Niall Hanan[1], Thomas Peterson[1], Jack Morgan[2], Jean Reeder[2], Indy Burke[3], and Keith Paustian[1] ([1]Natural Resource Ecology Laboratory, CSU, [2]Agricultural Research Service, USDA, [3]Department of Forest Sciences, CSU). Land-Use Impacts on Carbon and Water Flux on the Shortgrass Steppe in Eastern Colorado - Preliminary Results

The USDA Conservation Reserve Program (CRP) currently has active contracts on more than 2 million acres in the shortgrass steppe region of eastern Colorado alone. As contracts end, or if the CRP is discontinued, land owners will likely decide on future usage depending on the economic returns available in alternative management, e.g., grazing or dryland agriculture. The management changes will alter vegetation structure and phenology in ways that will impact short- and long-term carbon, water and energy exchange.

We have developed a manipulative experiment on a private ranch 60 km west of Fort Collins to measure the impacts of the land-use alternatives in CRP lands on short-term carbon, water and energy fluxes and long-term carbon and water storage. Three eddy covariance towers have been established in adjacent 40-hectare parcels of CRP land that had been in the program for approximately 17 years. After an initial comparison period to establish the similarity of the three parcels, one was opened to cattle grazing at moderate intensity, while the second was converted to the first stages of a minimum-till, wheat-hay millet rotation. The third parcel remained in CRP as a control. Fluxes of carbon, water and energy have been made in the three plots for more than a year, including baseline comparison and post-manipulation periods.

Preliminary results show divergence in daily net carbon flux (g C m^{-2}) and evapotranspiration (mm H_2O) between plots. Considerable divergence of fluxes in the crop treatment was evident. Following removal of CRP vegetation in April-May, the photosynthetic uptake was effectively zero and respiratory losses dominated the CO_2 flux. Transpiration was also reduced during the fallow period, representing a net saving of water important for the later germination and growth of the winter wheat crop. Following grass removal, the fallow crop site became a source of carbon dioxide release to the atmosphere. The graze site had greater cumulative uptake of carbon in the spring, perhaps related to reduced, moribund plant material and resulting increased photosynthetic uptake. Following further grazing and leaf-area index (LAI) reductions in mid-May, the graze treatment uptake was reduced to values similar to the control site. Water loss from the ungrazed and grazed sites appears similar, but a small amount of water was being conserved in the fallow crop site for the winter wheat seeding in September.

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Hardwicke, KB and Detling, JK. (Department of Biology). Species interactions across three trophic levels: *Cynomys ludovicianus* colonies increase floral visitation by insects.

Black-tailed prairie dogs (*Cynomys ludovicianus*) change vegetation structure and composition on the mixed grass prairie and shortgrass steppe, with active colonies showing higher herbaceous dicot coverage, reduced canopy height, and an increase in bare ground, allowing for higher germination of flowering annuals. Extensive (> 40 hectares) *Cynomys* colonies create large patches within the prairie matrix containing a higher density of floral resources, which pollinating insects should react to favorably and may perceive or utilize as a differing habitat type. In the first of three consecutive years of study, four large towns and paired off-town areas on the SGS-LTER in northeastern Colorado were sampled for floral resources. Vegetation sampling was followed by diurnal insect visitation measurement, which involved hand capture of observed floral foragers, and indication of the floral resources they utilized. In May – July of 2003, approximately twice as many inflorescences and open flowers were found on the towns as off. Concomitantly, over two times as many insect visitors were observed foraging on the towns during the paired sampling periods. Both of the dominant pollinator orders in this system, Hymenoptera and Lepidoptera, were observed foraging 2-3 times more frequently at on-town sites. The Hymenoptera, but not the Lepidoptera, showed differing relative abundances and community structure at the level of family on-town compared to off-town. These data suggest that *C. ludovicianus* may be an important driver of patch heterogeneity in the plantscape of this system, and affect floral resources that influence pollinator abundance and community structure on the shortgrass steppe.

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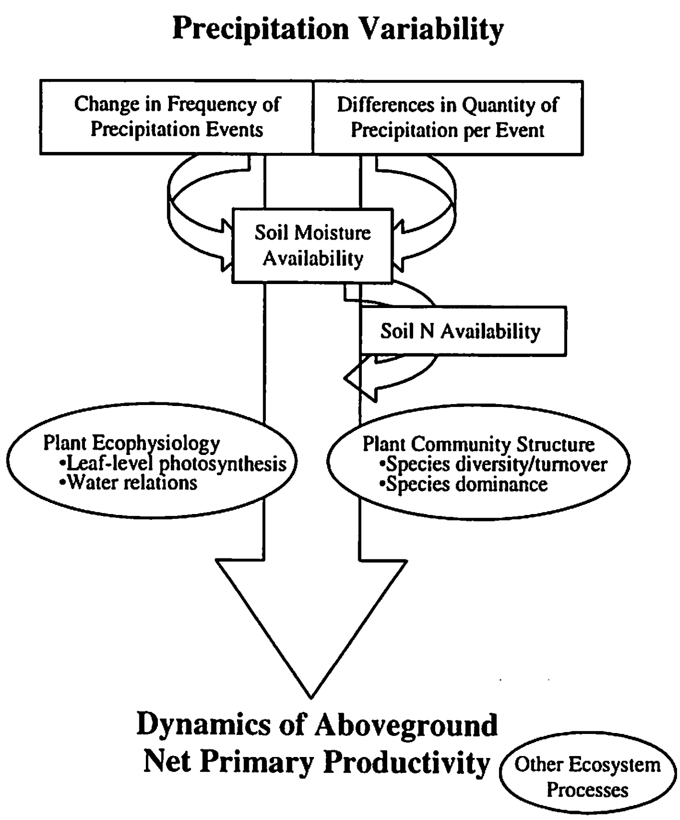
Heisler, JL, and AK Knapp. (Department of Biology). Ecosystem response to climate change: sensitivity of grassland ecosystems across the Great Plains to variability in precipitation.

Projected changes in climate include warming of the atmosphere and increasingly variable precipitation regimes, both of which may affect soil, plant, and ecosystem properties. Water availability is an important determinant of aboveground net primary productivity (ANPP) and increasing evidence suggests that many aspects of ecosystem structure and function are quite sensitive to intra-annual variability in precipitation. ANPP is an integrated assessment of ecosystem structure and function and thus a valuable means of identifying change in response to resource availability (water). However, responses in ANPP are subject to physiological, vegetation composition, and biogeochemical constraints that are altered on different time scales. For this reason, this investigation will additionally seek to identify alterations in plant physiology/phenology, community-level processes, and soil processes – as these system attributes may act independently or interactively to drive variations in ANPP.

The overall objective of this research is to develop a mechanistic understanding between variation in ANPP and variation in precipitation across sites that span a broad precipitation, soil nutrient and species composition (short to mixed to tallgrass) gradient. This research is a multi-site study that includes the Shortgrass Steppe LTER, the Konza Prairie LTER, and the KSU Agricultural Research Center in Hays, Kansas.



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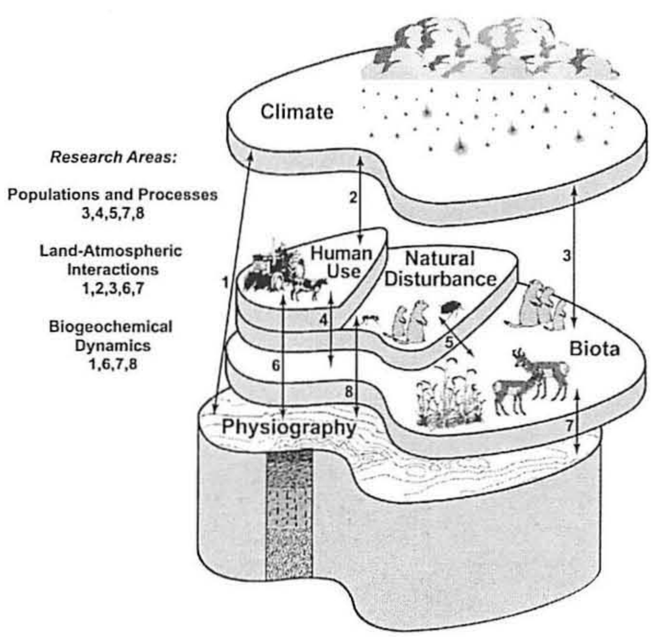
The shortgrass steppe (SGS) Long Term Ecological Research (LTER) site is part of a network of long-term research sites supported by the National Science Foundation. The network consists of 26 sites representing diverse ecosystems and research emphases, yet maintaining a common mission and sharing expertise and data.

The SGS site, located on the Pawnee National Grasslands, uniquely represents the shortgrass steppe ecosystem within the network. We assert that the ecological structure and function of the shortgrass steppe is governed by climate, human use, natural disturbance, biota and physiography. The representation of our conceptual framework, below, depicts the relationship between these factors and our core research areas: population dynamics, biogeochemical dynamics and land-atmosphere interactions. A summary of key research findings and current endeavors is presented for each core research area. Brief discussions of synthesis activities, cross-site projects and educational outreach activities are also presented.

Determinants of SGS Structure and Function:



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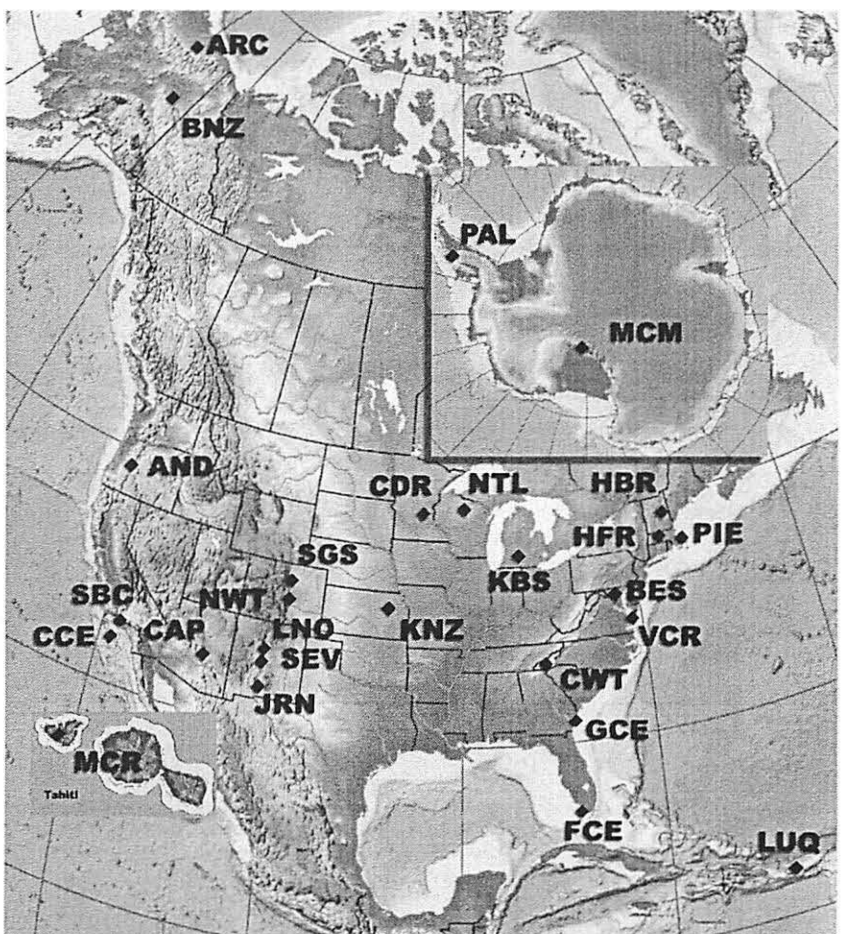
http://www.lternet.edu/ . LTER: Long Term Ecological Research Network.

With an initial six sites selected in 1980, the National Science Foundation established the Long Term Ecological Research Network to study broad spatial and temporal scale environmental phenomena. Currently, twenty-six sites (including shortgrass steppe, SGS) represent the Network – a collaborative effort of more than 1800 scientists, students, and educators. Each site has in common a research program developed around five core research areas:

- Pattern and control of primary production
- Spatial and temporal distribution of populations selected to represent trophic structures
- Pattern and control of organic matter accumulation and decomposition in surface layers and sediments
- Patterns of inorganic inputs and movements of nutrients through soils, groundwater and surface waters
- Patterns and frequency of disturbances



Source: LTER Network Office http://intranet.lternet.edu/archives/multimedia/

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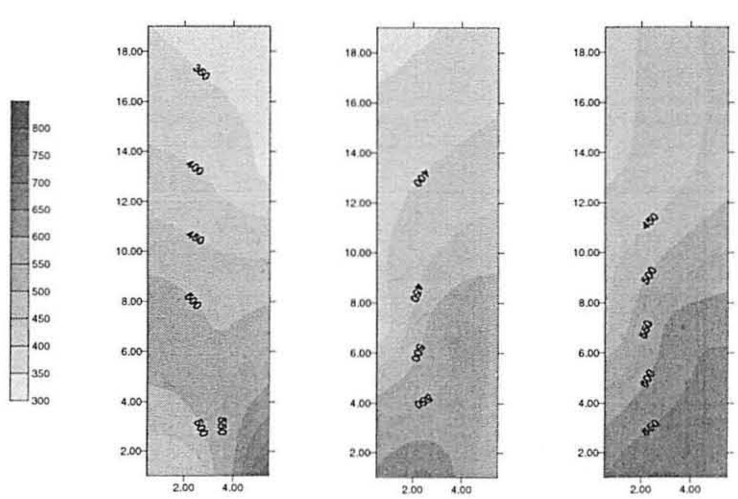
LeCain, DR, JA Morgan, and F Miglietta. (USDA-ARS). Gradient FACE: a new Free Air CO_2 Enrichment (FACE) system on native prairie.

Increasing atmospheric CO_2 and projected global climate change is one of the century's most significant environmental issues. Despite considerable research over the past two decades, many unanswered questions remain concerning how grassland ecosystems will respond to increasing CO_2. From 1996 to 2001, an Open Top Chamber (OTC), elevated CO_2 experiment was conducted at the Central Plains Experimental Range, Shortgrass Steppe site. Although we learned much about mechanisms underlying grassland responses to CO_2, our ability to extrapolate the results was limited by changes in microclimate due to the chambers.

Free Air CO_2 Enrichment (FACE) technology is a relatively non-intrusive CO_2 enrichment method, and is therefore easier to scale beyond the experimental boundaries compared to conventional chamber designs. In September, 2004 the ARS Rangelands Resource Unit, in collaboration with the Institute of Biometeorolgy, Firenze, Italy, began testing an innovative Free Air CO_2 Enrichment system, named "Gradient FACE". The system was installed on a northern mixed-grass prairie at the USDA-ARS High Plains Grasslands Research Station, near Cheyenne WY. Gradient FACE uses a 20m*8m network of piping, precision valves, and a computerized control unit to create a gradient of CO_2 concentrations, from a target enriched concentration (650 μmol mol^{-1}) to ambient levels. The control software uses wind speed, wind direction, and CO_2 concentration at the center of the plot, to control injection of pure CO_2 to 22 independently controlled zones.

Gradient FACE has several advantages over conventional "ring" FACE systems; most importantly, the improvement in statistical power of a gradient of treatment CO_2 concentrations vs. static CO_2 concentrations in a ring FACE system. The system also imposes a CO_2 gradient over a relatively large plot, with a minimal amount of structural components. Data collected in autumn of 2004 show that the system successfully creates a CO_2 gradient, over a wide range of wind speeds (0 to 20 m s^{-1}) and a 360° range of wind directions. The system will continue to be tested and "fine tuned" during winter 2004 and spring 2005, with the intention of installing three Gradient FACE systems in 2005, and beginning the CO_2 enrichment experiment in spring 2006.

Spatial Distribution of CO_2 over Gradient FACE plot (20m * 8m) during three days



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John Moore[1], Lori Reinsvold[1], Rob Wang[2]. ([1]University of Northern Colorado, [2]Center for Programs in Education, Antioch University, Seattle, WA 98121). Environmental Education and Outreach for Secondary Native American Educators and Students.

The Environmental Education and Outreach for Secondary Native American Educators and Students that took place during the Summer of 2004 was a joint effort between the University of Northern Colorado's Mathematics and Science Teaching (MAST) Institute and Rough Rock Community School (RRCS). RRCS is located in the within the Navajo Nation in Northeast Arizona. The school is operated under Public Law 638, the Indian Self-determination and Assistance Act. Even though this project was limited to RRCS, it is intended to serve as a model for the development of programs and partnerships with other tribal nations.

High school graduation rates for Native American students are among the lowest of any group in the United States. In addition, even though science is a required area of study few Native American students pursue a career in the sciences. As with other Native American schools, the current resources of RRCS to offer a quality science curriculum are extremely limited.

To impact student achievement and motivation to learn science, this project specifically focused on the design and delivery of a dynamic, culturally relevant, experiential field-based science experience for RRCS students. Nine high school students and three RRCS faculty members participated in this week-long program.

This program integrated field-based science, leadership and group development training, and technology (e.g., GPS, hand-held computers, etc.) into a week-long early college program for RRCS students. Teachers were introduced to strategies to integrate field-based science research into their classroom activities.

To determine the success of the week long program, the students were given a short qualitative survey to complete at the end of their week experience. Out of a rating system of 1 – Low, and 10 – high, students ranked the benefit of the week long activities with a 9.5. Specifically they thought highly of using technology to investigate the field based science topics and the group development training.

Another indicator of success that is used to determine the success of the experience is that students will be motivated to take additional science courses at the high school. Specifically Agriculture Science and Environmental Science courses will be offered and students will enroll in these Fall 2004 courses. Currently 3 of the 9 summer participating students are enrolled in Agriculture Science, and 5 of the 9 are enrolled in Environmental Science. The ninth student has moved to another high school. Students from the summer program are taking on leadership positions in both classes and applying knowledge gained in map and compass use and the use of GPS.

A lasting educational affect of this program is for participating teachers to integrate the summer program's activities, strategies and content into the classroom. Currently a 2 km plot has been organized by one of the participating teachers near their school where students of the Environmental Science course are studying erosion and soil deposition. In the Agriculture Science course, another participating teacher is introducing the students to plant growth cycles and the nutrient cycles.

The Summer 2004 Environmental Education and Outreach for Secondary Native American Educators and Students has positively impacted the student's interest to continue to learn more about the field of science. It has also given Rough Rock Community School educators tools to expand the field based science research activities of their course offerings. The successful program will now serve as a model for LTER Environmental Education Summer 2005 program at the Short Grass Steppe. This program will expand and involve the Navajo, Northern Cheyenne, and Lakota Native American educators and secondary students.

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Munson, S.M. and W.K. Lauenroth. (Forest, Rangeland, and Watershed Stewardship). Long-term response of shortgrass steppe vegetation to removal of *Bouteloua gracilis.*

The aim of this project is to assess the long-term response of vegetation to the removal of the dominant shortgrass steppe species, *Bouteloua gracilis.* Since complete removal of *Bouteloua gracilis* from 1 m^2 plots in 1997, plant density and cover by species have been monitored annually. Treatment and control plots are located inside and outside grazing exclosure sites to address grazing impact. Removal of *Bouteloua gracilis* affected vegetation dynamics, with slightly higher species richness in treatment plots. Perennial forb and subshrub density peaked 2-4 years after removal and then declined. Density of annuals was initially higher in treatment plots, but over time showed no difference from control plots. Some subdominant grasses initially increased in relative abundance in treatment plots, while *Bouteloua gracilis* averaged a 1.4% increase in basal cover per year following removal.

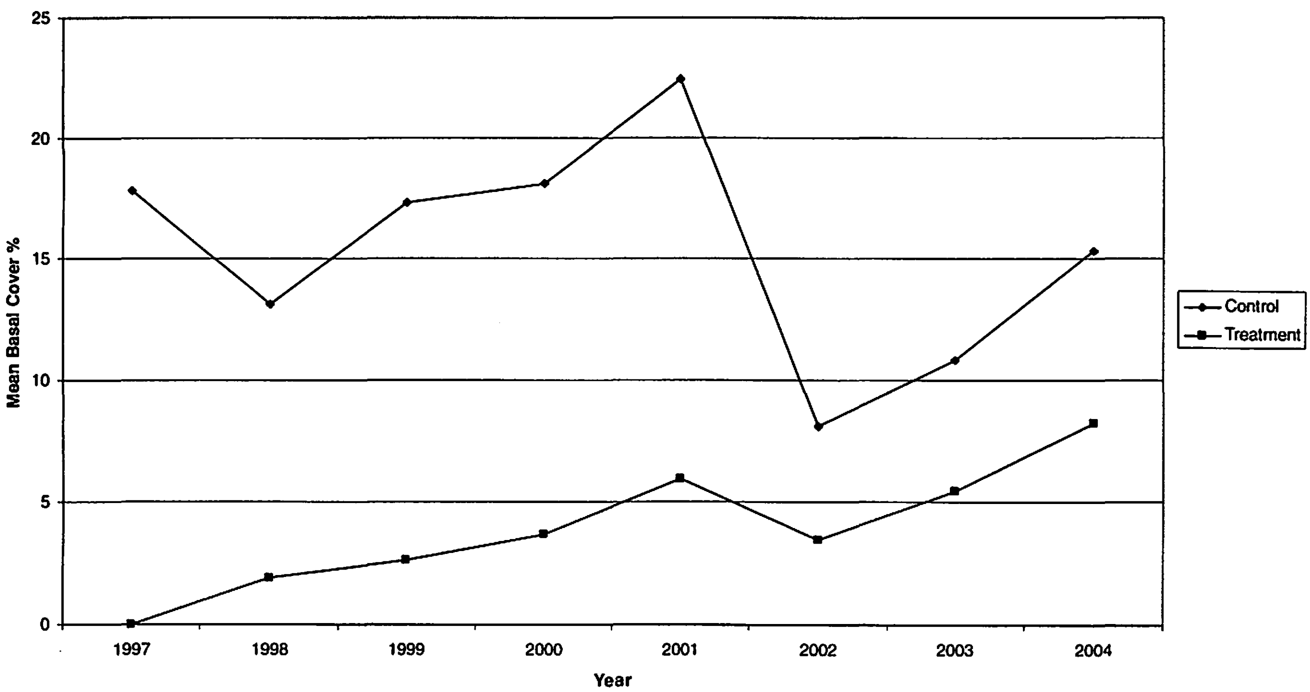

Figure 1. *Bouteloua gracilis* mean basal cover in control and treatment plots in six pastures between 1997 and 2004.

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[2]Natural Resource Ecology Lab Colorado State University, Fort Collins, [3]Rocky Mountain High School, Fort Collins). Colorado Front Range GK-12 Connecting kids and ecology—teachers and researchers

The mission of the Colorado GK-12 grant project is to bring university- based research into the classroom. Within this mission fellows and teachers work closely together to introduce students to scientific concepts that would not typically be introduced into K-12 classrooms. The theme revolves around "Human impacts on ecosystems along the Front Range."

Fellows help teachers to plan/design research projects that allow students to collect data in a real field setting. Students learn the importance of research protocols and planning, experience the realities of data collection, and analyze data to complete the experience.

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Rondeau, R. (Colorado State University). Longevity of Cow Fecal Pats.

In 1998 I established a post-grazing vegetation monitoring study at Pueblo Chemical Depot on the eastern plains of Colorado where the mean annual precipitation is 12 inches. I randomly chose 20 permanent vegetation plots that had been grazed up until the spring of 1998, when all cattle were removed. Within each plot, I randomly selected 8 permanent microplot photo points. From 1998-2003 I conducted repeat photography and recorded any changes from the preceding year. Out of 160 microplots, 15 cow fecal pats in 13 microplots were recorded in 1998. Each photographed cow fecal pat was given a relative score based on size: large, medium, small, and crumbs. Changes were tracked over six years (1998-2003). Of the 15 cow fecal pats noted in 1998, 40% were still present in 2003 (at least 6 years old). All large cow fecal pats in 1998 were still easily recognized in 2003, whereas only 25% of the small-class cow fecal pats were discernable. These small-scale disturbances destroyed the underlying vegetation until the cow fecal pat disintegrated. This information demonstrates a slow decomposition rate for already decomposed vegetation matter in this arid environment.

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Sherry, J; Riedel, L.; D'Amico, D.; Armstrong, A.; Pelster, A. Bowes, M.; Gershman, M.; Swanson, H. (City of Boulder, Open Space and Mountain Parks Department). *Mapping Grassland Vegetation in the Urban/Widland Interface:* Ecological Information for Integrating Management Goals

Background

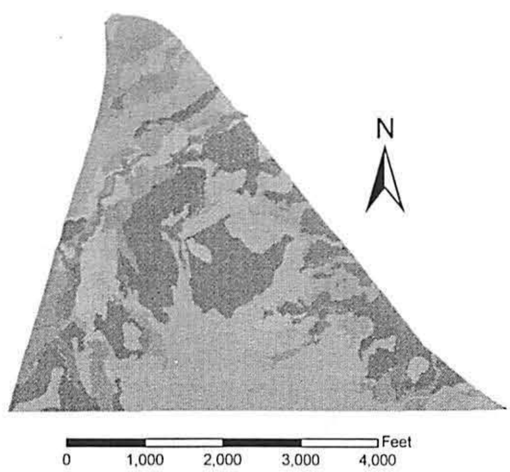
The City of Boulder Open Space and Mountain Parks Department (OSMP) manages over 17,500 ha (42,000 acres) of lands in a rapidly developing urban corridor at the juncture of the Great Plains and Southern Rocky Mountains. About half of the OSMP properties are grasslands. OSMP lands were set aside as buffers against development and to provide Boulder with the services of ecological conservation, agriculture preservation, and outdoor recreation. To provide these services sustainably and into the future, Open Space and Mountain Parks is in the process of completing a comprehensive vegetation map which will be used to aid planners and managers in understanding key attributes of ecological systems.

Product and Methods

This project will provide a map of vegetation at the *Alliance* level consistent with the United States National Vegetation Classification System (USNVC) (Grossman et al. 1998). For several years, beginning in the mid 1990's OSMP had been using a combination of GIS, aerial photography interpretation and field work to develop a vegetation map, but lacked a consistent methodology to organize and interpret this information. In 2002, the existing elements of the project were converted to the USNVC system. Over the past two years, additional field work, using USNVC-based methods has filled priority gaps. Additional data analysis and interpretation will allow for the production of the first map product in the spring of 2005. Quality assurance and control will begin during the 2005 growing season. We modified the data collection methods and adapted the classification system to address local ecological conditions as well as information and management needs.

Management Implications

OSMP grasslands are the focus of diverse use in an intensely developed landscape. The project will provide information important for integrating the management of grasslands across diverse interests—specifically: range management, recreation, and ecological conservation. The availability of vegetation data will permit us to better understand the dynamic relationships among grassland vegetation types (see figure) and identify rare elements of the landscape. This information will be used for a variety of planning projects, including the construction of ecological models and the development of conservation goals. Vegetation mapping will also be used with other GIS databases to improve our understanding of the legacies of past land use (e.g. grazing and sand/gravel mining) as well as the affects of current uses of and around OSMP (e.g. urbanization and recreation). Understanding our conservation goals, as well as the nature of current threats and historical impacts will help us develop restoration and conservation strategies. Agriculture and recreation managers will have a stronger basis to design livestock grazing practices or visitor facilities that are compatible with grassland conservation.



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Shortgrass Steppe Ecosystem Productivity

Ecosystem productivity was estimated in 1998-2001 at an essentially ungrazed shortgrass steppe site located on the Central Plains Experimental Range near Nunn, CO. Net Ecosystem Carbon Exchange (NEE) was estimated using Campbell Scientific's Bowen Ratio Systems (BREB). Monthly phytomass harvests were used to estimate Aboveground Net Primary Productivity (ANPP) at BREB sites. ANPP estimates reflect maximal green biomass summed by functional type across sampling period. An estimate of total net primary production (NPP) was calculated by multiplying ANPP by 3.12 to account for belowground primary production. Results indicate that in years with above average precipitation (1998 and 1999) more carbon was assimilated than in dry years (2000 and 2001) (long term average=321mm). However, in comparing NEE to NPP, our BREB method of measuring NEE appears to be overestimating carbon assimilation. Over the long term, NEE should equal NPP minus heterotrophic respiration. See Alfieri et al. (see poster, this session) for work underway to correct our BREB flux measurements.

Ecosystem productivity (Carbon uptake) at the CPER Bowen Ratio site.

Year	Precipitation Annual/season	NEE* ($g C m^{-2}$)	ANPP! ($g C m^{-2}$)	NPP+ ($g C m^{-2}$)
1998	387/319	145	44.2	138
1999	499/466	226	49.5	154
2000	210/181	5	20.7	65
2001	261/239	102	43.7	136

*NEE = Net Ecosystem C Exchange from BREB flux measurements
!ANPP = Aboveground Net Primary Productivity; green plant biomass * 0.40 (C conversion)
+NPP = Net Primary Productivity; green plant biomass * 0.40 (C conversion) * 3.12 (Milchunas and Lauenroth. 1992)

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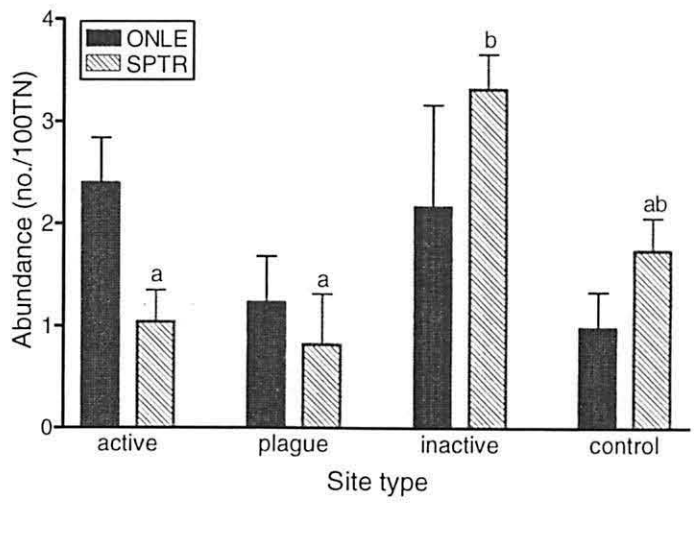
Stapp, P, AL Benson, JA Holm and CD Cannon. Department of Biological Science, California State University, Fullerton, CA 92834-6850. Patterns of small mammal abundance in prairie dog colonies in shortgrass steppe: effects of plague.

The grazing and burrowing activities of black-tailed prairie dogs (*Cynomys ludovicianus*) significantly alter the shortgrass-steppe landscape, creating and modifying grassland habitats for other small mammals. Prairie dogs are also extremely susceptible to plague, a bacterial disease spread by fleas that may infect other rodents living in prairie dog colonies. Rodents such as northern grasshopper mice (*Onychomys leucogaster*) and deer mice (*Peromyscus maniculatus*) may be resistant to plague, and act as key reservoirs and/or dispersal agents for the disease or infected fleas. To determine the effects of prairie dogs and plague on other small mammals, in 2004 we sampled small mammal populations at 35 sites on the Pawnee National Grasslands, Colorado, including 18 active colonies, four colonies that were hit by plague in 2004, six colonies that had been unoccupied for >8 years (inactive), and seven grassland sites lacking prairie dogs (controls). Rodents were live-trapped on 1.35-ha (60 Sherman traps) or 2.25-ha (100 traps) plots for four consecutive nights to estimate population densities and collect blood and fleas to survey for plague. Traps were left open during mornings to capture diurnal ground squirrels (*Spermophilus tridecemlineatus*). Each site was trapped at least once from May to August; several sites, including plague sites, were sampled a three times between May and September. We also measured vegetation characteristics and burrow densities at all sites to determine if the effects of prairie dogs on vegetation and other habitat features influenced local small mammal communities. Grasshopper mice and ground squirrels were captured on 91% of the sites and comprised 39% and 31% of individuals captured, respectively. Species richness ranged from 1-6 species, but most sites only had these two species. Deer mice were captured on 49% of the sites and comprised 17% of individuals captured. Ground squirrels were least abundant on active and plague colonies, and most abundant on inactive colonies and controls ($P = 0.002$; Fig. 1). There were no significant differences between sites in the abundance of any other species; however, the abundance of grasshopper mice was significantly related to density of burrows ($r^2 = 0.30$). Multivariate analyses revealed no significant differences among site types in either rodent or plant communities, although control sites had significantly taller vegetation than active colonies, and inactive colonies had more small burrows than active colonies (ANOVA, $P<0.04$). These results are from the first year of field sampling of an intensive study of the ecology of plague in prairie dog colonies.

Fig. 1. Mean abundance (+1 SE) of northern grasshopper mice (ONLE) and thirteen-lined ground squirrels (SPTR) in active, inactive and recently-plagued prairie dog colonies and control sites in Colorado shortgrass steppe in 2004. Bars sharing letters are not significantly different from each other.



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Wolchansky, J[1], Blanken, PD[1], Morgan, JA[2], Smith, D[2], Alfieri, J[1], and R Grossman[1] ([1]University of Colorado at Boulder, [2] USDA ARS Rangeland Resource Research). Effect of Grazing on Soil Temperature and Moisture on the Shortgrass Steppe.

Cattle grazing, a common form of land use on grasslands, may affect transpiration from vegetation and evaporation from soil by defoliation and, in turn, could alter the regional climate. This study focused on whether physical landscape changes associated with grazing could have a significant impact on soil temperature and moisture, and thereby affect the microclimate.

Objectives of this study were to analyze how soil temperature and moisture vary with simulated grazing treatments. Meteorological data were collected at the LTER-USDA shortgrass steppe site in northeastern Colorado. Eight (1 x 1 meter) plots were selected to represent variations in the fraction of bare ground, while two (1 x 1 meter) plots were used to measure the impact of the arrangement of bare ground. Soil temperature and soil moisture measurements were measured every 10 minutes under a vegetated and bare area in each plot from July 2 to November 8, 2004. Additionally, the eddy covariance method was used to measure water and CO_2 fluxes from the recommended practice of moderate grazing (40% reduction in above-ground biomass).

Results from the study were used to discuss implications for the effect of different grazing densities on the water and carbon budgets of moderate grazing management.

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Yackel Adams AA[1], SK Skagen[2], and JA Savidge[1] ([1]Department of Fishery and Wildlife Biology and Graduate Degree Program in Ecology, Colorado State University, Fort Collins, CO 80523, [2]United States Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Fort Collins, CO 80526). Modeling Post-Fledgling Survival of a Grassland Bird in Response to Drought.

Rigorous approaches to survival analysis can help elucidate potential mechanisms of population declines in avian species. We applied an information-theoretic approach to evaluate factors affecting post-fledging survival of a shortgrass prairie bird, the lark bunting (*Calamospiza melanocorys*) in northeast Colorado, 2001-2003. We estimated daily and 22-day post-fledging survival (n = 206, 82 broods) using radio-telemetry and color bands to track fledglings. For 2001-2002 data, we employed the joint model in program MARK to examine the effects of drought condition, time in season, age, nestling condition (rank, condition index, or brood size), mark type (radio-marked versus band-only), and sex of attending parent on post-fledging survival. Daily survival rates were higher under normal precipitation (2001: 0.933 ± 0.010) and mild drought conditions (2003: 0.933 ± 0.013) than during a severe drought (2002: 0.908 ± 0.011). For 2001-2002 data, post-fledging daily survival probabilities were best explained by models that incorporated effects of drought condition, time in season (quadratic trend), ages ≤ 3, and rank × drought interaction. Daily survival probabilities were lower under severe drought conditions than in a normal year; the model-averaged coefficient for the effect of drought on survival of fledglings was -3.99 (95% CI = -7.94, -0.05). Models also revealed greater survival in mid-season; the model averaged coefficient for quadratic seasonal trend was -0.002 (95% CI = -0.003, -0.001). Survival was lower for recently-fledged young (ages ≤ 3) than older fledglings. Rank was an important predictor of fledgling survival only during the severe drought of 2002. Both mark type and sex of attending parent had no effect on survival.

Survival estimates that account for age, condition of young, ecological conditions and other factors are important for parameterization of realistic population models. Age-specific estimates can help identify critical time periods within the species' life-cycle and guide conservation efforts. Species-specific estimates of post-fledging survival are more realistic than generalized estimates used in population growth models.

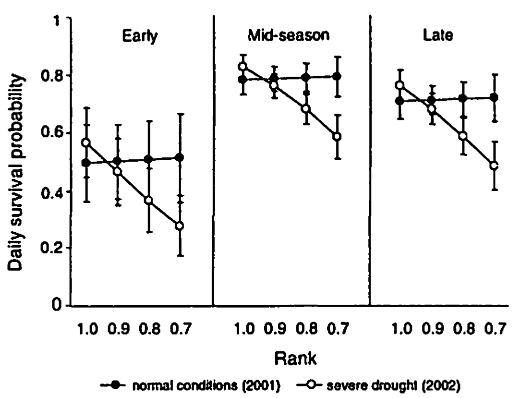

Figure 1. Daily survival probabilities of newly-fledged lark buntings on the Pawnee National Grassland, Colorado, vary as a function of time in season and rank × drought interaction, illustrated for post-fledging age 0. Rank was calculated by dividing each sibling's mass by the mass of the heaviest nestling. All estimates are model averaged ± SE. Early season begins 12 June, mid-season 4 July, and late season 26 July.

Additional Information About Shortgrass Steppe Long-term Ecological Research

The Shortgrass Steppe (SGS) Long-term Ecological Research (LTER) site is one of 26 sites in the national network of LTER (http://www.lternet.edu/) sites supported by the National Science Foundation (http://www.nsf.gov/). We have the privilege of having close working ties with the Agricultural Research Service, Great Plains Rangeland Resources Research Unit (http://rrru.ars.usda.gov/), the United States Forest Service, Pawnee National Grassland Ranger District (http://www.fs.fed.us/r2/arnf/districts/png), and the Colorado Agricultural Experiment Station (http://www.colostate.edu/Depts/AES/). These formalized relationships allow for easy transfer of ideas, data, technology, and expertise.

Our research site has a rich history of work performed by researchers associated with USFS, ARS, Colorado State University and other scientists on the Central Plains Experimental Range (CPER), Pawnee National Grassland, and Great Plains region. SGS-LTER maintains a database of publications, data sets, and metadata from a variety of studies dating back to 1939. Over one hundred short-term and long-term experiments have been or are being performed. Data sets collected in the 1940s helped CPER researchers gain an understanding of what drives production in the SGS ecosystem. Additional data sets were collected since the 1960s during the International Biome Project to gain a more complete understanding of the ecosystem. The LTER now manages many legacy data sets, and data sets generated by cross-site efforts between multiple LTER as well as other sites. Research projects such as net primary production or meteorological monitoring are conducted at all LTER sites simultaneously and produce data and metadata that are synthesized and published for the entire LTER Network and greater scientific community.

Please visit our web site at: http://sgs.cnr.colostate.edu/

• To search for experiments conducted on the CPER, go to:
http://sgs.cnr.colostate.edu/ars/default.asp

• To query and access citations for publications, go to:
http://sgs.cnr.colostate.edu/Publications/searchpblctns.htm

• To search for data sets and metadata for studies focusing on floral and faunal dynamics, biogeochemical processes, and land-atmosphere interactions, enter the data library through: http://sgs.cnr.colostate.edu/Data/AcquisitionPlcy.htm

• To view and download images from our GIS library, go to:
http://sgs.cnr.colostate.edu/website/

• To access Network-wide, USGS, and USFS meteorological data or query SGS-LTER meteorological data, go to: http://www.fsl.orst.edu/climhy/

• To search for other Network-wide data or locate information or data from other lter sites, go to: http://lternet.edu/data/

• For more information about the Climate of Colorado, go to:
http://ccc.atmos.colostate.edu/

Or please contact the SGS-LTER Information Manager with your request(s) at Nicole.Kaplan@colostate.edu, (970)-491-1147.

Home on the Range – The Experimental Range

Oh, give me a home where the bovine do roam,
Where the pronghorn and prairie dogs play
Where the air is so pure, save the scent of manure
With treasures not found on eBay.

(Chorus)
Home, home on the range (the experimental range)
Where hard working friends also play
Publications are found and good people abound
And cattle gain weight everyday.

Oh give me a creek, like the waters so meek
In the Owl, the Cow, the Horsetail
'Cause the rain is so fickle, they're 'oft just a trickle
The floodplain so sandy and pale.

Oh, I love the hills, rock outcrops and fills,
Their colors so subtle and brown.
And I love the buttes, the soil 'neath my boots
A beauty of local renown.

Oh, give me a steppe we can study in depth
Where we count and clip grass all the day
Where habitat is key, for you and for me
But all stays below ground 'til May.

Oh! A research site, where the sun's always bright
That tans your skin oh so well
And when the sun goes down, we count rabbits all around
Then retire to the Pawnee Motel.

At home in the lab, it's not really so bad
As the samples we carefully weigh
Where the students do toil over the prairie soil
And the seeds we do count many days.

Oh, the plants we do grind, into powder so fine
Into vials we place them with care
Then we analyze them on the old C-H-N
And burn them off into thin air!

If you're out in your truck, and you find yourself stuck
'Cause you've gone where others don't go
Call site manager Mark, before it gets dark
He'll rescue in hail, wind or snow.

This landscape I assess, with my personal GPS
My research this data doth foster
I get perfect stats, and fine-looking maps
All for my PowerPoint poster.

(Written for 2005 SGS Symposium by Caroline Yonker, Nicole Kaplan, Mark Lindquist, Judy Hendryx, Jeri Morgan, Sallie Sprague, and Bob Flynn)