Yonker

CENTRAL PLAINS EXPERIMENTAL RANGE

FIRST ANNUAL SYMPOSIUM

January 11, 1994

Holiday Inn

Fort Collins, Colorado

Sponsored by:

USDA - Agricultural Research Service and
Colorado State University Long Term Ecological Research Project

Agenda: CPER Symposium

January 11, 1994

8:00 Arrival and Poster Mounting

8:30 Welcome and Introduction, Dr. Jim Welsh

8:45 Keynote Presentation. Dr. Bud Rumberg, Executive Vice Pres. Society for Range Management Rangeland Research: "Partnerships for the Future"

9:15 Introductions: One half of participants

10:15 Poster Session

12:00 Lunch and Photo Contest

1:00 Introductions: Second half of participants

2:00 Poster Session

3:30 Keynote Address: Dr. Rod Heitschmidt, Research Leader for USDA-ARS Livestock and Range Research Program, Fort Keogh, Miles City Montana. "Priority research in semiarid grasslands - an assessment of CPER research"

4:15 Social Hour

CPER SYMPOSIUM PARTICIPANTS

Martin R. Aguiar	CSU - Dept. of Rangeland Ecosystem Science
Laj Ahuja	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Mary Ashby	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Menwyelet Atsedu	CSU - Biology Department
Tammy Bearly	CSU - Dept. of Forest Sciences and Natural Resource Ecology Laboratory
Terry Boothe	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Indy Burke	CSU - Dept. of Forest Sciences and Natural Resource Ecology Laboratory
Dexing Chen	CSU - National Resource Ecology Lab
Debra Coffin	CSU - Dept. of Rangeland Ecosystem Science and Natural Resource Ecology Lab
Martha Coleman	CSU - Dept. of Forest Sciences
Mike Coughenour	CSU - Natural Resource Ecology Lab
Thomas Crist	CSU - Biology Department
Jim Detling	CSU - Biology Dept. and Natural Resource Ecology Lab
Mike Dodd	CSU - Dept. of Range Science
Diana Dry	Willamette University
Howie Epstein	CSU - Dept. of Rangeland Ecosystem Science
Julie Fair-Hill	CSU - Dept. of Rangeland Ecosystem Science
Gary Frasier	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Sun Guowei	CSU - Dept. of Rangeland Ecosystem Science
Jon Hanson	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Dick Hart	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Jack Hautaluoma	CSU - Psychology Department
Paul Hook	CSU - Department of Forest Sciences
Bill Hunt	CSU - Dept. of Rangeland Ecosystem Science and Natural Resource Ecology Lab
Carol Jacobs-Carrē	CSU - Department of Rangeland Ecology Science
Robin Hedra-Kelly	CSU - Department of Forest Sciences
Gene Kelly	CSU - Agronomy Department
Roger Kerbs	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Tom Kirchner	CSU - Natural Resource Ecology Lab
Diana Lane	CSU - Department of Rangeland Ecosystem
Bill Lauenroth	CSU - Dept. of Rangeland Ecosystem Science and Natural Resource Ecology Lab
Bill Laycock	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Dan LeCain	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Andy Lenssen	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Mark Lindquist	CSU - Natural Resource Ecology Lab

Gustavo A. Martinez	CSU - Dept. of Rangeland Ecosystem Science
Lowell C. McEwan	CSU - Fish and Wildlife Biology
Nancy McIntyre	CSU - Biology Department
Daniel Milchunas	CSU - Dept. of Rangeland Ecosystem Science and Natural Resource Ecology Lab
Tamera Minnick	CSU - Department. of Rangeland Ecosystem Science
John Moore	University of Northern Colorado - Natural Resource Ecology Lab
Jack Morgan	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Dennis Mueller	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Daniel Palic	USDA-ARS-NPA-NRRC - Rangelands Resources Research Unit
Bill Parton	CSU - Natural Resource Ecology Lab
Jose Paruelo	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
John Read	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
Jean Reeder	CSU - Department of Rangeland Ecosystem Science
Marcos Robles	CSU - Department of Forest Sciences
Ron Ryder	CSU - Fish and Wildlife Biology
Jerry Schuman	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
Jai Singh	CSU - Rangeland Ecosystem Science
Susan Smith	CSU - Dept. of Rangeland Ecosystem Science and Natural Resource Ecology Lab
Paul Stapp	CSU - Biology Department
Ernie Taylor	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
Jeff Thomas	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
Stella Todd	CSU - Department of Forest Sciences
Hongliang Tong	CSU - Department of Range Science
Charlie Townsend	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
David Valentine	CSU - Natural Resource Ecology Lab
Mary Ann Vinton	CSU - Department of Forest Sciences
Jeff Welker	CSU - Natural Resource Ecology Lab
Jim Welsh	USDA-ARS-NPA-NRRS - Rangelands Resources Research Unit
Caroline Yonker	CSU - Agronomy Department

1. Aguiar, Martín R.
2. Colorado State University
3. Dept. Rangeland Ecosystem Science, Fort Collins, CO 80523.
4. (303) 491-7274

Aguiar, Martín R., William K. Lauenroth and Debra P. Coffin, Dept. Rangeland Ecosystem Science, Colorado State University. Fort Collins, CO 80521, USA. INTENSITY AND IMPORTANCE OF INTER- AND INTRASPECIFIC COMPETITION BETWEEN C4 PERENNIAL GRASSES.

We conducted a field experiment to compare inter- and intraspecific competition between two codominant grasses Bouteloua gracilis and Buchloë dactyloides. Plants of similar size of both species were grown surrounded by either six conspecific plants or six plants of the other species. In half of the plants metal tubes were used to restrict belowground competition; isolated plants were used to investigate conditions of no competition. Biomass accumulation and reproductive output were reduced under conditions of inter- and intraspecific competition (compared to growing in tubes) for both species. But intensity and importance of inter- and intraspecific competition were different for both species. Our results suggest that competitive interactions explain the relative dominance of these two warm season short grasses.

1. Christine M. Althouse
2. Department of Fishery and Wildlife Biology
3. Colorado State University
   Ft. Collins, CO 80523
4. (303) 491-1819

McEwen, Lowell C., and Althouse, Christine M., SMALL MAMMAL POPULATIONS IN SALTBUSH/GRASSLAND HABITAT AT THE CPER. Dept. of Fishery and Wildlife Biology, Colorado State University, Fort Collins, CO 80523

Three sites have been live-trapped for small mammal population studies at the Central Plains Experimental Range (CPER) annually beginning in 1987. These study sites were originally established as part of an experiment to examine effects of an insecticide spray application on the small mammal community. The original investigation included 8 treated and 3 untreated sites. The objective of the current study is to follow the long-term variation in small mammal species composition and population density at the CPER. Three permanently marked live-trap grids, each 16x16 (256 traps), spaced 15m between traps, (5.1 ha area/grid), are operated in August each year. Traps are set 4 consecutive days per trapping session. Captured animals are aged, sexed, weighed, and individually marked (small ear tags) for recapture study. Population estimates are derived from Program CAPTURE (White et al. 1982). Three species have consistently comprised 71-99% (mean = 86%) of the total small mammal numbers: deer mouse (Peromyscus maniculatus), 13-lined ground squirrel (Spermophilus tridecemlineatus), and the grasshopper mouse (Onychomys leucogaster). Five other species are present but in lower numbers: kangaroo rats, 2 species of harvest mice, hispid pocket mice, and prairie voles. Several larger species such as desert cottontails, jackrabbits, and long-tailed weasels utilize the sites but are not captured in the traps. The most significant result to date was a sharp decline in 13-lined ground squirrels in 1991-1993 after 4 years of high densities. There was a concurrent increase in deer mice beginning in 1991 possibly as a response to reduced competition with the ground squirrels. Grasshopper mouse densities have remained relatively stable over the 7 year period. All data will be examined in relation to precipitation patterns, vegetation biomass and seed production, and other factors such as small mammal species interactions/competition.

1. Mary M. Ashby
2. Agricultural Research Service
3. USDA ARS CPER, 58009 WCR 37, Nunn, CO 80648
4. (303) 897-2226
5. Member
6. Mary M. Ashby
7. Poster
8. N/A
9. 33

PLANT COMMUNITY RESPONSES TO FIFTY YEARS OF GRAZING ON SHORTGRASS PRAIRIE.
Mary M. Ashby, USDA-ARS Central Plains Experimental Range, Nunn, CO 80648 and Richard H. Hart, USDA-ARS High Plains Grasslands Research Station, Cheyenne, WY 82009 and James R. Forwood USDA-ARS (deceased).

Periodic vegetation measurements have been collected from pastures that have been grazed with heavy, moderate and light stocking rates since 1940. The study was conducted on shortgrass prairie at the Central Plains Experimental Range (CPER) northeast of Nunn, Colorado. Dominant warm-season grasses are blue grama and buffalograss and important cool-season grasses include western wheatgrass, needleandthread and bottlebrush squirreltail. Grazing treatments that removed approximately 60, 40 and 20 percent by weight of the current year's growth of dominant forage grasses by the end of the grazing season were respectively designated as heavy, moderate and light grazing until 1965. From 1965 on, the objective for heavy, moderate and light stocking rates was to leave 200, 300 and 450 pounds per acre, respectively, of ungrazed herbage at the end of the grazing season. Only one replication out of four remains in the study. Sampling techniques have not been consistent over the years. Data collected prior to 1991 included 36 years of partial biomass production, only 4 years with total biomass production and 18 years of cover data. In 1991, 1992 and 1993 total biomass production data was collected and in 1992 and 1993 pastures were sampled for basal cover and frequency of occurrence by species. Fifty-three years of grazing at different stocking rates has had little effect on biomass production of warm-season grasses. Cool-season grass and shrub production decreases with increased stocking rates. Moderate grazing maintains forage production and animal gains. Light grazing provides more species variety but does not utilize the range to its full potential.

Abstract Form - 1994 Annual Meeting

1. Presenting author: Menwyelet Atsedu
2. Affiliation: Colorado State University
3. Address: Dept. of Rangeland Ecosystem Science and NREL, Colorado State University, Fort Collins, CO 80523
4. Phone Number: (303) 491-1632
5. Abstract:

Atsedu, Menwyelet. DEFOLIATION EFFECTS ON WESTERN WHEATGRASS (PASCOPYRUM SMITHII (Rybd.) A. Love) PLANTS IN LONG-TERM PROTECTED AND LONG-TERM GRAZED PASTURES. Dept. of Rangeland Ecosystem Science and NREL, Colorado State Univ., Fort Collins, CO 80523, Detling, J.K. Dept. of Biology and NREL, Colorado State Univ., Fort Collins, CO 80523, and Goetz, H. Dept. of Rangeland Ecosystem Science, Colorado State Univ., Fort Collins, CO 80523.

Prior to defoliation, vegetative shoot height and leaf blade length both were significantly higher ($p<0.05$) in long-term (53 years) protected plants than in plants which had been grazed for that time. Biomass, nitrogen yield, growth, and tillering of western wheatgrass plants in response to defoliation were investigated in 1992. The study was conducted at the Central Plains Experimental Range. Results indicated that defoliation decreased biomass (g/tiller) by the same amount in long-term grazed and long-term protected plants. Nitrogen yield (mg/tiller) was significantly ($p<0.05$) higher in long-term protected plants than in long-term grazed plants following defoliation. No significant difference was observed between grazed and protected plants regarding new growth in length and number of new tillers per mother tiller following defoliation.

1. Burke, Ingrid C.
2. Colorado State University
3. Department of Forest Sciences and Natural Resource Ecology Laboratory
4. (303) 491-1620

Burke, I. C., W. K. Lauenroth, D. P. Coffin, J. K. Detling, D. G. Milchunas, J. Moore, M. Atsedu. INFLUENCE OF GRAZING AND EXCLOSURE FROM GRAZING ON ECOSYSTEM STRUCTURE AND FUNCTION IN SHORTGRASS STEPPE. Department of Forest Sciences, Natural Resource Ecology Laboratory, Department of Range Science, Department of Biology, Colorado State University, and Department of Biology, University of Northern Colorado.

Current understanding of the influence of grazing on grassland ecosystems has been generated from comparisons of grazed areas to exclosures. Differences between the two are interpreted as representing the effects of grazing. The shortgrass steppe ecosystem of the Central U.S. Grasslands was subjected to grazing by large generalist herbivores throughout its evolutionary history. Lack of grazing, such as that represented by exclosures, is not a natural condition for these grasslands. We have initiated an experiment to address the short and long-term effects of grazing and of exclosure on shortgrass steppe ecosystem structure and function at the Central Plains Experimental Range. In 1992, we manipulated long-term grazing exclosures initiated by the USDA Agricultural Research Service in 1939 to create 4 treatments: 1) long-term ungrazed; 2) long-term ungrazed, currently grazed; 3) long-term grazed; and 4) long-term grazed, currently ungrazed. We are assessing the following responses: aboveground net primary production, belowground net primary production, plant species composition, aboveground nitrogen yield, soil organic matter pools, nutrient availability, belowground food web structure, and small-scale disturbances. We anticipate that the study will provide important insights on the effects of grazing and exclosure over the short-term as well as over periods as long as several decades.

1994 Annual Meeting Central Plains Experimental Range

1. De-Xing Chen and H. W. Hunt
2. Colorado State University
3. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523
4. (303) 491-2104

Chen, D.-X. and Hunt, H. W., Responses of a C3 and a C4 perennial grass to CO2 enrichment and climate change: Comparison between GEM predictions and Phytotron experimental data. Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.

ABSTRACT

To quantitatively characterize ecosystem responses of C_3/C_4 perennial grasses to CO_2 enrichment and climate change, the grassland ecosystem model (GEM1.0) was adopted to simulate the long-term Phytotron data. The GEM2.0 simulates both short-term biophysical-physiological processes and long-term biogeochemical processes, and explicitly accounts for differences between C_3 and C_4 photosynthesis. The photosynthesis model successfully fit both Pascopyrum smithii (C_3) and Bouteloua gracilis (C_4) photosynthesis at different CO_2 and temperature treatments. The predicted shoot and root biomass, nitrogen contents in shoots and roots agreed well with observed data. Both data and simulation results show that the increase in biomass of B. gracilis (C_4) with elevated CO_2 was no less than that of P. smithii (C_3). The CO_2 enhancement effect on biomass production changes with temperature, precipitation, species and their interactions. Plant N concentration was decreased by doubling CO_2 and increasing water supply. N limitation was greater under doubling CO_2 in terms of plant N concentrations.

1. Debra P. Coffin
2. Colorado State University
3. Department of rangeland Ecosystem Science, Colorado State University, Fort Collins, CO 80523
4. (303) 491-7662

Coffin, D. P.[1,2], W. K. Lauenroth[1,2], and I. C. Burke[2,3]. RECOVERY OF VEGETATION IN A SEMIARID GRASSLAND 53 YEARS AFTER DISTURBANCE. [1]Department of Rangeland Ecosystem Science, [2]Natural Resource Ecology Laboratory, [3]Department of Forest Sciences, Colorado State University, Fort Collins, CO 80523.

Plowing and subsequent abandonment of old fields in semiarid grasslands had both immediate, short-term effects as wll as more persistent long-term effects on the ability of shortgrass plant communities to recover after large, intense disturbances. The traditional Clementsian model of succession where shortgrasses eventually dominate was modified for these grasslands to predict the dominance by the bunchgrass, Aristida purpurea, and a very slow or inability of shortgrasses to recover after large-scale disturbances. Because this conventional view of the role of disturbances is in contradiction with recent scale-dependent field studies and simulation analyses, we designed a field study to evaluate the recovery of shortgrass communities on 13 oldfields abandoned for 53 years at the CPER and in the Pawnee National Grasslands. Our objectives were to: (1) compare species composition and degree of recovery on abandoned fields with adjacent, unplowed areas; (2) compare vegetation on these fields with predictions from a Clementsian model and from the modified, conventional model; (3) evaluate the relationship between recovery patterns and distance from the source of propagules at the edge of a field; and (4) determine the environmental factors important in explaining recovery patterns between fields.

For most fields (9 of 13), relative shortgrass cover did not fit the predictions of either a Clementsian model or the conventional model for eastern Colorado. High shortgrass cover on two fields was similar to that expected by the Clementsian model, and low shortgrass cover on the remaining two fields was similar to that expected by the conventional model. Different conclusions were reached based upon the choice of indicator of recovery. The two fields with high shortgrass cover were dominated by the less drought- and grazing-resistant species, Buchloe dactyloides, compared to Bouteloua gracilis, the dominant species on undisturbed communities. Uniformity in cover of other perennial graminoids and density of perennial forbs and annuals on and off fields indicated that these groups had recovered on most fields. However, differences in similarity in species composition or species richness on and off fields resulted in the conclusion that none of the fields had recovered.

The perennial bunchgrass B. gracilis was found on all fields sampled, and dominated the basal cover on two fields. Four groups of fields were distinguishable based on the relationship between B. gracilis cover and distance from the edge with unplowed vegetation: (1) fields with uniformly high cover of B. gracilis; (2) fields with a decrease in cover with distance, and cover dominated by B. gracilis; (3) fields with a decrease in cover with distance, and cover dominated by Buchloe dactyloides and (4) fields with uniformly low cover of B. gracilis and B. dactyloides, and dominated by other perennial graminoids indicating a mid- to late-successional stage had been reached.

Our results are in contrast to the conventional view of shortgrass community response to disturbances, and suggest an alternative view of the recovery process that focuses on interactions between individual plants and their environment in explaining recovery patterns that vary in time or space. Accounting for this variability in recovery is critical to the management of these systems, especially under conditions of changing climate and land use.

1. Thomas O. Crist and John A. Wiens
2. Colorado State University
3. Department of Biology, Colorado State University, Fort Collins, CO 80523
4. (303) 491-0985

Crist, Thomas O., and Wiens, John A., SPATIAL SCALE AND THE DISTRIBUTION OF HARVESTER ANT COLONIES, Dept. of Biology, Colorado State Univ., Fort Collins, CO 80523.

The western harvester ant (*Pogonomyrmex occidentalis*) is an important disturbance agent in semiarid ecosystems because ants remove vegetation, modify soil characteristics, and selectively harvest the soil seed pool. To examine how ant abundance varies across a grassland landscape, we analyzed the density and dispersion of ant colonies in three 130-ha pastures at spatial scales from 0.1 to 100 ha. Maps of ant colonies were created from low-level aerial photographs (1:1900) and overlaid with soil-series maps to determine broad-scale distributions. At finer scales, spatial patterns of ant colonies were compared to computer simulations of random patterns using a multiple nearest-neighbor procedure. Ant colonies averaged 14-19/ha on upland plains and slopes with fine sandy loams and 3-7/ha in swales with loams or clay loams. We found considerable variation in colony densities within soil types, however, as a complete sampling of pastures with a 1-ha grid revealed a density range of 0-40/ha. Colonies were regularly dispersed at the scale of the nearest neighbor and were clumped at broader scales associated with soil and topographic variation. These findings suggest that interactions among ant colonies affect inter-colony spacing and therefore local density, whereas soil properties determine the distribution and abundance of ant colonies at broader spatial scales.

1. Howard E. Epstein
2. Colorado State University
3. Dept. of Rangeland Ecosystem Science, Colorado State Univ., Fort Collins, CO 80523
4. (303) 491-7274

Epstein, H. E.[1], Lauenroth, W. K.[1], Burke, I. C.[2] and D. P. Coffin[1]
ANALYSES OF THE ABUNDANCE OF DOMINANT GRASS SPECIES ALONG TWO REGIONAL TRANSECTS IN THE CENTRAL GRASSLANDS OF THE UNITED STATES
[1]Dept. of Rangeland Ecosystem Science and [2]Dept. of Forest Science, Colorado State Univ., Fort Collins, CO 80523.

We conducted research to quantify large-scale relationships between grass species abundances and their environmental controls. We analyzed the production of several dominant grasses along two transects in the central Grassland Region of the United States. To perform the analyses, we constructed a plant species database for the central Grasslands. The database utilizes ARC/INFO, a geographic information system, to combine Soil Conservation Service (SCS) range site descriptions with spatial data from the SCS State Soil Geographic (STATSGO) database. The outcome is a spatial database of the abundances of individual plant species. Analyses were performed on latitude (surrogate for mean annual temperature) versus biomass for four dominant grass species in the plains region extending from southern Colorado to northern Montana. The abundances of *Bouteloua gracilis* and *Buchloë dactyloides*, both C_4 species, decreased with increasing latitude, whereas the relationships between latitude and biomass for *Agropyron smithii* and *Stipa comata*, both C_3 species, were less clear. Analyses were also performed on longitude (surrogate from mean annual precipitation) versus biomass for four dominant C_4 grass species in the plains region extending from the shortgrass steppe in eastern Colorado to the tallgrass prairie in eastern Kansas. The abundances of *Bouteloua gracilis* and *Buchloë dactyloides* decreased, whereas the abundances of *Andropogon gerardii* and *Schizachyrium scoparium* increased, from west to east. These results provide insight into the quantitative relationships between individual species abundance and climate at a regional scale.

1. Julie L. Fair
2. Colorado State University
3. Rangeland Ecosystem Science Department
4. (303) 491-7274

Fair, Julie L.[1], Debra P. Coffin[1,2] and William K. Lauenroth[1,2], [1]Rangeland Ecosystem Science Department, Colorado State University, Fort Collins, CO 80523, and [2]Natural Resource Ecology Lab, Colorado State University, Fort Collins, CO 80523.

MORTALITY OF INDIVIDUAL *BOUTELOUA GRACILIS* (BLUE GRAMA) PLANTS AS A RESULT OF SMALL-SCALE DISTURBANCES.

Bouteloua gracilis, or blue grama, is the dominant species in shortgrass communities of North America and is widespread throughout the Great Plains, yet mortality of *B. gracilis* has not been studied. Our objective was to evaluate the effects of small-scale disturbances, such as cattle fecal pats, badgers, skunks, and nests of Western harvester ants, on mortality of individual *B. gracilis* plants. We also evaluated the role of small disturbances in the gap-dynamics of shortgrass communities. We used field experiments to simulate two types and three severities of small disturbances by covering or removing 50, 75, or 90% of the tillers of individual *B. gracilis* plants. Control plants were not disturbed. The number of surviving tillers per plant was compared for each type and severity of disturbance at three soil textures and on plots moderately-grazed and not grazed by cattle. Our results showed that soil texture and grazing had no effect on number of surviving tillers per plant regardless of disturbance treatment. Plants in which 50, 75, and 90% of the tillers were covered showed a significant increase in number of surviving tillers from the start of the experiment in August 1991 to the start of the 1992 growing season, but showed no change after the growing season. By contrast, plants in which 50, 75, and 90% of the tillers were removed and control plants having no experimental mortality showed no difference in the number of surviving tillers throughout the study period. Our results indicate that small disturbances which kill part of a *B. gracilis* plant do not cause mortality of the entire plant, regardless of the soil texture, grazing intensity, type, or severity of the disturbance. Therefore, only disturbances which kill all of the tillers of a *B. gracilis* plant create establishment gaps in shortgrass communities.

1. Paul B. Hook
2. Colorado State University
3. Department of Forest Sciences, Colorado State University, Fort Collins, CO 80523
4. (303) 491-2366

Hook, Paul B., and Burke, Ingrid C., EVALUATION OF METHODS FOR ESTIMATING NITROGEN AVAILABILITY IN A SEMIARID GRASSLAND. Department of Forest Sciences, Colorado State University, Fort Collins, CO 80523.

We compared several *in situ* methods of estimating N supply and availability in a semiarid grassland to evaluate potential problems related to root death, duration of incubations, and altered soil water dynamics. Results suggested that N mineralization in field incubations was affected by transient dynamics of N release and immobilization involving active organic matter, and that estimates of N availability are likely to be sensitive to the length of incubations. Net N mineralization was highest 15-30 d after starting open core incubations; generally no additional net mineralization occurred after day 30, and net immobilization sometimes occurred. Inorganic N pools often increased and declined more rapidly in sieved than intact soils, and removal of roots sometimes enhanced net mineralization. Net N mineralization was greater under than between Bouteloua gracilis plants, consistent with laboratory data. Water content in open core incubations fluctuated with the weather but was higher than ambient except during very dry periods. Time patterns of N capture on ion exchange resins were inconsistent.

1. H. William Hunt
2. Colorado State University
3. Range Science Dept., Colo. State Univ., Ft. Collins, CO, 80523
4. (303)491-1985
5. Member
6. H. William Hunt
7. Poster
8. N/A
9. 17, 12

GROWTH AND NITROGEN CONTENT OF BLUE GRAMA AND WESTERN WHEATGRASS IN INTACT CORES SUBJECTED TO ELEVATED CO2 AND CLIMATE CHANGE FOR TWO YEARS. H. W. Hunt, Range Science Dept., E. T. Elliott, Nat. Res. Ecol. Lab., J. K. Detling, Biology Dept, and D. E. Reuss, Nat. Res. Ecol. Lab., Colorado State Univ., Ft. Collins, CO 80523.

Intact soil cores were taken from nearly pure stands of blue grama (Bouteloua gracilis) and western wheatgrass (Pascopyrum smithii) at the Central Plains Experimental Range in northeastern Colorado. These cores were transferred to growth chambers and exposed to various CO2, temperature and moisture regimes in a factorial design. Conditions in the control treatment were chosen to mimic diurnal and seasonal patterns in the field. Nutrient supply was limited to that available aturally in the soil, and there was no grazing. Plant growth was affected by CO2, temperature and precipitation differently in the two species. Conditions for a climate change scenario included elevated CO2, elevated temperatures, and reduced precipitation. Such climate change had no significant effect on shoot biomass in either species. In the cool season grass (P. smithii), nitrogen concentration of standing dead shoots at the end of the growing season was greater than the control after the first year of climate change, but not after the second year. In the warm season grass (B. gracilis), standing dead shoot nitrogen concentration at the end of the growing season was no different after the first year of climate change, but was lower after the second year.

1. Robin H. Kelly
2. Colorado State University
3. Department of Forest Sciences, Fort Collins, CO 80523
4. (303) 491-7274

Kelly[1], Robin H. and Ingrid C. Burke[1,2]. [1]Department of Forest Sciences, [2]NREL, Colorado State University, Fort Collins, CO 80523. THE ROLE OF ROOTS IN SOIL ORGANIC MATTER FORMATION AND MAINTENANCE IN A SHORTGRASS STEPPE.

An understanding of the role of roots in soil organic matter formation and recovery is an important and little understood component of disturbance dynamics in the shortgrass steppe. We are conducting field and laboratory studies on the role of roots in the formation and maintenance of soil organic matter following disturbance. Western Harvester ant (*Pogonomyrex occidentalis* Cresson) nests provide us with a "disk" area that surrounds the central mound and is maintained without above- or belowground inputs for many (29 - 58) years. A nest can be aged by its morphology, allowing us to examine soil organic matter dynamics over temporal and distance gradients. The contribution of belowground detritus to organic matter formation in soils at the Central Plains Experimental Range, and the role of belowground detritus in controlling the dynamics of active and stabilized soil organic matter pools are being examined. We expect total soil carbon and nitrogen to be lower on-disk with increasing total C and N near the nest edge. We expect total C and N to decrease with increasing nest age. We also predict differences in active soil organic matter pools in the same direction along these gradients, but active pools will respond more rapidly and with greater proportionality because they are dependent upon inputs over a short period of time. Results of this study will allow us to test the temporal and spatial predictions of current abstractions of soil organic matter dynamics.

1. Diana R. Lane
2. Colorado State University
3. Dept. of Rangeland Ecosystem Science, Colorado State Univ., Fort Collins, CO 80523

Diana R. Lane[1], and Debra C. Coffin[1,2]. 1.Department of Rangeland Ecosystem Science. 2. Natural Resource Ecology Laboratory. Colorado State University, Fort Collins, CO 80523. THE INFLUENCE OF SOIL TEXTURE ON PLANT PRODUCTIVITY IN THE CENTRAL GRASSLANDS.

According to the inverse-texture hypothesis, coarse-textured soils should support more productive plant communities than fine-textured soils in arid and semi-arid regions. This is a consequence of lower evaporation from coarse-textured soils in environments characterized by low precipitation and high evaporative demand. The objective of this research is to test the inverse-texture hypothesis for an east-west transect extending across the Central Grassland region, from the Central Plains Experimental Range (precip.: 311 mm/y) in the west to Lincoln, NE (precip.:711 mm/y) in the east. The inverse-texture hypothesis will be evaluated for important individual species, functional groups, and the entire plant community. This transect was chosen in order to minimize differences in mean annual temperature between sites. Fourteen sites along the transect were selected: half of the sites are on sandy soils and half are on fine-textured soils. In August 1993 above-ground net primary production was estimated by sampling peak biomass. Sites will be resampled in 1994. Results from 1993 field work are not yet available.

1. William K. Lauenroth
2. Department of Rangeland Ecosystem Science
3. Colorado State University
Fort Collins, CO 80523
4. (303) 491-7581

Lauenroth, W. K., Sala, O. E., Coffin, D. P., and Kirchner, T. B., RECRUITMENT OF *BOUTELOUA GRACILIS* IN THE SHORTGRASS STEPPE: A SIMULATION ANALYSIS OF THE ROLE OF SOIL WATER. Department of Rangeland Ecosystem Science, Colorado State University, Fort Collins, CO 80523

In the shortgrass steppe region of North America there is a controversy about the ability of the dominant species to recruit from seedlings. The prevailing view is that *Bouteloua gracilis* H.B.K. Lag ex Griffiths is incapable of recruitment from seedlings in areas receiving less than 380 mm of annual precipitation. A common explanation for this situation is that environmental conditions which permit seedling establishment are infrequent. To assess the frequency of environmental conditions appropriate for the recruitment of *B. gracilis* we used a soil water simulation model and long-term climatic data in conjunction with detailed information about the ecophysiological requirements for seed germination, and growth of seminal and adventitious roots.

We found that recruitment events occur as frequently as every 30-50 years on silty clay, silty clay loam, and silty loam soils, but less than once in 5000 years on sandy soils. Simulated frequencies of recruitment were sufficient to account for the observed abundance of *B. gracilis* in 7 of 11 soil textures evaluated. The differences in silt content and available water holding capacity accounted for the difference among soil textures in the probability of occurrence of recruitment events. Therefore, soil texture variability may explain the spatial pattern of recruitment and of population recovery after disturbance which occur at the soil type and microsite scales.

Annual precipitation explained a large fraction of the temporal variability in recruitment. On average, recruitment occurred in years when precipitation was above the mean. The occurrence of recruitment events in some dry years (precipitation < mean) and their absence during some wet years (precipitation > mean) emphasizes the importance of the intraseasonal distribution of precipitation.

The sensitivity of recruitment to soil water availabilty suggests that climate change, particularly changes that increase or decreased the amount or the effectiveness of soil water, could have important effects on the future of populations of *B. gracilis*.

GUSTAVO A. MARTINEZ-TURANZAS
COLORADO STATE UNIVERSITY
Department of Rangeland Ecosystem Science, Colorado State University, Fort Collins, CO. 80523
(303) 491-7274

GUSTAVO A. MARTINEZ-TURANZAS[1] and DEBRA COFFIN[1,2]. 1) Department of Rangeland Ecosystem Science, and 2)Natural Resources Ecology Laboratory, Colorado State University, Fort Collins, CO. 80523. EFFECTS OF DISTURBANCE SIZE AND SOIL TEXTURE ON MICROTOPOGRAPHY IN A SHORTGRASS COMMUNITY.

Small disturbances produced in 1984 and 1985 at the Central Plains Experimental Range (CPER) in north central Colorado were used to evaluate the effects of disturbance size and soil texture on microtopography. Disturbances were located in two sites with different soil texture: one with a coarse-textured soil (25 NE) and the other with a fine-textured soil (25 SE). Disturbances of three sizes (50, 100, 150 cm-diameter) were created by removing plant material to a depth of 10 cm and replacing the soil. These disturbances are similar in size to common naturally-occurring disturbances found at the CPER. The disturbance plots have been unaltered since being created and plant recovery has been occurring through time.

We evaluated the effects of soil texture, disturbance size, and location (inside and outside the disturbance) on the microtopography of the landscape based upon the height of individual plants compared to bare soil. A total 24 plants and 24 soil points heights for each disturbance size and each soil texture were determined using a Total Surveying Station (Pentax II05). Our results indicate that disturbance size and soil texture are important in determining the microtopography of the shortgrass steppe.

1. D. G. Milchunas and W. K. Lauenroth
2. Colorado State University
3. Dept. Rangeland Ecosystem Science and Natural Resource Ecology Laboratory, Ft Collins, CO 80523
4. (303) 491-6691

Milchunas, D. G. and W. K. Lauenroth. Department of Rangeland Ecosystem Science and Natural Resource Ecology Lab, Colorado State University, Ft Collins CO 80523.
INERTIA IN PLANT COMMUNITY STRUCTURE: DEFLECTION AFTER CESSATION OF STRESS.

Additions of water, nitrogen, and water+nitrogen were applied to semiarid shortgrass steppe for 5 yrs at levels representing nutrient-enrichment-stresses. Plant population dynamics were monitored for an additional 16 yrs after cessation of the treatments. Invasions by exotic 'weed' species and the development of characteristics of highly disturbed plant communities did not occur until several years after treatments were terminated. Inertia in existing plant-community-structure can mask the presence of unstable conditions due to time-lags in deflections to alternate states. Populations displayed high amplitude oscillations during the 7 to 16 yrs following cessation of the stressors, but the temporal pattern was different for each treatment. Booms and crashes of exotics were as great as 1700 to 20/m^2 over 4-5 yr cycles. Anthropogenic pollutants and global climate change may act similarly with initial enrichment-stress-effects, rather than as an immediate disturbing force. Time-lags in response may render species an unreliable indicator of stressors.

1: Daniel B. Palic
2. USDA-ARS, Colorado State University
3. USDA-ARS, Great Plains Systems Research, P.O. Box E, Fort Collins, CO 80523.
4. (303)490-8348

Palic, D.B., J.D. Hanson, G.H. Dunn, and M.K. Brodahl. SPATIAL DISTRIBUTION OF SOIL WATER RETENTION CHARACTERISTICS AS INFLUENCED BY LANDSCAPE POSITION AND SOIL DISTRIBUTION. USDA-ARS, Great Plains Systems Research, P.O. Box E, Fort Collins, CO 80523.

Variability in soil chemical and physical properties poses a problem for many researchers and managers. Temporal and spatial distribution of water and soil-water holding capacity are important in plant distributions over a semi-arid land-scape. Soil moisture desorption samples were removed from the Central Plains Experimental Range (CPER) in northeast Colorado. Samples were takne on a grid pattern from a north facing slope, south facing slope, and a playa and analized at saturation and 33 kPa. Geostatistics, a common tool in soil analysis, was used for spatial analysis of soil hydraulic properties. In addition multivariate and conventiaonal statistical analysis was performed. A Global Positioning System (GPS) was used to geographically locate sample points. With the help of a Geographic Information System (GIS), data manipulation and displav was achieved. Soil maps were constructed for saturation and 33 kPa on each plot.

- get profile descriptions for Don
- sand-N interactions

1. Tamera J. Minnick
2. Colorado State University
3. Department of Rangeland Ecosystem Science, Colorado State Univ., Ft. Collins, CO 80523
4. (303) 491-2741

Minnick, Tamera J.[1], and Debra P. Coffin[1,2] . [1]Dept. of Rangeland Ecosystem Science, [2]Natural Resource Ecology Laboratory, Colorado State Univ., Ft. Collins, CO 80523.

CROSS-SITE COMPARISONS OF TWO IMPORTANT C_4 PERENNIAL GRASSES IN NORTH AMERICAN GRASSLANDS: *BOUTELOUA GRACILIS* AND *BOUTELOUA ERIOPODA*.

Our objective is to evaluate abiotic and biotic factors that control the geographic distribution and abundance of two important C_4 perennial grasses in North American grasslands, *Bouteloua gracilis* (blue grama) and *Bouteloua eriopoda* (black grama). Both species are found over large areas of the U.S., although their region of dominance varies. *Bouteloua gracilis* dominates shortgrass steppe communities found along the Front Range of the Rocky Mountains, whereas *B. eriopoda* dominates desert grassland communities in the Southwest. We will use field experiments conducted at three Long-Term Ecological Research (LTER) sites with communities dominated by either *B. gracilis* (Central Plains Experimental Range), *B. eriopoda* (Jornada Experimental Range) or pure or mixed stands of the two species (Sevilleta National Wildlife Refuge). During the summer of 1993, we investigated morphological characteristics of the two species at the three sites. We characterized the study areas within the three sites in terms of vegetation and soil texture. Within each study area, we set up replicated plots and measured the diameters of all of the individual *B. gracilis* and *B. eriopoda* plants within the plots. Preliminary results indicate that the mean size of *B. gracilis* plants is larger at the Sevilleta than at the CPER. *Bouteloua eriopoda* genets were larger at the Jornada than at the Sevilleta while ramet sizes were not significantly different. Additional experiments in this series of studies include planting a common garden at the CPER in order to examine possible environmental constraints on the northern spread of *B. eriopoda*, measuring differential growth of the two grasses at the sites where they are now located, determining the effect of small-scale disturbance by removing whole plants at each site, and investigating the importance of intra- and interspecific competition on establishment of seedlings at the Sevilleta.

1994 Annual Meeting Central Plains Experimental Range

1. Jack A. Morgan
2. USDA-ARS Rangeland Resources Research Unit
3. Crops Research Lab., 1701 Center Ave., Fort Collins CO 80523
4. (303) 498-4216

Read, J.J., J. A. Morgan, P.A. Harrison, and N.J. Chatterton, GROWTH AND C PARTITIONING OF WESTERN WHEATGRASS (C_3) AND BLUE GRAMA (C_4) AS INFLUENCED BY CO_2 AND TEMPERATURE. USDA-ARS Rangeland Resources Res. Unit, Fort Collins, CO 80526, and Forage and Range Research Laboratory, Logan, UT 84322.

ABSTRACT

This study investigated the effects of CO_2 and temperature on dry matter (DM) accumulation and total nonstructural carbohydrates (TNC) in western wheatgrass (Pascopyrum smithii, C_3) and blue grama (Bouteloua gracilis, C_4), two grasses native to the Colorado shortgrass prairie. Plants were maintained under favorable nutrient and soil moisture conditions. CO_2 enrichment increased final shoot DM of the C_3 grass 97% at 20° but only 8% at 35°C.. Final shoot DM of the C_4 grass was unresponsive to CO_2 at 20°C, but was enhanced by 32% at 35%C as compared to present ambient [CO_2]. Root: shoot DM ratio of both species remained relatively constant between CO_2 levels. Partitioning of TNC was conditioned by both temperature and species; however, optimal growth temperatures were accompanied by significant CO_2-induced accumulations of TNC in leaves of both species. Results indicate that temperature growth responses are important in the acclimation of these species to CO_2, and also in the allocation of TNC for growth.

1. José M. Paruelo
2. Colorado State University
3. Dept. of Rangeland Ecosystem Sciences, Colorado State University, Fort Collins, CO 80523.
4. (303) 491-7274

Paruelo, J.M.[1] and W.K. Lauenroth[2]. Dept. of Rangeland Ecosystem Sciences and [2] Natural Resources and Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.[1] Permanent Address: Dpto de Ecología, Facultad de Agronomía, Universidad de Buenos Aires, Argentina. FUNCTIONAL CHARACTERISTICS OF NORTH AMERICAN SHRUBLANDS AND GRASSLANDS AT A REGIONAL SCALE.

We characterized the function of 37 grassland and shrubland sites of North America using the seasonal dynamics of the Normalized Difference Vegetation Index (NDVI). Each site was characterized by a vector of 21 element where each elements corresponded to the average NDVI for one date, and by five traits from the seasonal curve of NDVI: annual average NDVI, annual maximum NDVI, annual minimum NDVI, difference between maximum and minimum NDVI, and number of peaks of the seasonal NDVI curve.

Principal component analysis of the SITExDATE matrix showed that 44% of the variability of the seasonal NDVI curves was associated with the average annual NDVI, a variable closely related to primary production. A 32% of the variance was related to the difference between the NDVI during the warmest and coldest months of the year, an estimator of the seasonality of carbon gains.

Grassland sites have the highest average NDVI (ANPP), displayed the greatest seasonality, and have a more regular dynamics than southern shrublands (i.e. less than two peaks of growing). Northern shrublands were in general more productive (higher average NDVI) than southern ones. Southern shrublands displayed a low intra-annual variability in carbon gains. This unit also showed a higher number of growing peaks than grasslands and northern shrublands.

The high correlation in the first two canonical variables (0.89 and 0.75, $p<0.00001$) suggest a high degree of correspondence between the NDVI seasonal dynamics and climate variables. Annual average NDVI was positively correlated with precipitation and temperature during May and June ($r^2=0,49$, $n=37$, $p<0.00001$). The maximum and minimum difference in NDVI values showed a positive correlation with both precipitation during May and June, and temperature in July and August. This trait was also negatively correlated with temperature during January and February ($r^2=0.51$, $n=37$, $p<0.00001$). The number of peaks tended to increase with temperature during January and February, and to decrease with precipitation during May and June ($r^2=0.37$, $n=37$, $p<0.0001$). Maximum NDVI tended to increase with precipitation during May and June ($r^2=0.31$, $n=37$, $p<0.0001$).

1. Marcos D. Robles
2. Colorado State University
3. Dept. of Forest Sciences, Colorado State Univ., Ft. Collins, Co 80523
4. (303) 491-2741

Robles, Marcos D.[1], I. C. Burke[1,2]. [1]Dept. of Forest Sciences and [2]Natural Resources Ecology Laboratory. Colorado State University, Ft. Collins 80523. EFFECTS OF PLANT SPECIES, MICROBES AND SOIL CHARACTERISTICS ON RATES OF ROOT LITTER DECOMPOSITION IN SEMIARID ECOSYSTEMS.

Mass of soil organic matter decreases in the Central Great Plains from north to south, but it is unclear whether this pattern is induced to a greater extent by changes in organic matter production or decomposition. The level of soil organic matter is determined by the balance of plant production and decomposition. Aboveground net primary production is relatively constant along this gradient, about 300 g/m^2, and it is believed that constant mean annual precipitation controls this pattern. Rates of decomposition may increase from north to south as mean annual temperatures rise, thus accounting for the pattern of soil organic matter. Alternatively, plant litter chemistry or other abiotic factors (microbes) may account for higher decomposition rates at souther sites. To test this hypothesis, recently live roots of two grass species, *Bouteloua gracilis* and *Bouteloua eriopoda*, were placed in fine-textured soils from the CPER and Jornada LTER sites in a common garden site at the CPER on January 1994. Rates of litter mass loss and net nitrogen mineralization in the soils will be determined for 1994 to 1995. Because the temperature variable is held constant, we expect the decay of the two litter types to be the same in the two soil types.

1. Ronald A. Ryder
2. Colorado State University
3. Dept. of Fishery & Wildlife Biology, Colorado State Univ., Fort Collins, CO 80523
4. (303) 491-6547

Ryder, Ronald A., WINTER BIRDS OF THE CENTRAL PLAINS EXPERIMENTAL RANGE AREA IN NORTHEASTERN COLORADO, 1966-1993. Dept. of Fishery & Wildlife Biology, Colorado State Univ., Fort Collins, CO 80523.

Christmas Bird Counts (CBC) have been made for 28 consecutive years (1966-1993) in a standard 15-mile diameter circle centered at the CPER headquarters, 10 mi. NE of Nunn, Weld County, Colorado. In addition, birds were counted on a 24½ mi. long, 50-stop roadside route from 2 to 10 times per winter (15 Nov.-15 Mar.) for 5 consecutive years; and spot-mapping censuses have been made on 5 to 10 twenty-acre plots monitored 2 to 7 times for 6 winters. Raptors were counted regularly on a 56 sq. mi. area for 4 winters. In all, 52 species of birds were recorded on the CBC's, but no more than 37 species in any one year (R=11-37). Similar species richness was noted on the roadside counts, but far less on the 20-acre plots. Rough-legged Hawks, Golden Eagles, Horned Larks, Black-billed Magpies, European Starlings, Rock Doves, American Tree Sparrows and House Sparrows were seen every year. Horned Larks were by far the most numerous species seen on all counts except the 1983 CBC when Lapland Longspurs were more abundant. Nineteen species were seen 5 or fewer of the 28 years.

1. Presenting Author: Gerald E. Schuman

2. Affiliation: USDA-ARS, Cheyenne, WY

3. Address: High Plains Grasslands Research Station
8408 Hildreth Road, Cheyenne, WY 82009

4. Phone Number: (307) 772-2433

G.E. Schuman, G.F. Frasier, J.D. Reeder, and R.H. Hart, UTILIZATION OF MUNICIPAL, INDUSTRIAL AND ANIMAL WASTES ON SEMIARID RANGELANDS. G.E. Schuman and R.H. Hart, USDA-ARS, High Plains Grasslands Research Station, 8408 Hildreth Road, Cheyenne, WY 82009; G.F. Frasier and J.D. Reeder, Crops Research Laboratory, 1701 Centre Ave., Ft. Collins, CO 80526.

Industrial, municipal and animal wastes were applied (22.4 Mg/ha) in 1993 to semiarid rangelands to determine short- and long-term changes in soil, plant and water quality properties. The study was established in pasture 11N of the Central Plains Experimental Range, 21 km northeast of Nunn, CO. Blue grama is the dominant plant species at the study site. Soil and vegetation baseline data were collected in 1993. Preliminary plant production data indicate increased biomass production with composted manure and composted sewage sludge applications, but not with phosphogypsum or feedlot manure. Soil and plant properties and surface/subsurface water quality will be monitored over the next 5 years.

1. J. S. Singh, W. K. Lauenroth, and D. G. Milchunas
2. Colorado State University
3. Dept. Rangeland Ecosystem Science and Natural Resource Ecology Laboratory, Ft Collins, CO 80523
4. (303) 491-7781

Singh, J. S., W. K. Lauenroth, and D. G. Milchunas. Department of Rangeland Ecosystem Science and Natural Resource Ecology Lab, Colorado State University, Ft Collins CO 80523.
LONG-TERM DYNAMICS AND PATTERNS OF SOIL WATER IN A SHORTGRASS STEPPE.

Soil water at 30, 45, 60, 75, and 90 cm depths were monitored on four sites at the CPER from 1985-92, using a neutron probe. Each site comprised an upland, a midslope and a lowland position. The study focused on the soil water dynamics in the portion of profile which is beyond the influence of bare-soil evaporation. The clay-loam site was the wettest and the sandy-loam site was the driest, while the two sandy-clay-loam sites were intermediate. Soil water did not vary systematically among the slope positions. Across all sites, slope positions and years, the water content of each soil layer was related to that of all other layers; the correlation coefficient between any pair of soil layers declined with increasing distance between the layers. Linear combinations of soil texture and precipitation terms explained a significant amount of variability in water content of different soil layers. Current water content of a soil layer was also related with the previous water content of that layer; this relationship strengthened with depth. Soil water showed a marked seasonality, a recharge during the winter and a depletion during the growing season. The deeper soil layers were more dynamic in terms of soil water during the wet years compared to the dry years NPP had an inverse non-linear relationship with growing season mean soil water content of different layers, indicating water use even from the deepest layer investigated.

1. Susan M. Smith
2. Colorado State University
3. Natural Resource Ecology Lab., Colo. St. Univ., Ft. Collins, CO 80523
4 Masters student with Bill Hunt
4. (303)491-1604

CHANGE IN ATMOSPHERIC CO2 LEVELS AND THE RELATIONSHIP BETWEEN DECOMPOSITION AND CHEMICAL QUALITY OF SHOOTS OF BLUE GRAMA AND WESTERN WHEATGRASS. S. M. Smith, Range Science Dept. and H. W. Hunt, Range Science Dept., Colorado State Univ., Ft. Collins, CO 80523.

The chemical quality of substrate affects the rate of litter decomposition. Increased atmospheric CO2 and related temperature and precipitation changes influence the chemical quality of the substrate by changing the plant growth rates and chemical composition. This was determined by a study conducted at the Central Plains Experimental Range in northeastern Colorado from 1989 to 1993. The study was done on Pascopyrum smithii and Bouteloua gracilis grown under varying regimes of CO2, precipitation, and temperature. Decomposition experiments are being carried out on litter from all of these treatments. The soils used in the experiment are from the original sites, and each litter is being decomposed on its own soil and on the alternate soil. Decomposition is being estimated gravimetrically and through CO2 respiration.

1994 Annual Meeting Central Plains Experimental Range

1. Paul Stapp
2. Program for Ecological Studies, Department of Biology
3. Colorado State University, Fort Collins, CO 80523
4. (303) 491-0952

Stapp[1], Paul, L. Ennis[2], and B. Van Horne[1], MICROHABITAT USE AND MOVEMENTS OF PEROMYSCUS MANICULATUS ON THE COLORADO SHORTGRASS PRAIRIE: RESPONSES TO THE AVAILABILITY OF SHRUB COVER. [1]Program for Ecological Studies, Dept. of Biology, [2]Dept. of Physiology, Colorado State Univ., Ft. Collins, CO 80523.

As part of a larger study that investigates habitat use and behavioral interactions among rodents on the shortgrass prairie in northeastern Colorado, we assessed the movements and microhabitat use of deer mice (Peromyscus maniculatus) in Summer 1992 and Winter 1992-93. Deer mice were more abundant on an area with homogeneous shrub (Atriplex canesens) cover than on one with cover divided between shrubs (Yucca glauca) and bare sand/grass. Capture locations had greater shrub cover than non-capture locations on both sites during summer and on the Yucca site in winter, but deer mice were captured in more open microhabitats on the Atriplex site in winter. Fluorescent powder tracking conducted in winter revealed that surface bouts on the Atriplex site were longer and more linear than on the Yucca site; mice on the latter may have moved more tortuously to remain closer to the more widely-spaced shrubs. Despite site differences in shrub spacing, the use of shrubs on the two cover types was similar, which suggested similar responses to the dispersion of shrub cover. The abundance of deer mice may be determined by the availability of shrub cover (i.e., macrohabitat selection) but mice apparently use open and shrub microhabitats in a similar fashion, regardless of habitat type.

Poster presented at the Seventy-third Annual Meeting of the American Society of Mammalogists, 19-23 June 1993, Western Washington University, Bellingham, WA 82255.

1. Guowei Sun
2. Colorado State University
3. Department of Rangeland Ecosystem Science and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523
4. (303)491-7274

Sun, Guowei, Coffin, Debra P. and Lauenroth, William K., QUANTITATIVE STUDIES OF ROOT DISTRIBUTIONS OF INDIVIDUAL PLANTS FOR GRASS, FORB AND SHRUB SPECIES IN NORTH AMERICAN GRASSLANDS USING GIS. Department of Rangeland Ecosystem Science and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.

Our objective was to quantify the vertical distribution of roots from individual plants for grass, forb, and shrub species from the Central Great Plains grasslands of North America. We obtained approximately 100 root drawings of individual plants for 62 species from the literature for analysis. Each root system was scanned electronically and imported to Arc/Info, a GIS program. Root lengths with depth in the soil profile were then calculated. Root systems were classified based upon the function that best fit the distribution of root length with depth. A general model for the vertical distribution of roots wiil be obtained for each species and functional type.

1. Stella W. Todd
2. Colorado State University
3. Dept. of Forest Sciences
4. (303) 491-7531

Todd, Stella W., Hoffer[1], Roger M., and Milchunas[2], Daniel G., THE IMPACT OF GRAZING ON STANDING CROP ESTIMATION USING REMOTE SENSING VEGETATION AND SOIL INDICES, [1]Dept. of Forest Sciences, [2]Dept. of Range Science and Natural Resource Ecology Laboratory, Colorado State Univ., Ft. Collins, CO. 80523

Standing crop at the Central Plains Experimental Range (CPER) was estimated from Landsat TM derived vegetation and soil indices. Values of the normalized difference vegetation index (NDVI), green vegetation index (GVI), red reflectance (RED), soil brightness index (SBI) and soil wetness index (SWI), were regressed against field measurements of standing crop (SC) on six sites, each with two grazing treatments. Possible remote sensing models for standing crop estimation were compared for grazed treatments, ungrazed treatments, and all treatments combined, using stepwise multiple regression and single variable regression. The use of multiple regression models improved biomass estimation, relative to single variable models. Regression models derived from grazed treatments were more highly correlated with standing crop than those from ungrazed treatments, or all treatments combined. On grazed treatments, significant multiple regression models for biomass estimation included (GVI or NDVI) in combination with (SBI or RED). A model containing SWI and RED was also significant. On ungrazed treatments, two variable models including (SBI or RED) in combination with SWI were significant. When grazed and ungrazed treatments were combined, the best two variable model included SWI and RED indices.

1. David W. Valentine
2. Colorado State University
3. Natural Resource Ecology Laboratory, Colo. St. Univ.,
   Ft. Collins, CO 80523
4. 303-491-0240

SOIL-ATMOSPHERE EXCHANGE OF METHANE AND NITROUS OXIDE IN THE COLORADO SHORT GRASS STEPPE. A.R. Mosier, USDA/ARS, Ft. Collins,
D.W. Valentine, W.J. Parton, D.S. Ojima and D.S. Schimel,
Natural Resource Ecology Laboratory, Colo. St. Univ.

Methane and nitrous oxide are long-lived, radiatively active trace gases that account for about 20% of the total anticipated atmospheric warming. The atmospheric concentrations of both gases have increased dramatically over the past few decades. Increased biospheric production is generally suggested as the reason for the increases, but decreases in global sinks are now known to be important. Recent extensive changes in land management and cultivation could be contributing to the observed increases in both atmospheric CH_4 and N_2O. Little information existed on CH_4 uptake or N_2O production in temperate grasslands or the effect of land management, nitrogen fertilization or cultivation on the flux of these gases. Since the spring of 1990, 15 different sites within CPER have been instrumented to quantify the soil-atmosphere exchange of CH_4 and N_2O and to monitor a number of parameters which affect the flux of these gases. We have found that cultivation and nitrogen fertilization both generally decrease CH_4 consumption and increase N_2O production. Using data generated from the CPER gas flux monitoring program a first generation model to describe soil CH_4 consumption and a N_2O flux model are being developed. The CH_4 uptake models link uptake rate to soil temperature and moisture, gas diffusion rates and concentration gradients, and biological demand. The N_2O model describes nitrification and denitrification processes which produce N_2O in terms of soil moisture, substrate, and temperature variables that are quantified at each site.

1. Mary Ann Vinton and Ingrid C. Burke
2. Colorado State University
3. Department of Forest Sciences and the Program for Ecological Studies, Colorado State University, Fort Collins, CO 80523
4. (303) 491-2741

Vinton, M. A., and I. C. Burke. Department of Forest Sciences and the Program for Ecological Studies, Colorado State University, Fort Collins, CO 80523. INTERACTIONS BETWEEN INDIVIDUAL PLANT SPECIES AND SOIL NUTRIENT STATUS IN SHORTGRASS-STEPPE.

The extent to which ecosystem structure (i.e. plant species composition and distribution) interacts with nutrient cycling is fundamental to our understanding of ecosystem function. We examined plant-soil interactions and tested the importance of individual plant species identity and presence on nutrient cycling in semi-arid shortgrass-steppe of northeastern Colorado. The shortgrass steppe has both discontinuous plant cover and a variety of plant species and lifeforms; we tested the effects of both plant cover (i.e. plant covered microsites vs. bare soil) and different species on soil nitrogen and carbon cycling. We examined these issues in an area of undisturbed shortgrass-steppe as well as an area that had undergone nitrogen and water additions from 1971-1974, resulting in significant shifts in plant species composition. The presence of plant cover had strong effects on soil properties, with soil under plants having consistently higher rates of carbon and nitrogen mineralization, and in some cases, higher levels of total and microbial biomass carbon and nitrogen, than soils from bare ground between plants. The five native, perennial grasses and one shrub differed from one another in the quantity and quality of above- and belowground biomass but differences in soil nutrient cycling among the five species were slight. Soils under bunchgrasses had higher rates of carbon mineralization. The one introduced annual in the study, *Kochia scoparia*, differed from the other species significantly, both in terms of the degree of plant-induced soil heterogeneity as well as the rate of nitrogen cycling. Soils associated with *Kochia scoparia* had less plant-induced heterogeneity and higher rates of nitrogen mineralization than soil associated with the other species. This species was abundant only on the historical water and nitrogen addition plots, suggesting a positive feedback between species persistence and soil nutrient status. Local plant-induced patterns in soil properties were important on a larger plot scale, indicating that structural attributes of the shortgrass-steppe ecosystem were critical to estimates of ecosystem function.