

A DELICATE BALANCE: RAINFALL AND GROUNDWATER IN NEBRASKA DURING THE 2000-2005 DROUGHT

Mark E. Burbach and R. Matthew Joeckel

*School of Natural Resources
University of Nebraska-Lincoln
102 Nebraska Hall
Lincoln, NE 68588-0517
mburbach1@unl.edu*

ABSTRACT—Recent decreases in rainfall and the accompanying decreases in groundwater levels since 1999 indicate heightened vulnerability to drought in Nebraska and the surrounding Great Plains. Precipitation across Nebraska during 2000-2005 ranged from 72% to 108% of the 30-year normal value, with fully 90% of 150 stations reporting below-normal precipitation. Simultaneously, groundwater levels declined more than 9 m in the most heavily impacted areas, most of which were already experiencing declines due to extensive irrigation development and low recharge rates. Thus, recovery from the drought and long-term intensive land use will be particularly challenging in densely irrigated areas of Nebraska. In contrast, contemporaneous groundwater-level changes in areas with little groundwater irrigation were comparatively modest. These observations demonstrate that drought mitigation efforts in the central and northern Great Plains must consider the combined effects of area-specific reduced recharge, local geohydrology (especially as it affects recharge), and increased groundwater withdrawals.

Key Words: climate impacts, drought, groundwater levels, groundwater monitoring, vulnerability

Great Plains Research 16.1:5-16

HYDROLOGICAL EFFECTS AND GROUNDWATER FLUCTUATIONS IN INTERDUNAL ENVIRONMENTS IN THE NEBRASKA SANDHILLS

**David C. Gosselin, Venkataramana Sridhar, F. Edwin Harvey,
and
James W. Goeke**

*School of Natural Resources
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln
102 Nebraska Hall
Lincoln, NE 68588-0517
dgosselin2@unl.edu*

ABSTRACT—Nine years of groundwater monitoring data has documented the important influence that topographic relief and location in the groundwater flow system have on the hydrologic function of interdunal valleys. The western “wet” valley at the Gudmundsen Sandhills Laboratory in central Nebraska, which is a net discharge area, is more strongly buffered from the effects of annual-scale climatic variability than the eastern “dry” valley. The east valley is generally an area of net recharge and as such is more responsive to climatic variability. This study employed a simple water balance approach to estimate evapotranspiration (ET) from water level measurements in the west valley for four specific time intervals in 1998-99 that included growing and senescence periods. The estimates of ET ranged between 5-6 mm/day in the mid-growing season and 2-3 mm/day during the period of senescence.

Key Words: evapotranspiration, groundwater fluctuation, interdunal valleys, Nebraska Sandhills

Great Plains Research 16.1:17-28

ECOPHYSIOLOGICAL RESPONSES OF *SCHIZACHYRIUM SCOPARIUM* TO WATER AND NITROGEN MANIPULATIONS

Amy Kochsiek

*School of Biological Sciences
348 Manter Hall
University of Nebraska-Lincoln
Lincoln, NE 68588-0118*

Veronica Ciganda, Neal Bryan, Lena Hite

*Department of Agronomy and Horticulture
279 Plant Science
University of Nebraska-Lincoln
Lincoln, NE 68583-0915*

and

Tala Awada

*School of Natural Resources
University of Nebraska-Lincoln
12-D Plant Industry Building
Lincoln, NE 68583-0814
tawada@unl.edu*

ABSTRACT—Nitrogen is increasing in terrestrial ecosystems as a result of agricultural practices and the burning of fossil fuels. This increase is expected to be accompanied by changes in water availability due to global warming. We examined the effects of nitrogen and water manipulations on *Schizachyrium scoparium*, one of the dominant grasses in the Great Plains. *Schizachyrium scoparium* responded positively to watering, with an increase in photosynthesis, stomatal conductance, water and nitrogen use efficiencies, and water potential. Under watered conditions, fertilization had no significant effect on measured parameters, except for nitrogen-use efficiency. Significant differences appeared between fertilized and nonfertilized plants under moderate drought, with fertilized plants maintaining higher photosynthesis and water-use efficiency than nonfertilized plants. Water potential declined with water stress but did not differ between fertilization treatments, while nitrogen-use efficiency was significantly higher under nonfertilized than fertilized treatment. Differences among fertilization treatments disappeared under severe drought. We conclude that *S. scoparium* will likely respond positively to fertilization under moderate drought in the Great Plains. However, under severe drought, fertilization will not provide any physiological advantages to *S. scoparium*.

Key Words: bluestem, climate change, gas exchange, Great Plains, nutrient availability, water potential

Great Plains Research 16.1: 29-36

PRECIPITATION AND FIRE EFFECTS ON FLOWERING OF A RARE PRAIRIE ORCHID

Gary D. Willson

*Great Plains Cooperative Ecosystem Studies Unit
School of Natural Resources
314A Biochemistry Hall
University of Nebraska–Lincoln
Lincoln, NE 68583
gwillson2@unl.edu*

Manda J. Page

*School of Natural and Rural Systems Management
The University of Queensland-Gatton
Queensland, Australia 4343*

and

F. Adnan Akyüz

*Missouri Climate Center¹
369 McReynolds Hall
University of Missouri-Columbia
Columbia, MO 65211*

ABSTRACT—A small, isolated population of the threatened western prairie fringed orchid (*Platanthera praeclara* Sheviak & Bowles) occurs at Pipestone National Monument, Minnesota, in a mesic prairie that is periodically burned to control invasive cool-season grasses. During 1995–2004, monitoring counts of flowering orchids in the monument varied considerably for different years. Similar precipitation amounts in the spring and histories of burning suggest that fire and precipitation in the spring were not the causes of the variation. For the eight non-burn years in the monitoring record, we compared the number of flowering plants and the precipitation amounts during six growth stages of the orchid and found a 2-variable model (precipitation during senescence/bud development and precipitation in the dormant period) explained 77% of the annual variation in number of flowering plants. We also conducted a fire experiment in early May 2002, the typical prescribed burn period for the monument, and found that the frequency of flowering, vegetative, and absent plants observed in July did not differ between burned and protected locations of orchids. We used the model and forecasts of precipitation in the spring to develop provisional burn decision scenarios. We discussed management implications of the scenarios.

Key Words: burn decision scenarios, Pipestone National Monument, prescribed fire, precipitation, western prairie fringed orchid

Great Plains Research 16.1:37-43

REDUCING SMOOTH SUMAC DOMINANCE IN NATIVE TALLGRASS PRAIRIE

Susan J. Tunnell, James Stubbendieck, Sal Palazzolo

*Department of Agronomy and Horticulture
University of Nebraska–Lincoln
P.O. Box 830915
Lincoln, NE 68583-0915
stunnell2@unl.edu*

and

Robert A. Masters

*Field Research Biologist
Dow AgroSciences, LLC
3618 South 75th Street
Lincoln, NE 68506*

ABSTRACT—Smooth sumac (*Rhus glabra* L.) is a resprouting shrub native to the tallgrass prairie region that increases in density without an active disturbance regime. Our objective was to use prescribed fire and herbicides to decrease smooth sumac density as a strategy to improve a degraded tallgrass prairie remnant. In two separate experiments repeated in space and time, we used prescribed fire in combination with herbicides at various rates and two application methods to develop an effective management scheme for reducing smooth sumac. We used a randomized complete block design with 13 herbicide treatments and a control with three replicates in burned and non-burned areas. Results were similar in both experiments in which herbicide treatment and burning were the significant main effects. All herbicide treatments reduced smooth sumac stem density compared to the control, but no distinct advantage was detected regarding specific herbicide, application rate, or whether the herbicide was applied as a broadcast spray or with a hand-held wick. We expected burning to make the plant more susceptible to herbicides, but burning increased stem density. In this tallgrass prairie remnant, we determined that herbicides were the most effective management tool in reducing smooth sumac stem density.

Key Words: Great Plains, herbicide, prescribed burning, *Rhus glabra*

Great Plains Research 16.1:45-49

GRAZING AND MILITARY VEHICLE EFFECTS ON GRASSLAND SOILS AND VEGETATION

John A. Guretzky and Alan B. Anderson

*U.S. Army Engineer Research and Development Center
Construction Engineering Research Laboratory
2902 Newmark Drive
Champaign, IL 61822-1076
John_Guretzky@huskeralum.com*

and

Jeffrey S. Fehmi

*School of Natural Resources
P.O. Box 210043
University of Arizona
Tucson, AZ 85721*

ABSTRACT—Vehicle training, a common disturbance of military lands, is part of a suite of land uses that also includes cattle grazing. Yet, no studies have examined their interaction. Our objective was to review the effects of vehicle training and grazing on grassland soils and vegetation and develop a state-and-transition model that incorporates grazing and training for Fort Hood, TX. Both grazing and training can cause soil compaction and vegetation disturbance, altering hydrology and increasing erosion. While the effects of grazing largely depend on stocking rate, vehicle training causes greater disturbance when wet soils are driven on, when vehicles are turned sharply, and as the number of vehicle passes increases. Grazing and training are expected to maintain grasslands in secondary succession, though eroded sites dominated by annuals also could develop under frequent training. The state-and-transition model may guide decision making for military land managers faced with training and grazing effects.

Key Words: cattle grazing, disturbance, grasslands, Great Plains ecosystems, military impacts, state-and-transition models

Great Plains Research 16.1:51-61

UNDERLYING CAUSES AND IMPLICATIONS OF NEBRASKA RETAIL TRADE PATTERNS

Rex Nelson

*Executive Director
McCook Economic Development Corporation
P.O. Box 626
301 Norris Ave. Suite 200
McCook, NE 69001
medc@mccookne.org*

Bruce B. Johnson

*Professor of Agricultural Economics
University of Nebraska-Lincoln
314 HC Filley Hall
Lincoln, NE 68583-0922*

and

David L. Darling

*131 E.J. Frick Drive
Manhattan, KS 66503*

ABSTRACT—Declining retail trade in rural America is a concern for rural residents, their leaders, and rural development professionals. This cross-sectional study presents a framework for understanding relationships between changes in retail trade and rural population declines. The study uses county trade pull factors as a benchmark for retail trade in Nebraska and develops a theoretical and a statistical model to explain changes in this measure. The model suggests that retail trade in a given county is a function of the customer base, the buying power of those customers, and the quality of the retail environment.

Key Words: retail trade pull factors, rural economic development, rural retail development,

Great Plains Research 16.1:63-71

BISON AND THE FOOD DISTRIBUTION PROGRAM ON INDIAN RESERVATIONS

David Lulka

*Department of Geography
San Diego State University
San Diego, CA 92182-4493
dlulka@rohan.sdsu.edu*

ABSTRACT—In recent years, bison products have been incorporated into the Food Distribution Program on Indian Reservations (FDPIR). This paper examines the factors leading up to this particular development and the structural problems that have yet to be resolved within the program. Altogether, the findings illustrate that cultural traditions, health problems, and economic concerns instigated the federal government to embark upon this new policy. Unfortunately, while the program has responded to tribal demands in certain respects, it has not resolved underlying structural inequalities between tribal and nontribal communities. In particular, the FDPIR does not acknowledge the problematic nature of production-consumption networks within the program. These networks currently undermine some of the fundamental reasons for including bison in the FDPIR.

Key Words: bison, Food Distribution Program on Indian Reservations, Great Plains, Native Americans

Great Plains Research 16.1:73-84

DEMAND ESTIMATION FOR AGRICULTURAL PROCESSING COPRODUCTS

Cheryl J. Wachenheim

Patrick Novak

Eric A. DeVuyst

and

David K. Lambert

*Department of Agribusiness and Applied Economics
Box 5636
North Dakota State University
Fargo, ND 58105-5636
cwachenh@ndsuxext.nodak.edu*

ABSTRACT—Coproducts of processing agricultural commodities are often marketed for use as livestock feed through private transaction. The resulting lack of historical price information prohibits the use of positive time series techniques to estimate demand. Linear programming is used as a normative technique to estimate step function demand schedules for coproducts by individual livestock classes. Seemingly unrelated regression is used to smooth demand schedules by fitting demand data to generalized Leontief cost functions. Estimates are adjusted for data censoring using probit analysis. Aggregate quantity demanded of sugarbeet pulp, wheat middlings, and potato waste is relatively responsive to price changes (i.e., demand is elastic) but less so for specific species and at higher prices for sugarbeet pulp (i.e., demand is inelastic).

Key Words: coproducts, demand estimation, econometrics, linear programming, livestock feeding

Great Plains Research 16.1:85-94