The Legacy of Nine-Mile Prairie

I. Brief History

II. Ecological Changes

III. Environmental Changes

IV. Changing Perspectives on Tallgrass Prairie Conservation

V. The Future of Nine-Mile Prairie

John E. Weaver (1884-1966)
1857: GLO Survey of 9MP – “The surface is of high rolling prairie”, no trees were noted. Bison and fire soon disappeared.

1885: Charles Bessey arrives at UNL

1898: Frederic Clements receives PhD UNL

Early 1900’s: 9MP owned by the Flader family (west half), and the McManaman family (east half). Most of the area hayed annually.

1909: John E. Weaver receives BS UNL

1915: J.E. Weaver new Professor at UNL

1927-1928: First ecological descriptions for “800 acres of treeless, unbroken prairie” by T.L. Steiger, a PhD student of Weaver (published 1930)

1934: J.E. Weaver publishes “The Prairie” in Ecological Monographs (one of >100 publications)

1930’s: Drought and Dust Bowl
1941: Professor Frank purchases eastern half of 9MP

1944: F.W. Albertson & J.E. Weaver publish “Nature & degree of recovery of grassland from the Great Drought 1933-1940”

1952: Weaver retires

1966: Weaver dies


1970’s: Lincoln Airport Authority acquires 9MP & Air Park. 9MP is rented by Ernie Rousek on behalf of Wachiska Audubon.

1981: Legislative Act (Bill 58) encourages LAA to protect 9MP (R.B. Crosby, E. Rousek, A.T. Harrison)

1984: NU Foundation purchases Nine-Mile Prairie (donation by Marguerite Hall)

2001: Michael Forsberg’s 9MP photo released as US postage stamp.
February 1950 – construction of weapons storage facility
Nine-Mile Prairie Area
2016-2018 image
Remaining unplowed land around Nine-Mile Prairie.

Map based on a time-series of aerial photos, but not validated with soil surveys.
Locations of prairie violet (v), ground plum (g) and indigo (i) plants in LAA Bunker area (June 2014). Note that the distribution of these flowers matches the remnant unplowed prairie distribution.

Unplowed land (yellow hatching) at and around Nine-Mile Prairie based on historic aerial photos.

Prairie violet, host for endangered regal fritillary butterflies found at Nine-Mile Prairie.
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John E. Weaver (1884-1966)
Fig. 14. Transects one half meter wide: A, near the head of a small ravine; B, 20 meters farther down the same ravine.


Fig. 15. Aspect chart showing the period of anthesis for each species of the several prairie habitats.
Current Nebraska Capital
Former Nuclear Bomb Bunkers

Long-term burned and hayed prairies
Steiger observed only one non-native species in his upland prairie quadrats: *Poa pratensis*. 
Grass cover at Nine-Mile Prairie in 1928 and 2011-2012

Cool-season grasses (C3)

Warm-season grasses (C4)
Issues with old and new species
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John E. Weaver (1884-1966)
How much nitrogen do we get from air pollution? To get the total we have to estimate the dry deposition component.

Figure 1. Map of Total Nitrogen Deposition 2013

Wet: 20 kg/ha = 2.0 g/m² = 19.6 lb/acre

Influence of Nitrogen Loading and Species Composition on the Carbon Balance of Grasslands

David A. Wedin* and David Tilman

In a 12-year experimental study of nitrogen (N) deposition on Minnesota grasslands, plots dominated by native warm-season grasses shifted to low-diversity mixtures dominated by cool-season grasses at all but the lowest N addition rates. This shift was associated with decreased biomass carbon (C):N ratios, increased N mineralization, increased soil nitrate, high N losses, and low C storage. In addition, plots originally dominated by nonnative cool-season grasses retained little added N and stored little C, even at low N input rates. Thus, grasslands with high N retention and C storage rates were the most vulnerable to species losses and major shifts in C and N cycling.

Productivity up
(red live, blue dead biomass)

Plant diversity down

Shift from warm-season to cool-season grasses
The most famous, but certainly not the only, record of our changing atmosphere.

Charles David Keeling (1928-2005)

http://keelingcurve.ucsd.edu/
What favors warm-season (C4) grasses?
Dry and hot conditions, but it’s not that simple.

“C₄ photosynthesis is an evolutionary solution to high rates of photorespiration and low photosynthetic efficiency caused by high temperature and low atmospheric CO₂. The C₄ pathway evolved independently over 45 times in 19 families of angiosperms, and thus represents one of the most convergent of evolutionary phenomena.” Rowan Sage, U of Toronto

Atmospheric Carbon Dioxide Concentrations

Ice Age (14,000 ybp) = 180ppm
Pre-industrial (1840) = 280ppm
2018 = 405ppm and going up
The 6-Million Year Battle between Trees (C₃) & Prairie Grasses (C₄)

I can’t imagine a better place to study this battle than Nebraska.

- We are a C₄-dominated landscape
- The importance of this battle has been clear for a century at UNL
- We have an incredible fossil record spanning the Tertiary when grasses became players in global vegetation
- We have excellent fossils from the period when C₄-dominated grasslands expanded.
- We have the worlds greatest company for equipment to measure leaf level physiology and atmospheric CO₂ dynamics

1900 - “We have to preach the crusade of filling Nebraska with trees, and to do that we must plant trees, and plant trees, and plant trees.” Charles E. Bessey

Tiezen et al. 1997
“Climax” prairie and trees in the prairie?

J. Weaver, 1965 (Native Vegetation of Nebraska)- “It has been conclusively shown that trees cannot successfully invade undisturbed true prairie (climax). This is not the opinion of a layman, but the conclusion after long-term experimentation and observation.”

P.V. Wells, 1965 (Science 148:246-249)- “It is misleading to describe the climate in the Great Plains as a grassland climate, with the implication that precipitation limits trees...Apparently, there is no range of climate in the vast grassland province of North America that is too arid for trees...the distribution of woodlands in the plains may be accounted for by the simple fact that topographic breaks have acted as fire breaks”.
Woody Encroachment in the Great Plains

- Woody species encroachment is changing the face of the Great Plains
- Expansion of mesquite (*Prosopsis*) in Texas and the Southwest
- Expansion of pinyon-juniper woodlands in the southwest and Great Basin
- Red Cedar (*Juniperus virginiana*) invasion in the tall grass prairie region
- Shifts in functioning within grasslands (balance of C$_4$ and C$_3$ grasses and forbs)
From UNL’s 2014 Climate Change Report (Bathke et al.)

Figure 3.3. The colors on the map show temperature changes over the past 22 years (1991-2012) compared to the 1901-1960 average, and compared to the 1951-1980 average for Alaska and Hawaii. The bars on the graphs show the average temperature changes by decade for 1901-2012 (relative to the 1901-1960 average) for each region. The far right bar in each graph (2000s decade) includes 2011 and 2012. The period from 2001 to 2012 was warmer than any previous decade in every region. (Source: Walsh et al., 2014)
Figure 3.4. The colors on the map show annual total precipitation changes for 1991-2012 compared to the 1901-1960 average, and show wetter conditions in most areas. The bars on the graphs show average precipitation differences by decade for 1901-2012 (relative to the 1901-1960 average) for each region. The far right bar in each graph is for 2001-2012. (Source: Walsh et al., 2014)
Lincoln Historical Data:

- Winter - up > 20°F
- Summer - up 10°F

It's getting warmer, but not that much hotter.

Warming is falling more in the winter, and spring is coming earlier.

Which plants will that favor?
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What a thousand acres of Silphiums looked like when they tickled the bellies of the buffalo is a question never again to be answered, and perhaps not even asked. 1948

Aldo Leopold
(1887-1948*)

1940’s

Grassland soils through untold centuries have been thoroughly protected by the unbroken mantle of prairie vegetation. The vegetation and soil are closely related, intimately mixed, and highly interdependent upon each other and upon the climate. Hence prairie is much more than land covered with grass. It is a slowly evolved, highly complex organic entity, centuries old. It approaches the eternal. Once destroyed, it can never be replaced by man.

University of Nebraska, January, 1944

John E. Weaver
(1884-1966)
I grew up in Iowa in the 1960—1970s. Prairie conservation took off in the 1970’s. The challenge was finding and protecting the few remnants of tallgrass prairie left in our agricultural landscape. Most pieces protected by schools, universities, DNR and TNC were less than 80 acres. The emphasis was on preserving prairie species, with limited effort put toward management (other than a fence and a sign). The North American Prairie Conferences, held every 2 years, began.
1980’s

Prairie conservationists began emphasizing prescribed fire as a management tool for healthy grassland natural areas, particularly in the tallgrass prairie region. Interest and expertise in prairie restoration rapidly grew. Elsewhere on the landscape, the Farm Crisis led to the start of the Conservation Reserve Program.
Nebraska Conservation Reserve Program in Nebraska

Nebraska CRP Past and Present

- Total CRP
- General CRP
- Continuous CRP

Acres (x100,000)

Year
1990’s and 2000’s

New Problems and Questions:
* Are small isolated prairie preserves viable in the long term?
* Why are we losing native plant and insect species in protected prairies, even with prescribed fire management?
* Why does the encroachment of shrubs and trees seem to be accelerating?
* Why does the invasion of non-native cool season grasses seem to be accelerating?
Threats to Prairies (Chris Helzer slide)

- Invasive Species
- Chronic Overgrazing
- Loss of Diversity
- Tree Encroachment
- Broadcast Herbicides

[Image of a prairie with arrows pointing to each threat]
“In 2016, NET will fund $18,780,000 in grants. By my count, 19% ($3,500,000) directly involve grassland conservation. Many of the other grants also impact grassland conservation.”

Mark Brohman

Mark Brohman, Executive Director, Nebraska Environmental Trust.
Grassland Conservation in Nebraska - 2018

1. Set realistic, forward-looking conservation goals. Chris Helzer (TNC) - “Building and maintaining ecological resilience in prairies”.

2. Plan, fund and manage grasslands at the landscape scale
3. Build conservation partnerships
4. Encourage grassland conservation on private lands in rural, agricultural landscapes
5. Use all of the tools in your grassland management toolbox:  
   * prescribed burning
   * herbicide control of woody vegetation and non-native plant
   * grazing
   * haying (different from mowing!)
   * managing species: overseeding/reseeding/restoration

6. Adjust/adapt to unprecedented global change in our grasslands (warmer winters, more big rain events, elevated CO2, atmospheric N deposition, new invasive species, etc)
7. Pollinators!!
The two faces of Grassland Conservation

Goal of the Neal Smith National Wildlife Refuge (central Iowa)
“Neal Smith National Wildlife Refuge was established in 1990 with ambitious goals and a multifaceted mission. The mission of the Refuge is to actively protect, restore, reconstruct and manage the diverse native ecosystems of tallgrass prairie, oak savanna, and sedge meadow. These were the native habitats existing on the Refuge’s 5600 acres prior to Euro-American settlement. “

Goal of the USDA Conservation Reserve Program
“The Conservation Reserve Program (CRP) is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. “
Resilient, diverse working landscapes
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Nine-Mile Prairie Partnerships

Wachiska Audubon

Lincoln Police Department

Neighbors (noxious weeds)

NRCS

Nebraska Forest Service
Areas in blue are either publicly owned (multiple agencies) or under long-term contract (USDA/NRCS) in a conservation program.

** Two Lincoln Airport Authority parcels being discussed (October 2018) by the Lincoln-Lancaster County Commission and the Lincoln City Council as properties to be sold for development.
Nine-Mile Prairie in Nebraska Natural Heritage Database of rare species occurrences (Rachel Simpson, NGPC, 1/9/2014)

“To summarize, the database shows four Tier 1 species (Married Underwing, Whitney’s Underwing, Iowa Skipper, and WPFO) and five Tier 2 species (Sedge Wren, Yellow-grey Underwing, Zabulon Skipper, Senna, and Spring Ladies’ Tresses) documented at Nine-Mile since 1985. As I mentioned we do not track Regal Fritillary, but it is a Tier 1 species that occurs at the site. “ (pollinator species in bold)
New pollinator habitat demonstration project at Nine-Mile Prairie

Nine-Mile Prairie
University of Nebraska – Lincoln

The 0.8-acre grassland of smooth bromegrass west of the entrance path was sprayed with an herbicide to suppress the grass and then interseeded with a 46 species seed mixture on April 15, 2014.

The seed mixture, donated by Stock Seed Farms, included 36 native forb and legume species that can support native pollinators and honey bees, including 6 rare moth and butterfly species found at Nine-Mile Prairie.

Dr. Bruce Anderson explaining use of a no-till drill to the capstone Grassland Conservation and Management course at 9MP

New pollinator planting after one growing season.

Please report problems to the Director, Nine-Mile Prairie
402-472-3471

For more information on this project see:
http://snr.unl.edu/aboutus/where/fieldsites/ninemileprairie.asp
Nine-Mile Prairie
University of Nebraska – Lincoln

This transmission line, built in 2008, is part of Lincoln Electric System’s North Tier II network of 345kv lines.

LES and UNL are working together at Nine-Mile Prairie to develop best management practices for maintaining high diversity prairie while meeting federal standards for control of trees and tall shrubs in transmission line right-of-ways. The approach emphasizes a combination of mowing, prescribed fires and targeted herbicide use on encroaching woody vegetation.

Please report problems to the Director, Nine-Mile Prairie
402-472-3471

For more information on this project see: http://go.unl.edu/ninemileprairie