# AMERICA'S GRASSLANDS CONFERENCE

UNITED FOR GRASSLAND CONSERVATION

PROCEEDINGS OF THE FOURTH BIENNIAL CONFERENCE ON THE CONSERVATION OF AMERICA'S GRASSLANDS

NOVEMBER 15-17, 2017 • FORT WORTH, TEXAS

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## PROCEEDINGS OF THE FOURTH BIENNIAL CONFERENCE ON THE CONSERVATION OF AMERICA'S GRASSLANDS

November 15-17, 2017
Fort Worth, Texas

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*Cover photo: Jaime Gonzalez*

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# INTRODUCTION TO THE PROCEEDINGS

America's Grasslands Conference continues to grow in significance and scope since its start in 2011. The National Wildlife Federation is proud to have hosted its fourth biennial grasslands conference in the southern plains from the 15th-17th of November 2017 in Fort Worth, TX. Aside from the geographic relocation of every conference, this iteration also included a unique merging with the Southern Plains and Prairies conference through our partnership with Native Prairies Association of Texas and the Coastal Prairie Partnership.

As before, the conference attracted participation from a diverse group of stakeholders with over 230 attendees in Fort Worth, TX. We had individuals from 24 states, the District of Columbia, plus attendees from Canada and Mexico. Participants included over 20 ranchers and producers, academics from over 20 universities and a number of other research institutions, 35 different non-profit organizations, multiple state and regional wildlife agencies, joint ventures, local and federal agency representatives, and numerous other entities ranging from conservation districts and wildlife reserves to native seed and prairie restoration companies.

This fourth conference was themed "United for Grassland Conservation." The suitability of the theme was apparent in the varied presentations on efforts to conserve grasslands and promote rangeland health from different sectors. The most common refrain heard at the Hilton Fort Worth was that there were too many interesting and relevant talks to choose from. We started the conference with a full day of fabulous field trips that enabled participants to visit native prairies in the Fort Worth area and learn about sustainable grazing and management activities.

During the conference we heard from a few groups on the tracking of continued conversion of native grasslands including new data regarding carbon emissions stemming from conversion of grassland and other habitats into crop production, in relation to the federal ethanol mandate. Others outlined their methodology for tracking annual grassland conversion in the northern plains. We had a number of livelihood centered sessions that ranged from panel discussions to individual presentations and roundtable discussions. Given the timing of the conference in the lead up to the 2018 federal Farm Bill negotiations, grasslands focused policy and the conservation programs were keenly discussed.

Many thanks to our conference organizing committee and to a number of other local groups in Texas that helped us plan the conference. The continued success of this conference owes itself to the dedication of a large group of individuals and we hope to continue this valuable partnership in conferences to come. Finally, the generous support from our conference sponsors is what continues to make America's Grasslands Conference possible and we are grateful for their continued contributions.

Lekha Knuffman
National Wildlife Federation

Pat Merkord
Native Prairies Association of Texas

Jaime Gonzalez
Coastal Prairie Partnership

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- North Central Chapter of the Native Plant Society of Texas
- USDA Natural Resources Conservation Service-Texas

# KEYNOTE AND PLENARY SPEAKERS

## KEYNOTE ADDRESS

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## PLENARY SPEAKERS

- **Steve Apfelbaum**
  **Applied Ecological Services**
- **Tyler Lark**
  **University of Wisconsin, Madison**
- **Jerry Doan**
  **Black Leg Ranch**

## STATE OF AMERICA'S GRASSLANDS: RECENT CONVERSION AND RESEARCH FRONTIERS

**Tyler J. Lark, University of Wisconsin-Madison**

*Other Authors: Matt Bougie, Beichen Tian, Holly Gibbs; all UW-Madison*

Grasslands provide several benefits to society, including the purification of water, avid recreational opportunities, and valuable forage and feedstocks for agricultural production. Despite the many benefits we derive from grasslands, they are the most human-impacted biome in the world, and nearly half of all temperate grasslands have been modified for human-dominated use (Hoekstra, 2005).

Recent research has shown substantial conversion of grasslands to croplands across the United States, to the extent of over 7 million acres of uncultivated land converted to cropland between 2008 and 2012 (Lark et al., 2015). Analysis of more recent data through the 2015 growing season suggests that widespread conversion of land has continued, albeit in varied location and magnitude. Key hotspots like North and South Dakota as well as southern Iowa continue to see high rates of conversion. However, new locations of elevated conversion like Kentucky are also emerging. Monitoring land conversion at the national scale will continue to be an important process for understanding the status and trends of grassland loss and conservation (Lark et al., 2017).

To better understand the types and history of grasslands converted to other uses, new research is underway to map intact lands across the United States. Intact lands are those that have not been previously cultivated and are thus likely to contain native prairie and sod. Our current approach to identifying intact land delineates areas that have not been planted, plowed, or otherwise improved for at least 25 years, and thus captures areas of both true native prairie as well as restored long-term grasslands. A map of all intact lands (including grasslands and other intact lands like shrublands, wetlands, and forest) across the United States is shown in **Figure 1.** This preliminary data is currently available at the field level, and collaborative efforts are underway to expand the dataset's historical coverage, certainty, and vegetation characteristics.

Research on grassland conversion has also identified several opportunities to help conserve these critical ecosystems. With respect to the Farm Bill, expansion of the Sodsaver provision to reduce crop insurance incentives for converting native sod could help protect remaining prairie locations. Currently, the Sodsaver provision applies to only six states surrounding the Prairie Pothole Regions. Expanding Sodsaver nationwide would provide more equitable and complete protection of our nation's intact native lands. In addition, effectiveness of the provision could be improved by closing the existing loophole allowing conversion of native sod to frequently uninsured crops

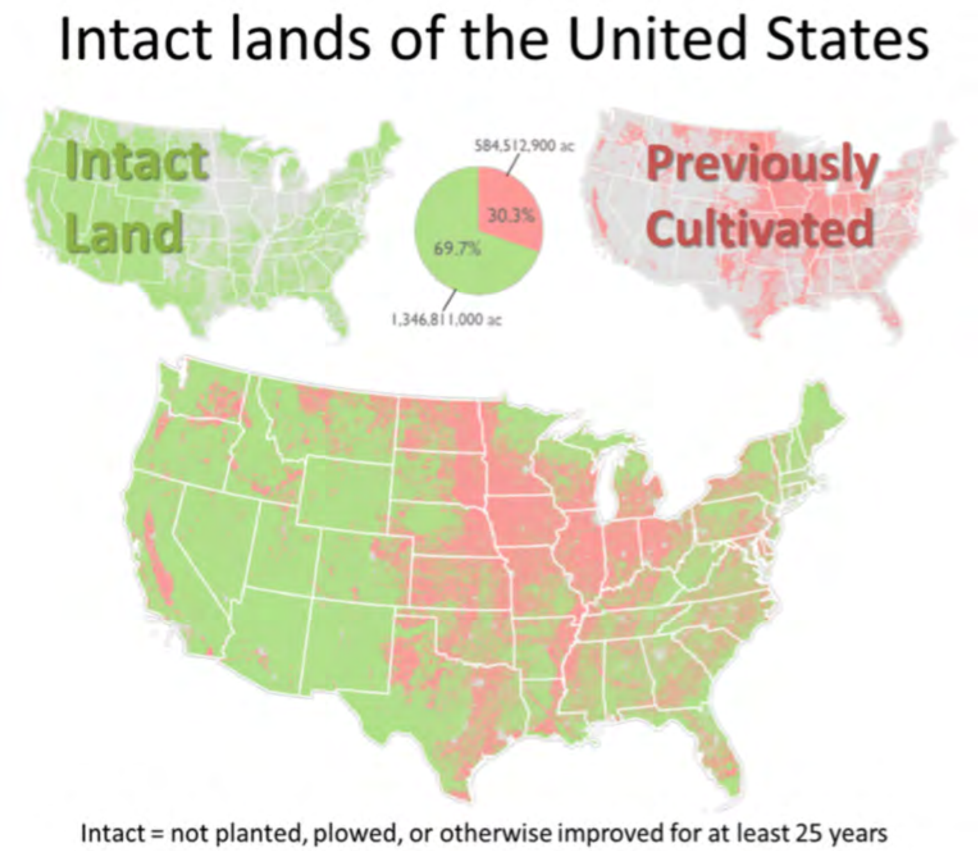


**Figure 1: Map of intact lands across the United States. The current approach identifies intact lands that haven't been planted, plowed, or otherwise improved for at least 25 years.**

like alfalfa and subsequently to insured row crops without reduction of insurance subsidies. Lastly, the improved mapping and monitoring of intact lands and land conversion could help enable actors across crop production and consumption supply chains to reduce the loss of grasslands and other native ecosystems across the U.S.

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## REGENERATING SOIL HEALTH TO BENEFIT WILDLIFE, THE BOTTOM LINE, AND QUALITY OF LIFE

### Jerry Doan, Black Leg Ranch

Black leg Ranch was started when my Great Grandfather came from Canada and then homesteaded in 1882 in what was then Dakota Territory. They lived in a sod house and we can only imagine what it was like to keep food on the table and stay warm in the Northern great plains.

*Photo: Shirley Gangwere*

My wife, Renae and I run the operation with our sons, Jeremy, Jay, and Jayce along with help from our daughter, Shanda. We are extremely fortunate as it is very unusual for all of your kids to want to come back to a life in ranching! This is after they all went away to get college degrees and work, and then decide they wanted to be the 5th generation to be involved in the ranch.

We operate a holistically managed operation. Our major goals that dictate our operational plan are.

1. We are a multi- generational operation which means are goal is to be able to turn the operation over to the next generation in better shape than we received it.

2. We want to be Diversified. Adding ventures or ideas that complement the operation

3. We want to regenerate our soil heath, including native range, cropland, and wildlife.

4. Profitability. Improving it to allow sustainability and growth

5. Quality of life. Improve it so all involved enjoy being involved

The grazing system we utilize involves short duration with high animal impact and long recover periods. It is a planned grazing system using planning and then adjusting for weather and grass production. This system mimics what the bison did on the range years ago. They came with thousands of head and grazed an area and caused very high animal impact with their hoof action and the spreading of urine and dung. We use fencing to replicate this. This allows cattle to be less selective and are constantly moving to new grass.

We have seen tremendous regeneration of our native range land with this practice. Very fragile, sandy land that was bare of grass is now becoming covered. Litter on the soil surface allows for better water infiltration and keeps the evaporation to a minimum. We see Big Bluestem moving up the slopes and the diversity of the grass and forage species improving. This is moving the grass land in a positive direction. The dramatic improvement in the range land has allowed pounds of beef produced to increase while allowing for nesting grassland wildlife species to flourish.

Another practice we are using to improve our cropland is the use of cover crops. Over years of constant tillage and erosion many cropland fields in the Northern Great Plains are very depleted in organic matter. This was amplified by the practice of a cropping system of wheat and black summer fallow. Wind erosion as well as water erosion was extreme and over time these lands have become far less productive or require higher and higher inputs causing the bottom line to look bleak.

In our operation we have three goals we use in our cover crop plans.

1. Use cover crops for winter forage to cut winter feed costs to our cattle
2.Build and regenerate soil health
3. Propagate the wildlife

As we have worked through this for several years now we have learned that by using full season cover crops we can meet these goals. We currently use a 20 cover crop species mix and plant it in mid-June. We use several legumes, brassicas, millets, collards, forage sorghums, etc. in the mix. The key is to use crop types for your goals and to have a lot of diversity. In nature there is much diversity and we have tried to change that with monocultures. We plant this mixture no-till at 23#/ acre with no additional fertilizer. We try not to use a burn down chemical application but sometimes we must to insure the weed pressure isn't extreme. We let this cover crop mixture grow for the season. It is excellent cover and a feed source for wildlife.

The principles of soil health that we strive to abide by are:

1. Keep litter on the soil
2. Increase plant diversity
3. Keep a living root as long as possible
4. No or little soil disturbance
5. Integrate livestock

This cover crop system we use is designed to help with nutrient cycling, water quality through improved infiltration, propagate wildlife, integrate livestock, and build soil health. This will work very well in crop rotation with other cash crops or forage crops. We utilize all four crop types to offer diversity in our rotation. Cool season grasses and broadleaves, and warm season grasses and broadleaves.

We have found that this system will keep soil temperature down around 70 degrees in the heat of the growing season. At 70 degrees biologic activity is at its maximum and near 100% of the water is going to the plant. This means evaporation is at close to zero.

As we graze these cover crops in the winters of N.D. you must have a back-up plan and some hay for extreme weather and blizzards. However, cattle adapt very well to grazing through snow which makes this work very well. We do use the Nutritional Balancer Program to monitor that we are meeting the cattle needs. It is also very easy to supplement with cubes or alfalfa hay if you fall below their nutritional needs line.

One item to remember if your goal is to improve soil health is to leave 50% of the cover crop in the field and not graze it. We must feed the soil!

The residue left after grazing:

1. Soil surface 100% covered
2. Improves water infiltration
3. Keeps evaporation down
4. Helps with weed pressure
5. Builds soil biology
6. Builds organic matter

We test the biology in our soil with the help of Jay Fuhrer, the N.D. NRCS soil health specialist. After removing the cows in the Spring of the year our total biology test was 7397ng/g. This was the highest total biology test ever taken in Burleigh Co. N.D. to that point. This shows this system has the potential to regenerate these depleted soils.

We have shown the N.D. Health Dept. this system and they are very encouraged. It keeps cattle on the land and out of the water sheds. It saves costs. It improves our public perception. Quality of life goes up and profitability improves!

We have added other ventures here on the ranch to help meet our holistic goals. Rolling Plains Adventures is a full-service hunting/outfitting business which has been featured on most national hunting shows. We also have established an Agri-Tourism operation to spread a positive message about agriculture to the consuming public. We have hosted all 50 states and some 40 foreign countries to the ranch through these entities. We host many grazing and soil health tours and workshops such as the Allen savory Grazing workshop this past summer. We have a living classroom on the ranch and are always willing to help educate and promote the regeneration of our natural resources.

Utilizing Holistic Management and working towards our goals have brought back excitement and fun to a profitable business structure while giving us extreme pride in the regeneration of grass lands, croplands, and wildlife. Tying it all together is what makes it successful!

# PRESENTATIONS AND POSTERS:

# 1. TRACKING THE THREATS, DRIVERS, AND STATUS OF CONVERSION OF GRASSLANDS

## TRACKING CROPLAND CONVERSION IN THE GREAT PLAINS AND QUANTIFYING THE BENEFITS OF CONSERVING GRASSLAND

**Anne Gage, World Wildlife Fund**

*Other Authors: Sarah Olimb, Jeff Nelson, World Wildlife Fund; Amanda Flynn, Chelsie Boles, Brian Lord, Derek Schlea, Todd Redder, Wendy Larson, LimnoTech*

We provide a summary of three recent analyses regarding grassland conversion in the Great Plains of the U.S. and Canada: 1) WWF's Plowprint update for 2016 showing grassland conversion to cropland; 2) an analysis of grassland conversion since 2009 based on soil suitability for cropland; and 3) the benefit of avoided grassland conversion in the Missouri River Basin quantified by water retention and sediment and nutrient discharge.

Grasslands are being converted to cropland at an alarming pace, and this conversion leads to a decrease in available habitat for wildlife and other species. WWF's Plowprint (Gage et al., 2016), an analysis that tracks conversion of grassland to cropland across the Great Plains, provides an annual snapshot of this change. For 2016, we found a loss of approximately 2.5 million acres across the Great Plains (excluding Mexico; Fig. 1). This represents a decrease in loss compared to 2015, when we found a loss of 3.7 million acres of grassland. Of the acres that have been converted to cropland since 2009, wheat, corn, soy and canola are the most common crops planted in 2016. In addition, about half of the acres that have been converted to cropland have reverted to some type of perennial cover, including grassland, wetland, shrubland, alfalfa, hay or abandoned fields. For additional information on the Plowprint, please visit www.plowprint.org.

In addition to tracking grassland loss, we also examined the overlap between soil quality and grassland conversion in the U.S. portion of the Northern Great Plains. Using soil conversion risk models developed

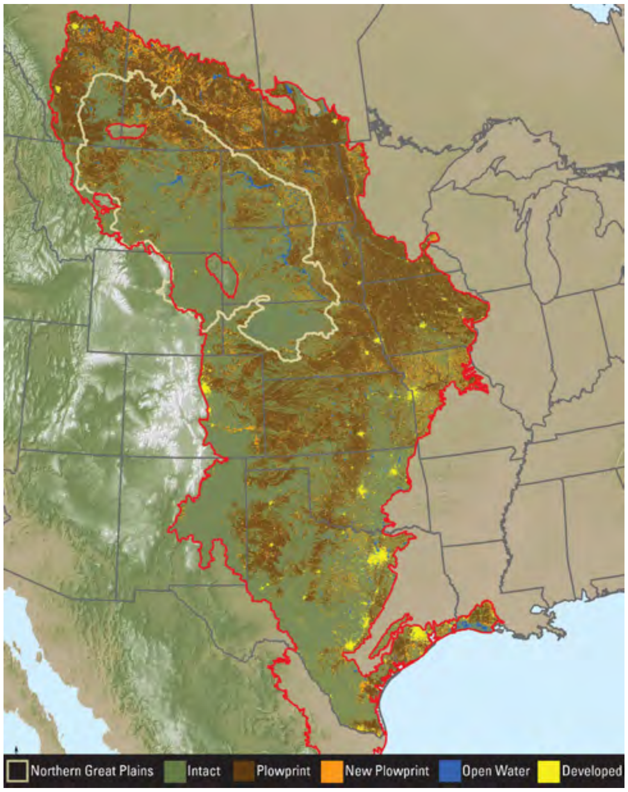


**Figure 1: Map of intact grasslands, Plowprint (lands that have been planted to crops beginning in 2009) and the new addition to the Plowprint in 2016 (lands that were plowed in 2016) in the Great Plains.**

by The Nature Conservancy (Smith et al., 2016), we compared conversion risk with areas that have been recently plowed. In 2016, we saw over 300,000 acres of conversion on soils with low to moderate conversion risk (i.e., less optimal soils for cropland); this accounts for over 60% of the new breakings that year. Cumulatively (since 2009), we show about 12.3 million acres of new breakings on soils with low to moderate conversion risk, and 19.7 million acres of new breakings on soils with high conversion risk. This overlay suggests that many of the new breakings are continuing to occur on soils with low to moderate risk that are not appropriate for row-crop agriculture.

Finally, we examined the benefits of avoiding grassland conversion on water quality and quantity in the U.S. portion of the Missouri River Basin. Currently, the Missouri River Basin is largely intact (~65%) and forms the “life zone” of the Mississippi River Basin; that is, the portion of the region that is largely intact and provides infiltration of precipitation, reduced erosion and carbon storage, among other ecosystem services. Our goal with this study was to predict the impact of conserving these grasslands on water quality and quantity.

Using the soil conversion risk model described above, we showed a predicted loss of 25 million acres of grassland to cropland in this region. We must note, however, that this is a conservative estimate because it assumes that only high conversion risk soils would be converted, which we see is not the case in our most recent Plowprint analyses. If we were to conserve those 25 million acres, instead of converting them, the total quantity of water saved is 5.2 M acre-feet annually, which is equivalent to the amount of water used annually by 11.6 million four-person households. The average amount of sediment saved per acre would be 1.8 tons/yr, or 46 million tons for all new modeled conversion, which is equivalent to 127 Empire State Buildings worth of sediment (based on weight). The average amount of nitrogen saved per acre would be 3.5 lbs/yr (over 40,000 tons/yr total), while the amount of phosphorus saved per acre is 16.9 lbs/yr (over 200,000 tons/yr total; Flynn et al., 2017).

We are interested in quantifying these benefits because the impacts of nitrogen and phosphorus pollution on aquatic resources are wide-ranging, including increased algal blooms, decreased water quality for human consumption, decreased quality of habitat for aquatic species, and decreased oxygen availability for fish and other species. Furthermore, nutrient pollution is directly linked to hypoxia, or dead zones, in the Gulf of Mexico. Maintaining grasslands could have an impact on downstream flooding events by regulating runoff, as well.

This research highlights the importance of maintaining intact, natural systems for improving water quality and increasing water quantity in the Missouri River Basin. While many communities rely on built infrastructure to ensure water availability, protecting natural systems is a simple way to ensure high-quality water supplies are available for future generations. Much research and emphasis has been directed toward the importance of forested systems for providing water quality and quantity benefits, but our work shows that intact grasslands are an important ecosystem to protect as well, and provide vital services to many communities in the Plains.

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# SHIFTING PRIORITIES FOR NORTH AMERICAN GRASSLAND CONSERVATION

**Joanna Grand, National Audubon Society**

*Other Authors: Chad Wilsey and Joanna Wu, National Audubon Society*

Prioritizing North American grasslands for conservation is urgent given the rapid decline of grassland birds due to land conversion. The most recent tri-national spatial prioritization of North American grasslands was conducted in 2005 by the Commission for Environmental Cooperation and The Nature Conservancy (CEC and TNC 2005) and modified in 2010 by the Bird Conservancy of the Rockies (Pool and Panjabi 2010). This comprehensive, stakeholder-driven conservation planning process resulted in the identification of 55 Grassland Priority Conservation Areas (GPCAs) throughout the Great Plains and Chihuahuan Desert. The focus of this prioritization effort was on the identification of areas of immediate conservation concern. Since then, rapid rates of land conversion have persisted and studies have better characterized the threat of climate change to grassland birds (Langham et al. 2015). Further, many have recognized the potential for market-based solutions to mitigate loss of healthy grassland habitat; however, decision-support tools to guide the strategic targeting of grasslands for these programs is lacking. Here we present a preliminary prioritization of North American grasslands intended to complement the GPCAs with projections of climate change impacts on the full annual cycle of grassland birds, using an optimization approach.

We conducted the analysis with the spatial conservation planning software Zonation V4 (Moilanen et al. 2014). Zonation produces a priority ranking of the landscape based on the level of suitability for multiple biodiversity features and optionally, condition of the landscape. The biodiversity features consisted of

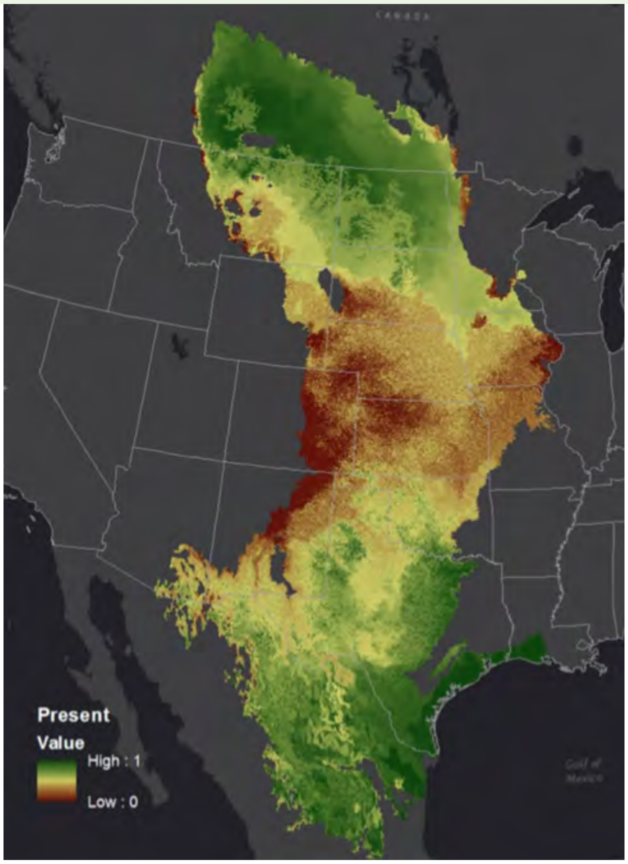


**Figure 1. Landscape ranking based on present-day distributions of 35 grassland bird species.**

Audubon's current and future projected distributions of 35 grassland-dependent birds (unpublished data). We used land cover change projections published by Li et al. (2016) to derive a binary landscape condition raster, representing suitable (1) and non-suitable (0) habitat. Inputs included each of the above data sets at four time steps; present, 2030, 2060, and 2090 for a total of 144 input rasters.

Results suggested that climate change will shift breeding season priority grasslands northward and non-breeding season priority grasslands toward the southwest, while projected future land-use change will have the largest negative impact in the east. Grassland strongholds, or grasslands that are currently high priority and will remain high priority in the future, were located mainly in the Coastal Prairie, central Texas, the western Chihuahuan Desert, Alberta, Saskatchewan, northern Montana and the Dakotas. High priority grasslands that are most vulnerable to conversion to other land uses include the Coastal Prairie, and portions of Alberta and Saskatchewan. This information will be used to inform the selection of ranches to target for enrollment in Audubon's

Conservation Ranching program. Future work will focus on regional grassland priorities in the Northern and Southern Great Plains.

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*Photo: Denis Josefina Perez-Ordonez*

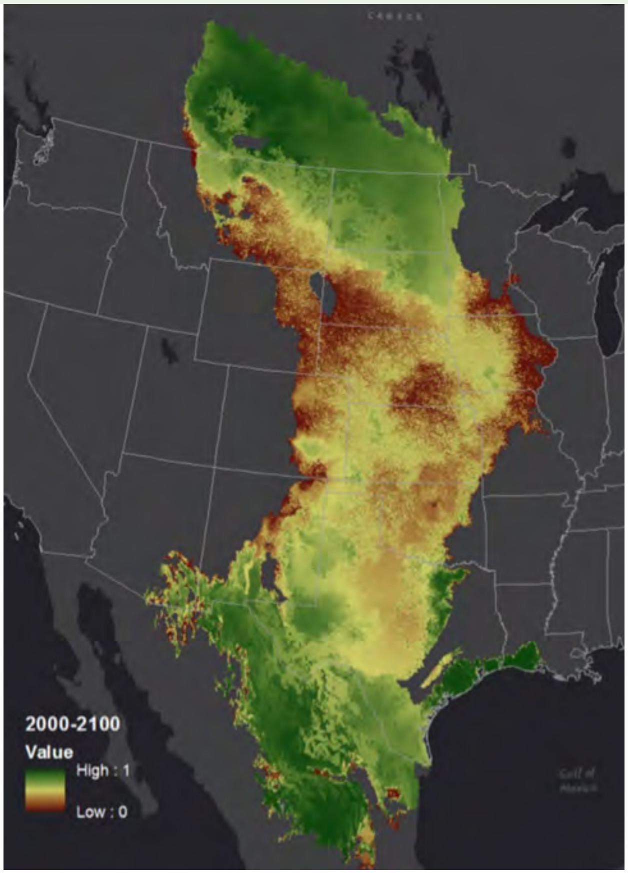


**Figure 2. Landscape ranking based on present-day and future distributions of 35 grassland bird species.**

# FARMERS' MOTIVATIONS FOR LAND CONVERSION IN THE PRAIRIE POTHOLE REGION OF NORTH AND SOUTH DAKOTA


**David Hennessy, Michigan State University**

*Other Authors: Mary Doidge and Hongli Feng, Michigan State University*


## Introduction

In the Prairie Pothole Region of the Northern Great Plains, land conversion has drawn attention and concern in recent years. Due to several factors, including technological advances making crop production more feasible and high crop prices through 2013, a significant amount of grassland in the Prairie Pothole Region has been converted for row crop cultivation. Net grassland losses in North and South Dakota from 2006 to 2011 have been estimated to be

220,000 and 450,000 acres, respectively (Wright and Wimberly, 2013). Corn and soybeans are the dominant crops grown on newly planted lands (Lark et al., 2015).

Land conversion in the region is a concern for several reasons. Grassland in the area provides the most important North American breeding ground for many migratory waterfowl bird species. Converting this land to grow crops, and especially to grow spring-seeded crops, may remove much of their remaining feeding and nesting grounds (Claassen et al., 2011). Conversion of land for crop production in the area may also be of lower quality and therefore require more intensive input use, potentially increasing the levels of fertilizer and pesticide residues entering the Greater Mississippi Watershed. Furthermore, conversion of grassland releases large amounts of sequestered carbon.

Previous studies of land conversion have primarily considered the economic drivers of conversion (Claassen et al, 2011; Rashford et al, 2011; Song et al, 2011; Miao et al, 2014). In work explicitly modelling farmers' conversion decisions, assumptions must be made about conversion costs (Song et al, 2011; Miao et al, 2014). These costs are important factors in conversion, and play a significant role in determining returns. In this work, we incorporate estimates of these costs and reported returns to land conversion obtained directly from farmers in small focus group meetings. These data, which are unavailable in the existing literature, enable us to directly estimate returns to land conversion. We also examine farmers' stated motivations for their land use decisions. This research provides valuable information for policy discussions regarding grassland preservation in critical ecosystems such as the Prairie Pothole Region.

## Economics of Land Conversion

To obtain comprehensive information on farmers' land use and conversion decisions, focus group meetings were conducted in early 2016. Meetings were held in four locations along the James River Valley (see Figure 1), in areas that have seen high grassland to cropland conversion in recent years. A total of 76 farmers attended these meetings. At these meetings, farmers completed questionnaires about their farm, farming practices, and land conversion in the preceding ten years (since 2006). We also collected information on conversion costs and returns from conversion, reliable estimates of which are unavailable from other sources. This allowed us to directly estimate returns to conversion among those who had converted land.

Almost 60% of farmers had converted some land on their farm in the preceding ten years, with 27% converting grassland to cropland. Farmers were asked to report the cost of converting their land for all land conversion undertaken on their farm since 2006. Farmers who had not converted land were asked to estimate costs for land on their farm that they would be most likely to convert. The average per-acre cost of converting grassland to cropland was $85.73 per acre.

Reported changes in land values after conversion were used to estimate returns to conversion were estimated for those who had converted land. We estimated returns to conversion for land that had not been converted using county-level averages for land in grass and land being used for crop production. These data were obtained from the 2015 South Dakota State University Farm Real Estate Market Survey report (Janssen et al., 2015) and the 2015 County Rents and Values North Dakota report (ND Department of Trust Lands, 2015). We compared the rental rates and land values for high productivity hay and range land to those for low productivity cropland to account for the possibility of converted land being of lower quality than land already in production. To estimate returns to conversion, we subtracted the reported conversion costs from these estimates.

The estimated returns suggest that there were significant gains to conversion among farmers who had converted land to cropland. For land converted from grassland, the average increase in rental rate was $79, and the average increase in net returns was $120 per acre. The average conversion cost for this type of land conversion was less than $86 per acre, indicating that conversion costs could be recovered roughly one year after conversion.

Using county-level rental rates and land values, the estimates of returns to land not converted suggest that there are negative returns to converting hayland to cropland. The difference between the rental rates of high productivity hayland and low productivity cropland were -$37 and -$324. These values for converting high productivity rangeland to low productivity cropland were $1 and $517, suggesting that returns to converting rangeland may be profitable for some farmers.

### Motivations for Land Use Change

Much of the previous work on farmers' land use decisions has approached the issue using secondary data rather than asking farmers directly about the factors that impact their land use and conversion decisions. A survey of North and South Dakota farmers was conducted in 2015 to query farmers about land conversion and the factors they consider when making land use decisions on their farms (Wang et al., 2017). A section of the survey asked farmers "how much impact has each of the following farm-related issues had on changes you have made in the way you use your land?" Ten factors listed were categorized into three groups: prices and policies (output prices, input prices, crop insurance, labor markets), technology (drought-tolerant seed, pest management issues, improved yields, better cropping equipment), and environmental concerns (wildlife, changing weather/climate).

Crop prices and improved crop yields were most often listed as those with the highest impact, with almost half (47%) stating that crop prices had quite a bit or a great impact on the changes to agricultural land use. Thirty eight percent said that input prices had the same level of impact. In contrast, environmental concerns were most often listed as having a low impact on farmers' land use decisions, with fewer than 10% of respondents reporting that improving wildlife habitats had a significant impact on their decisions. Almost 68% said that improving wildlife habitat had no or only a slight impact on their land use decisions. The responses differed according to their crop profile (proportion of land in crops), with those receiving more income from cropping more likely to report that economic factors had a high impact on their land use decisions.

At the focus group meetings conducted in 2016, farmers were asked to provide comments about the factors they consider when making land use decisions on their farms. Among participants, profit and economic concerns were stated as important drivers of their land use decisions, with almost 65% of farmers listing these factors. Farmers who did not convert land from grass to cropland stated that they considered land characteristics (often the physical characteristics of their land) when making conversion decisions. This may provide some insight into why farmers seem to forego potential returns to land conversion.

### Climate and Weather Conditions

Research has suggested that land use change is driven in part by changing climate and weather patterns that make the region more suitable for row crop production (Rietsma et al, 2015). In the initial survey conducted in 2015, farmers were asked specifically about the importance of weather and climate on their land use decisions. Farmers were asked to state the level of impact changing weather and climate had on their land use decisions, choosing from no (1), slight (2), some (3), quite a bit (4), or great (5) impact. Climate and weather ranked the seventh most important of the ten factors listed, with a mean importance response of 2.56. Almost 50% of respondents claimed that changing climate and weather had little or no impact on the way

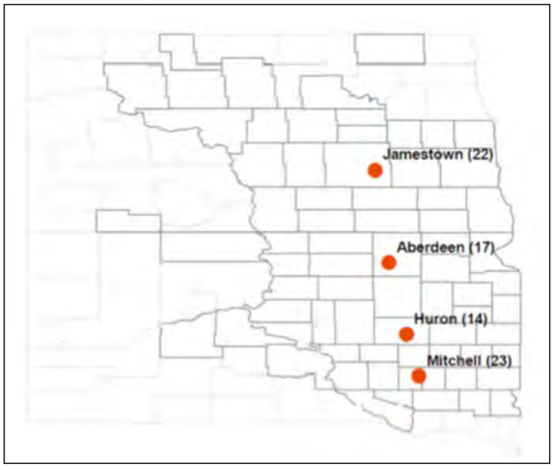


**Figure 1. Focus group meeting locations and counties represented. Counties outlined in dark grey. Numbers in parentheses indicate the number of participants at each meeting location.**

they use their land. Farmers in North Dakota were more responsive to climate and weather factors, reporting a mean importance of these factors of 2.69; farmers in South Dakota averaged 2.49.

In the 2016 survey, specific questions about the importance of changing weather and climate patterns were not asked of survey respondents. However, when farmers were asked open-ended questions about their land use decisions, weather and climate factors were mentioned very infrequently. Only three of the 76 participants mentioned weather as having an impact on their land use decisions, and no reference to changing climate patterns was made. These responses suggest that weather and climate factors have little direct influence on farmers' land use decisions. This may have implications for farmers' willingness to adopt strategies aimed at addressing climate change, and for policies aimed at encouraging such strategies.

## Conclusion

The results from the two surveys of farmers in the Prairie Pothole Region of North and South Dakota shed light on how farmers make important land use decisions on their farms. Profit and economic concerns were consistently stated to have the largest impact on farmers' land use and land conversion decisions in both surveys. Comparatively, climate and weather conditions had little direct impact on farmers' land allocation decisions.

Farmers who have converted land out of grass for crop production have likely received significant economic returns from doing so. Our estimates of returns to conversion indicate that conversion costs are significantly less than estimated increases in land value. However, our estimates of the potential returns to land not yet converted do not indicate that all such conversions would be profitable. Farmers who have not converted land from grass to crop listed the physical characteristics of land more frequently than those who have converted, suggesting that the land may not be suitable for other uses. Nevertheless, estimates in this paper indicate that there may be significant gains to converting grassland to grow crops that are not being captured by farmers and landowners, which warrants further investigation.

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*Photo: Kirsti Harms*

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## COLLABORATIVE ADAPTIVE RANGELAND MANAGEMENT: A MODEL FOR GRASSLANDS CONSERVATION?

**Ted Toombs, Environmental Defense Fund**

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Understanding the human dimensions of decision-making for socio-ecological systems in complex semiarid rangelands is needed for sustainable management. The vast majority of prior research on this system has focused on biophysical responses to management with human dimensions largely excluded. There is an emergent need for novel approaches that incorporate science into management decisions to optimize tradeoffs between conservation and production goals. Here, we showcase the inclusive, participatory approach of 11 Stakeholders in the Collaborative Adaptive Rangeland Management (CARM) initiated in 2012 that enhances learning and trust through a facilitated stakeholder engagement process. This process is compared and contrasted with the current predominant conservation approaches associated with private land owners and governmental agencies.

## UNDERSTANDING AND ADDRESSING THREATS ON NATIONAL GRASSLANDS: A REVIEW OF FOREST SERVICE RESEARCH

**Deborah M. Finch, USDA Forest Service Rocky Mountain Research Station**

The USDA Forest Service manages 20 National Grasslands and 1 tall grass prairie, the majority located in the Great Plains. This presentation seeks to increase the visibility of National Grasslands by providing an overview of their history, mission and distribution, and offers a snapshot of the research that Forest Service conducts on grasslands. Topics include studies of invasive plant species and methods for controlling them, energy development, landscape level patterns of grazing effects, and plant - pollinator interactions with climate. In addition, methods and models for restoring resilience and resistance of grasslands depending on types of threats, soil moisture and climate, and restoration objectives are explored.

## THE RANGELAND VEGETATION SIMULATOR: A DECISION SUPPORT TOOL FOR MONITORING AND PROJECTING GRASSLAND CONDITIONS

**Paulette L. Ford, USDA Forest Service Rocky Mountain Research Station**

*Other Authors: Matt C. Reeves, USDA Forest Service*

Rangeland landscapes occupy roughly 662 million acres in the coterminous U.S. (Reeves and Mitchell 2011) and their vegetation responds quickly to climate and management, with high relative growth rates and inter-annual variability. Current national decision support systems in the U.S. such as the Interagency

Fuels Treatment Decision Support System (IFT-DSS) require spatially explicit information describing production, fuels, grazing capacity and successional trajectory. However, no single system presently offers this information. In addition, issues of increasing national attention, such as preservation of lekking birds (e.g. greater sagegrouse *(Centrocercus urophasianus),* and greater prairie chicken *(Tympanuchus cupido),* has prompted new management guidelines such as stubble height standards. Currently, ecological tools for predicting this type of management outcome on rangelands are quite limited in their ability to predict these variables. We developed a program for simulating succession, productivity, and fuels in non-forest environments called the Rangeland Vegetation Simulator (RVS). The RVS uses Normalized Difference Vegetation Index from a variety of sensors (it is agnostic to spatial resolution), combined with Biophysical Settings (Bps) from the LANDFIRE Project, and includes subroutines for management options including fire, and herbivory. The RVS can also work in concert with Ecological Sites to produce annual estimates of vegetal structure and composition. In addition, subroutines or parameters from the RVS can be used in concert with ST-Sim, an ecological simulation program aimed at probabilistic estimation of landscape conditions. Planners and managers alike can benefit from using RVS to understand likely management outcomes. In this vein, we have deployed the program to aid the National Forest System in Regions, 3, 4, and 5, and to provide a demonstration of the capabilities of the RVS. This project provides the best available science and information for planning and management activities, especially where geo-referenced plot data are lacking. In this paper we discuss applications and results derived for grasslands and shrublands in varied habitats across the extent Regions 3, 4, and 5.

## Study Area and Methods

We focused on Regions 3, 4, and 5 of the USDA Forest Service (Figure 1). RVS was applied to these regions to assist Forest Plan Revision and NEPA assessments. Grazing allotments under USFS jurisdiction were obtained and used to aggregate results to represent allotment–wide trends (Figure 1). In addition, we wanted to examine how much variability could be explained in the trends of annual production by the US Drought Monitor (https://www.drought.gov/drought/) given its linkage with the numerous disaster relief programs such as the Livestock Forage Payment program. To do this we quantified the annual summation of drought monitor values and compare these with the production trends in allotments of Region 5. In Regions 5 and 4 we focused on quantifying trends in annual production (pounds per acre) from 2000 to 2015 and 2000 to 2016, respectively, whereas in Region 3, we focused on characterizing the range of variability of forage from 2000 to 2016. To quantify annual production for Regions 4 and 5, the RVS was run in a spatially explicit mode, at 250 m spatial resolution, with no presumed management actions (such as prescribed fire or herbivory). For each year in the analysis, and for each allotment, average annual production was quantified and linearly related (Pearson) to time as a means of detecting trends in annual production. For Region 3 the linear correlation (Pearson) of production with time was calculated in addition to the coefficient of variability (C.V.) (standard deviation as a proportion of the mean) from 2000 to 2016.

## Results

Overall, in Region 5, about 34% of the area experienced positive or flat trends in annual production. However, less than 1 percent of the region exhibited strong positive correlation (0.7 or greater). In comparison, 6% of rangeland vegetation analyzed exhibited correlation coefficients of annual production with respect to time of -0.7 or less (increasingly more negative) (Figure 2). This is somewhat expected since the Region has experienced very significant drought, over the study period. However, the US Drought Monitor only explained, on average, about 31% of the variation in annual production. This suggests that other factors are influencing the trends we observed, or that the US Drought Monitor is not a good indicator of rangeland production on annual time-steps. In Region 4 the production situation was markedly different. From 2000 to 2016 in Region 4 only 3.2% of grazing allotments exhibited negative trends in excess of

-0.7 while not a single allotment exhibited a positive correlation in excess of 0.7. Note the prevalence of estimated declines in the northern part of Region 4. The region has experienced many wildfires from 2000 to 2016 so it is reasonable to expect that some of this decline could be explained by wildfires and this should be considered for another study. This demonstrates the capacity of RVS to support an objective assessment of conditions to identify where rangelands are trending in one direction or the other, indicating where further study or monitoring are needed. In Region 3, extreme variability (up to 81% C.V.) was observed in rangeland production in the region. This situation is exemplified by the extreme range of production from about 400 to over 1,100 pounds per acre in 2006. For context, average variability of production on U.S. rangelands is about 15%. Interestingly, in 2006 in New Mexico, the first 6 months of the year were some of the driest on record while the last 6 months were some of the wettest and the production response was captured by the RVS. This represents one of the strengths of the RVS which is consistent and objective monitoring across large areas enabling comparison between areas and to identification of "hot spots" or areas requiring further examination. Figure 2 demonstrates that a good number of grazing allotments in California have seen steep declines in rangeland production and that, in some cases, these allotments are in close proximity to allotments where little or decline is observed. One explanation is different soil or vegetation conditions, or perhaps fire has influenced the trends in production. In either case the RVS offers a platform to examine these trends and provide impetus and rationale for pinpointing or prioritizing monitoring and possibly management actions.

## Conclusions

Here we offer examples of how the RVS can be used to quantify rangeland conditions. The most significant findings and implications can be characterized with three points. First, significant trends in rangeland production in Regions 3, 4, and 5 have been quantified using the RVS. These trends are both positive and negative depending on the allotment being analyzed. Second, extreme variability in rangelands of Region 3 have been quantified and this information can be directly used by managers and producers alike to put upper and lower bounds on expected forage yield. In this manner, the RVS and will be helpful for both ranch planning and allotment management. Third, overall, southern California has experienced significant declines in rangeland production, explained in part by the serious droughts that have manifested across that region. The data produced by the RVS clearly indicate that it can support activities such as Forest Plan revision, NEPA analysis, and improve communication between land managers and constituents, such as permittees, to manage expectations more efficiently.

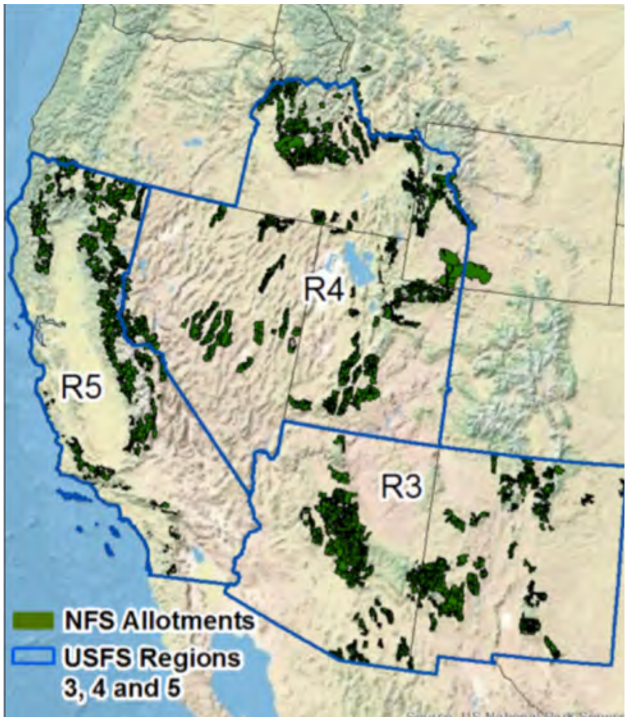


**Figure 1. Regions and allotment. Location of Regions 3, 4 and 5 and grazing allotments used in the analysis.**

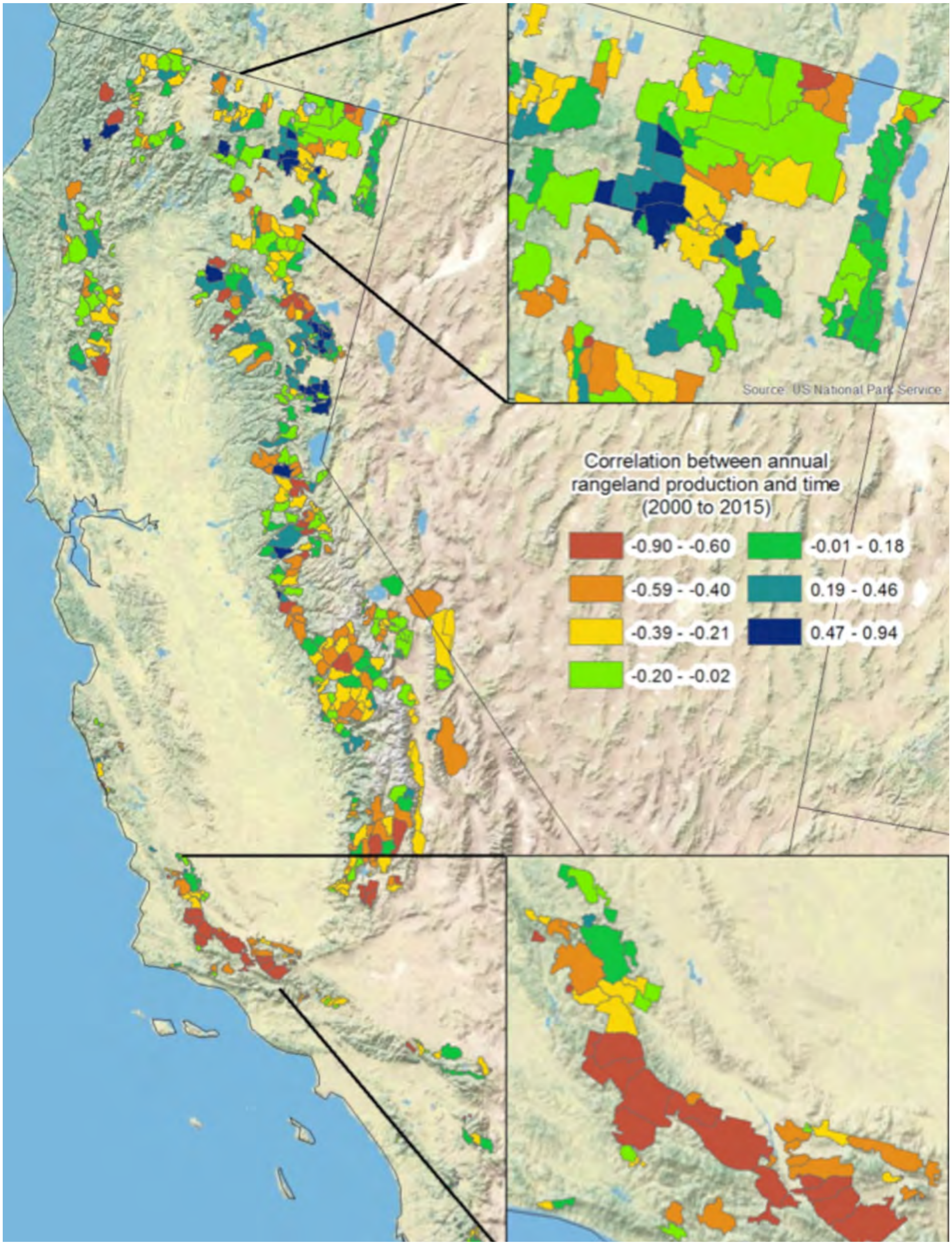


**Figure 2. An analysis of annual rangeland production from 2000 to 2015 in Region 5. Shown are grazing allotments and the correlation between annual rangeland production and time. Data were aggregated to grazing allotments for display purposes.**

# 2. GRAZING AND MANAGEMENT

## UPLAND BARE GROUND AND RIPARIAN VEGETATIVE COVER UNDER STRATEGIC GRAZING MANAGEMENT, CONTINUOUS STOCKING AND MULTI-YEAR REST IN NEW MEXICO MID-GRASS PRAIRIE

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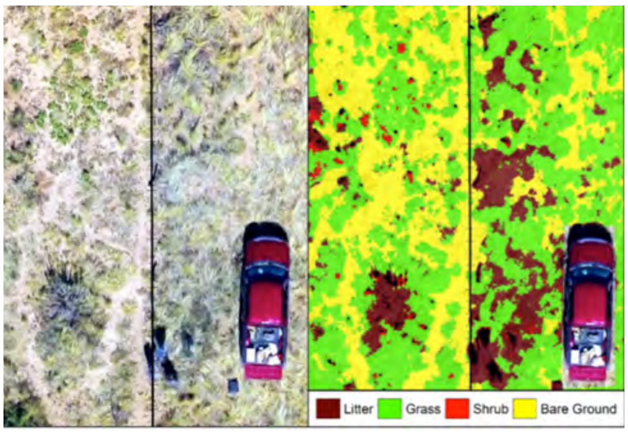
Despite the complex nature of biophysical systems, ranchers need ways to assess ecological progress, and grazing management practices must be science-based to be broadly accepted. We used innovative remote sensing technology in this case study to quantitatively assess whether four New Mexico mid-grass prairie ranches using Strategic Grazing Management (SGM) and rotational grazing, had less upland bare ground and more riparian vegetation than neighboring lands which did not use SGM.

All four subject ranches managed using *long recovery periods,* short grazing periods and few herds. Pastures were generally grazed less than 10% and recovering for 90% of each calendar year. While neighboring lands were generally managed with continuous stocking (CS), some received multi-year (>3 years) rest. A combination of Ground-Based Vertical Photograph and Pleiades 0.5m2 were used to develop continuous cover maps of each subject ranch and neighboring pastures in fall of 2015. This allowed us to compare upland bare ground and riparian vegetative cover on 700+ ecologically similar paired polygons along 100-m wide strips along either side (inside and outside) of the perimeter boundary of the four subject ranches. Since these adjoining, paired SGM/non-SGM polygons received identical precipitation and were of the same SSURGO soil type, any differences observed in ground cover characteristics were attributed to differences in management rather than weather or soil type. Pleaides imagery was then used to train (correlated with) Landsat 30m2 imagery to determine percent riparian vegetative cover on paired SGM and CS managed stream reaches crossing subject ranch boundaries. This allowed us to compare riparian vegetative cover trend through time (1984-2015). Reported long-term stocking rates on both the subject and neighboring ranches were generally in the range of 40-60 acres/AU. Ranchers lowered stocking rates (or de-stocked) when severe drought limited forage and water.

Upland bare ground averaged significantly less (13% less; $p < 0.001$) on SGM ranches than on adjacent paired polygons (using pooled data from all four ranches). On Ranch 3 alone, bare ground was significantly lower on SGM than adjacent CS polygons (27% lower, $p < 0.001$) and lower than on adjacent polygons rested > 3 years (20% lower; $p = 0.072$). Riparian vegetation averaged 19% greater on SGM stream reaches than on paired CS reaches ($p < 0.002$), 1984-2015. However, precipitation-driven changes in percent riparian vegetation on both SGM and CS pastures over the thirty-year period caused cover values to fluctuate significantly, and to converge at high and low precipitation extremes. Initial comparisons of soil carbon from samples taken on SGM, CS and rested pastures suggest that soil carbon values may be 30% greater on SGM pastures than on CS pastures, and are comparable to values on pastures rested > 3 years.

Results of this study suggest that SGM practitioners may be able to improve ground cover (comparable to multi-year rest) and generate grazing revenue. It is difficult to determine how much of the observed effects were due to the practices employed vs. the skill of the practitioners – the two are intertwined. However, we believe this type of innovative monitoring and analysis on large, working landscapes provides invaluable feedback to land managers, scientists and others striving to learn, adapt and build resilience in the face of constantly changing conditions.




**Drone-photo on the left, and corresponding ground cover classification on the right.**

## SIMULATED IMPACTS OF GRAZING MANAGEMENT PRACTICES ON RESTORATION OF KEY ECOSYSTEM SERVICES

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*Other Authors: Jongyoon Park, Korea Environment Research; Richard Teague, Texas A&M AgriLife Research*

Grazing management practices have a significant influence on ecosystem services provided by rangelands. The heavy continuous (HC) grazing in which high stocking rates (9 to 11 ac/cow) are maintained is commonly adopted on most ranches. However, it causes soil compaction, reduces infiltration and increases sediment and nutrient losses. The light continuous (LC) grazing under which the stocking rates are reduced to 18-20 cows/ac, eliminates some of the negative environmental impacts of HC grazing, but it results in lower forage quality and yield, and uneven manure distribution. In contrast, adaptive multi-paddock (MP) grazing has the potential to increase vegetative cover, and reduce sediment and nutrient losses while maintaining high stocking rates (9 to 11 cows/ac). The objective of this study was to compare the impact of HC, LC and adaptive MP grazing practices on key ecosystem services at the ranch and watershed scales using the Soil and Water Assessment Tool (SWAT; Arnold et al., 1998).

The Clear Creek Watershed, which is located in north central Texas was selected for this study (Figure 1) because it consists of large extent of rangelands (in about 71% of watershed area), and contains four study ranches that have been monitored by the Rangeland Ecology Group at the Texas A&M AgriLife Research center at Vernon over the last decade. While the Mitchell and Danglemayr Ranches in the Clear Creek Watershed have been under the HC and LC grazing practices, respectively over several generations of landowners, the Pittman and Leo Ranches have been under the MP grazing practice for more than 20 years. In addition, two grazing exclosures (EX) of 78.5 m2 each, which have been protected from grazing, exist at the Pittman Ranch.

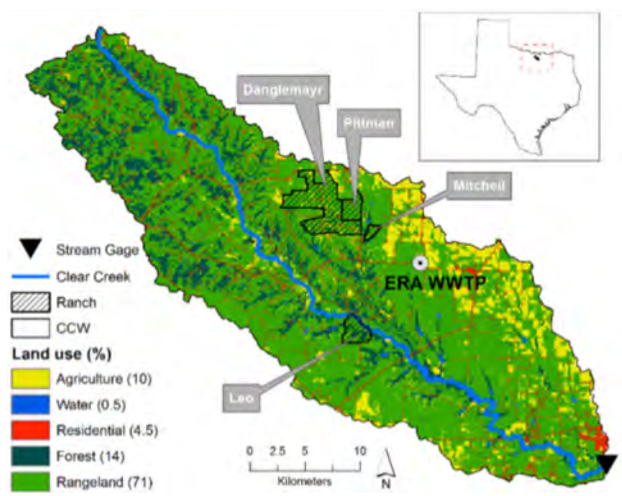


**Figure 1. Map showing the Clear Creek Watershed in Texas with 2011 land use.**

The SWAT model is a process-based, daily time-step, river basin/watershed scale model, which is widely used to assess the effects of changes in land use and management including grazing management, on hydrology and water quality. The model was initially calibrated and validated at the ranch-scale using measured data on daily soil moisture (over 2 years, 2011-2012) and plant biomass weight (over five years, 2009-2013) at the study ranches in the watershed (Park et al., 2017a). The model was then calibrated and validated against measured streamflow (34 years, 1980-2013), sediment losses (1994-2009), and total nitrogen and total phosphorous losses (1986-2009) at the watershed outlet (Park et al., 2017a, 2017b).

After achieving a satisfactory calibration, the model was used to run three alternate grazing management scenarios including: i) replacement of baseline MP grazing practice at the Pittman Ranch with the LC, HC and EX grazing practices, ii) replacement of HC grazing, which was simulated in the entire rangeland in the watershed (except in three study ranches) under the baseline scenario, by LC and EX grazing practices, and iii) simulating MP grazing in the entire watershed by assuming each subwatershed as a paddock. The simulated effects of these changes in grazing management on average (1980-2013) annual water balance components, sediment and nutrient losses, and streamflow characteristics were then assessed.

At the ranch-scale, when the baseline MP grazing management at the Pittman Ranch was replaced with the HC and LC grazing, the simulated average (1980-2013) annual water yield (sum of surface runoff and baseflow) from the ranch increased by 39% and 14%, respectively (Table 1). Interestingly, changing grazing management from MP to HC (or LC) resulted in an increase in surface runoff and a decrease in baseflow, which indicates that more water was retained in the soil under the MP grazing when compared to HC and LC grazing.

At the watershed-scale, changing the grazing management in the Clear Creek Watershed from the baseline scenario (predominantly HC grazing) to adaptive MP grazing resulted in the reduction of average (1980-2013) annual streamflow, and sediment, total nitrogen and total phosphorus losses by about 30%, 40%, 35% and 34%, respectively (Figure 2). In addition to the reduction in streamflow, the frequency of high flow events decreased substantially under the MP grazing, indicating that the adoption of MP grazing practices within the watershed has the potential to reduce flood-risk downstream of the watershed.

**Table 1. Simulated average (1980-2013) annual water balance components, and sediment and nutrient losses from the Pittman Ranch under the baseline MP and alternate HC, LC and EX grazing practices (values in parentheses indicate percent changes from the baseline MP scenario) (adopted from Park et al., 2017a, 2017b).**

| Component | Grazing management scenario | | | |
|---|---|---|---|---|
| | HC | LC | MP (baseline) | EX |
| Precipitation (mm) | 878.4 | | | |
| Infiltration (mm) | 790.5b (-5) | 821.9a (-2) | **835.7a** | 843.2a (1) |
| Water yield (mm) | 131.7a (39) | 108.0ab (14) | **94.8ab** | 89.1b (-6) |
| Surface runoff | 88.0a (106) | 56.6ab (32) | **42.8b** | 35.3b (-18) |
| Baseflow | 43.7a (-16) | 51.5a (-1) | **52.1a** | 53.8a (3) |
| Sediment (ton ha$^{-1}$) | 9.3a (677) | 5.3a (345) | **1.2b** | 0.9b (-24) |
| Total nitrogen (kg ha$^{-1}$) | 14.4a (390) | 8.7a (196) | **2.9b** | 2.4b (-20) |
| Total phosphorus (kg ha$^{-1}$) | 2.9a (883) | 1.5a (403) | **0.3b** | 0.2b (-24) |

**Within a row, means followed by the same letter are not significantly different ($p < 0.05$).**

Furthermore, the hydrologic and water quality responses to the MP grazing were found to be similar to those under no grazing (EX). Overall, the results from this North Texas study indicate that with appro¬priate MP grazing management, ruminants facilitate provision of key essential ecosystem services such as increase in infiltration and water holding capacity; decrease in surface runoff, erosion and soil nutrient losses; and reduction in the chances of flooding downstream of a rangeland-dominated Clear Creek watershed.

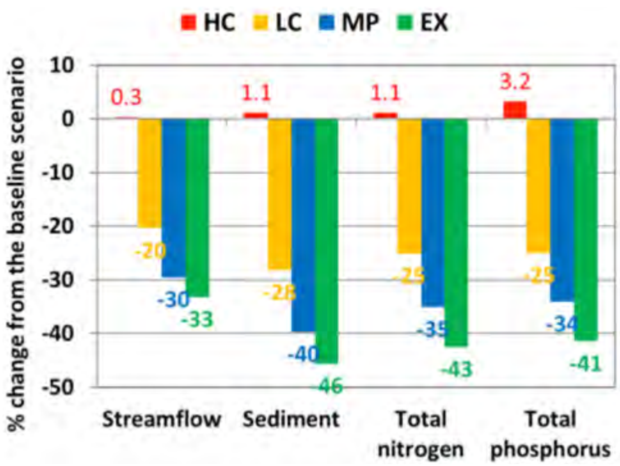


**Figure 2. Effect of changes in grazing management on streamflow and water quality at the watershed outlet.**

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## DUCKS UNLIMITED'S COVER CROP & LIVESTOCK INTEGRATION PROJECT - A WORKING LANDS APPROACH TO CONSERVATION


### Tanner Gue, Ducks Unlimited, Great Plains Regional Office, Bismarck ND

*Other Authors: Jonas Davis, Ducks Unlimited*


The grasslands and wetlands of the Prairie Pothole Region (PPR) are some of the most unique habitats in the world. They support hundreds of different wildlife species including more than 50% of North America's breeding duck population. However, pressures to convert grasslands and wetlands to row-crop agriculture also make the PPR one of the most threatened ecosystems in the world. In this presentation, we briefly discuss 1) some current trends in conservation and agricultural practices in the PPR, 2) a new working lands conservation program intended to reduce habitat conversion pressures, and 3) the benefits of this novel approach to agricultural producers, our natural resources, wildlife and society.

Current conservation program strategies on privately owned and operated lands in the PPR have proven effective. For example, since 1997, Ducks Unlimited and the U.S. Fish and Wildlife Service have perpetually protected 1,195,271 acres of grassland and more than 265,828 acres of wetlands in the PPR of the Dakotas and Montana alone. United States Department of Agriculture programs, like the Conservation Reserve Program and the Environmental Quality Incentive Program, are also significant short-term conservation options for agricultural producers. Even with extensive conservation program options like these, grassland loss rates continue to exceed habitat protection rates in the PPR (Doherty et al. 2013). Between 2006 and 2011, more than 1.3M acres of grasslands were converted to row-crop agriculture, primarily for corn and soybean production (Wright and Wimberly, 2013). During this same time when crop rotations have become less diverse in the region, the number of cattle have also declined. For example, the cattle herd in North and South Dakota declined by more than 70,000 head (USDA, 2017).

The loss of grassland and wetland habitat taken together with reduced agricultural diversity has resulted in several negative impacts. At the scale of individual farms and ranches, the primary impact is degraded soil health. Soils in poor health have low organic content, reduced nutrient availability to cash crops, increased soil compaction, and reduced water infiltration. This may ultimately lead to reduced profitability of cropland and grassland acres for farmers and ranchers. Reduced soil health at the local farm and ranch scale can also have implications at a much larger watershed scale. For example, unhealthy soils may be susceptible to to increased rates of surface runoff, which is frequently associated with increased sediment loads deposited into downstream aquatic environments. Increased runoff also carries fertilizers such as nitrogen and phosphorus, resulting in eutrophication of downstream environments. The conservation community must work closely with farmers and ranchers to identify functional solutions that promote sustainability for both the agricultural community and habitat conservation.

To address degraded soil health and associated resource concerns, some innovative producers in the eastern Dakotas have started using cover crops and integrating livestock on their cropland. Diversification of cropland systems using cover crops, a type of plant or mixture of plants grown in conjunction with or between principle cash crops, can improve overall soil health and functionality by restoring organic matter, reducing wind and water erosion, increasing soil aggregate development and porosity, reducing soil compaction, and increasing water infiltration (Hoorman 2009). Importantly, integration of livestock on cropland further enhances soil health. Grazing stimulates plant root growth, urine and manure distributes carbon back to the soil, and the nutrient cycle process is strengthened (Hillmire 2011).

The use of cover crops and livestock integration may also have benefits for conservation of grassland habitat. For example, increased grazing days on cropland may increase the rest recovery period on adjacent grasslands, providing enhanced nesting cover for ground nesting birds and thermal cover for overwintering wildlife species. Perhaps most importantly, these kinds of practices may reduce pressures to convert grassland and wetland habitat by providing a mechanism to keep livestock on a landscape that currently lacks agricultural diversity.

With assistance from local landowners, the North Dakota Natural Resources Trust, Pulse USA, and North Dakota's Outdoor Heritage Fund, Ducks Unlimited built a conservation program called the "Cover Crop & Livestock Integration Project" (CCLIP). The primary goal of CCLIP is to offer short-term voluntary project options that provide landowners with the incentive needed to kick-start cover crops and livestock integration on cropland. Farmers and ranchers interested in this 5-year program have the opportunity to plant cover crops and develop grazing infrastructure on cropland (Fig. 1). CCLIP provides up to 60% cost share on grazing infrastructure that consist of, but are not limited to fencing materials, windbreak panels, rural water hookups, well hole and casing, water tanks, solar and/or wind stations, electrical hookups, water pumps, and pipelines. CCLIP also provides up to 60% cost share for expenditures associated with cover crop seeding equal to as many as but no more than two years for each enrolled cropland acre. North Dakota producers enrolling in CCLIP may also receive a discount on cover crop seed mixes from Pulse USA, should producers choose to order seed from Pulse USA. Provisions include no-till practices, cover crops planted at least two out of five years, no wetland drainage for the extent of the agreement, and grazing management plans. CCLIP partners will help producers develop grazing plans based on duration, rest recovery time, available crop residue, and cover crops. However, grazing plans will give farmers and ranchers the flexibility to adapt given changing resource conditions while maintaining their soil health goals.

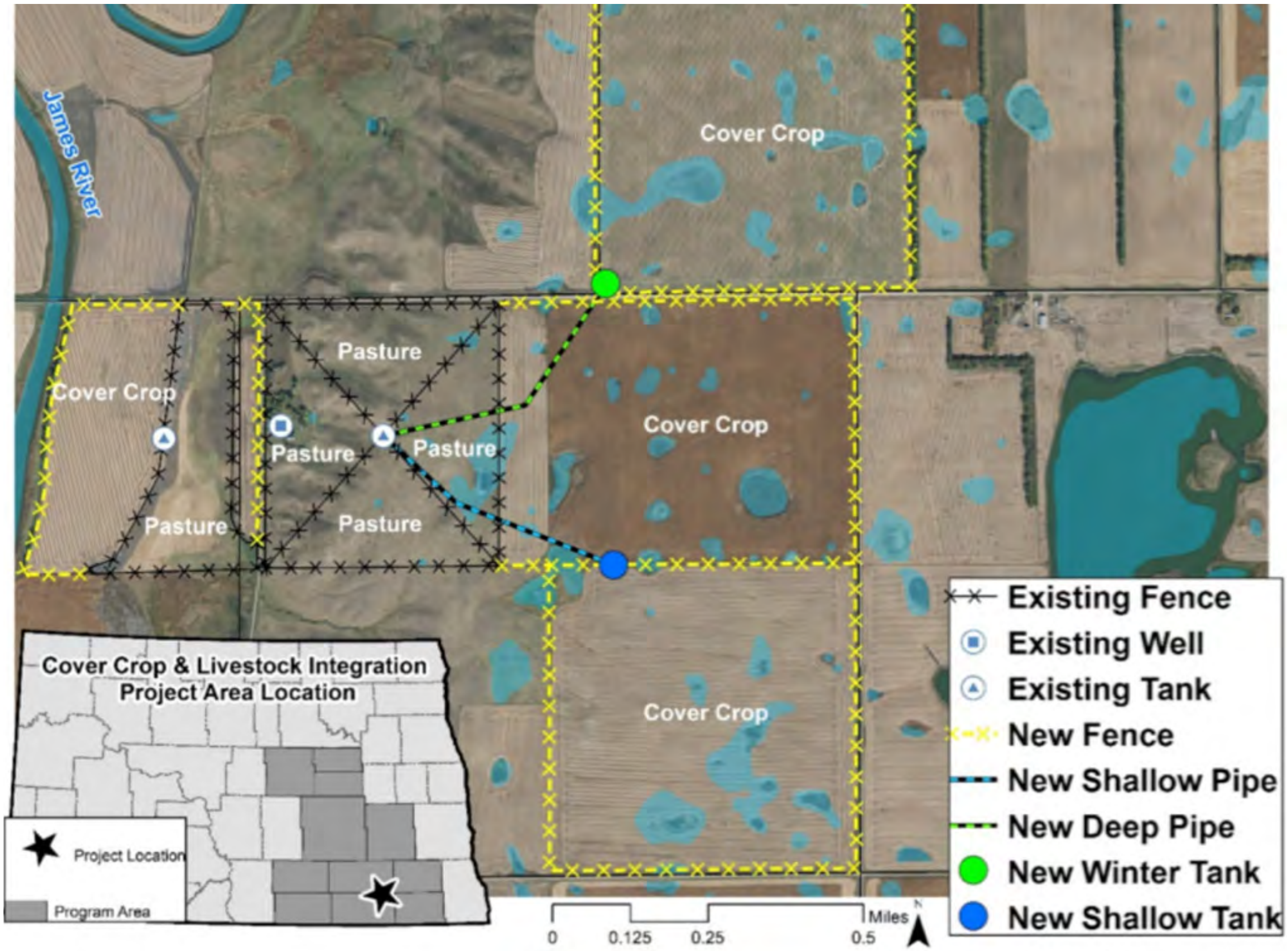


**Figure 1. Example of a Cover Crop & Livestock Integration Project on an operation in Dickey County, North Dakota.**

The primary objective of CCLIP is to assume some of the upfront costs and risks of implementing new sustainable practices like cover crops and livestock integration on cropland. These practices are economically and biologically impactful to the farmer and rancher, as well as our natural resources. As alternative and flexible working lands conservation programs like CCLIP expand and practices are adopted at larger spatial scales, anticipated gains in soil and water health through diversification of agricultural operations will benefit rural communities, watersheds, and North America's grasslands.

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## BIRDS, HERDS, AND STEWARDS: SUSTAINABLE WORKING LANDS FOR THE FUTURE

**Cheryl Mandich, American Bird Conservancy**

The continued population declines of grassland birds have resulted in these species being a conservation focus in the United States, Canada, and Mexico. Grasslands are many times managed as working lands, providing a livelihood to people and sustenance for livestock. Since 2013, American Bird Conservancy (ABC) has used the habitat requirements of the Long-billed Curlew to focus conservation efforts. We have been collaborating with the stewards of the land - landowners and land managers - and other partners to promote land stewardship practices to achieve sustainable land use of grasslands and the birds that inhabit them while maintaining economic viability. These activities have included incorporating habitat needs into conservation plans, grazing as a management tool to control invasive and noxious weeds, soil health, promoting use of native seeds, and compatibility of wildlife and grazing.

### Grassland Bird Declines

Grassland birds have shown the most widespread and severe population declines of any suite of birds in North America, with some species down 75-90% over the past 50 years. Habitat conversion has played a huge role in these declines, and there is continuing pressure to put native grasslands into crop production. Energy and residential development are placing additional stress on these habitats, as larger blocks of habitat are fragmented by roads and infrastructure. With the introduction of key USDA Farm Bill programs, grassland bird populations have stabilized over the past few decades (NABCI, 2011).

Many of these bird species are adapted to grassland systems where grazing by large herbivores (e.g. bison) and periodic disturbance by fire were common, meaning there are opportunities to manage for these declining species on working farm and ranch lands. Some require shorter-stature grasses for nesting, while others prefer more residual cover. Stemming or reversing population declines may be possible if further habitat conversion can be minimized, in combination with the adoption of appropriate management actions to maintain or enhance the grassland habitat qualities needed by each species (or those with similar needs).

### Why Curlews?

The Long-billed Curlew is used as the focal species to target habitat conservation delivery in the portions of the Northern Great Plains. It is North America's largest shorebird with a population estimated at fewer than 200,000 birds. Curlews breed and nest in grassland landscapes throughout the United States and southwest Canada (Fellows and Jones 2009), and winter primarily in southern California, Mexico and along the Gulf Coast. Roughly 50% of the breeding curlew population is found in the Northern Great Plains.

The species is not listed as threatened or endangered (nor has this been proposed), and its habitat needs can be met in working agricultural landscapes with appropriate management. The bird is recognized as a conservation priority by state and federal wildlife agencies and organizations, in part due to long-term declines. Since it co-occurs with other declining species across its range, sustainable management of working lands for curlews can also provide for the needs of other birds and wildlife. Loud, large, and fiercely territorial, it is easily recognized and therefore easily monitored.

The 2013 report completed by ABC for the Natural Resources Conservation Service (NRCS) Conservation Effects Assessment Program (CEAP), *Assessing the Effects of Conservation Practices 2005-2011*, concluded that conservation of this charismatic and recognizable species could be achieved in large part through United States Department of Agriculture (USDA) conservation programs, but only if delivery was focused geographically and incorporated specific management actions to address habitat needs.

## Enhancing Habitat for Grassland Birds While Maintaining Sustainable Land Use

Grasslands cover approximately 358 million acres of the U.S., provide critical wetland buffers that improve water quality, and often times are managed as working lands that provide food, fiber and other resources. Of these grasslands, 85% are privately owned and provide important habitat for 29 breeding obligate grassland bird species. The 2013 State of the Birds Report emphasized the importance of private lands to bird and habitat conservation. Management practices that promote healthy grasslands while meeting the economic bottom line for private landowners play a key role in maintaining grassland bird populations.

ABC is working closely with many partners in portions of North and South Dakota, Montana, and Wyoming to assist landowners in conservation planning and implementing NRCS programs and practices to sustain the economic value of working lands while improving and conserving habitat for declining or at-risk bird species. NRCS practices **(http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/fotg/)** have the potential to meet the needs of breeding curlews, particularly where native mixed grasses and forbs have been planted, or where there is willingness to switch to native vegetation. We assist private landowners in conservation planning and enrollment in NRCS conservation programs where sustainable management practices for grasslands and livestock production will also result in habitat conservation for multiple declining or at-risk bird species, including Long-billed Curlew, McCown's and Chestnut-collared Longspurs, Lark Bunting, and Baird's and Brewer's Sparrows. Our efforts are focused on those areas within our two Northern Great Plains BirdScapes, Cheyenne Headwaters and Northern Prairie (Figure 1). BirdScapes are conservation delivery units delineated based on importance to priority birds, conservation opportunity, and partner interest that facilitate annual life cycle conservation efforts at the scale that allows for setting and measuring progress towards goals intended to positively influence populations of priority species.

In addition to using NRCS program funding to enhance habitat for birds, we have been able to expand our efforts using funding from other sources for conservation activities not covered by NRCS funding. With funding from National Fish and Wildlife Foundation (NFWF), North Dakota Outdoor Heritage Fund (NDOHF), and Northern Great Plains Joint Venture (NGPJV), we have been able to assist landowners with the cost of using temporary electric fencing and watering facilities to distribute livestock grazing. For example, since 2013 ABC has worked with North Dakota producers, Jerome and Sandra Schaar, who are using targeted cattle grazing to improve the plant community on their place. In 2012, they enrolled their lands in the USDA Wetland Reserve Program. Since that time, they have worked closely with multiple partners to showcase grazing as a management tool to sustain a productive ecosystem. They have gone from a three pasture system to a 17 paddock system. By using smaller paddocks, they have been able to implement a targeted grazing system whereby their cattle grazed selected pasture areas which assisted in controlling noxious weeds and rejuvenating the rangeland. Their goal has expanded from *"forage for cattle"* to *"a healthy, sustainable rangeland for livestock, birds, wildlife, and people".* For additional information on their efforts, please review their *Birds, Herds, and Stewards: From Grazing Alternatives to Grassland Sustainability* proceedings.

Ranching operations many times consist of private and public lands, such as national grasslands. The private landowner has grazing rights on these public lands but land management decisions, such as when grazing can commence and for how long, are set by the public land managers. We are in the initial stages of collaborating with private landowners on how best to incorporate

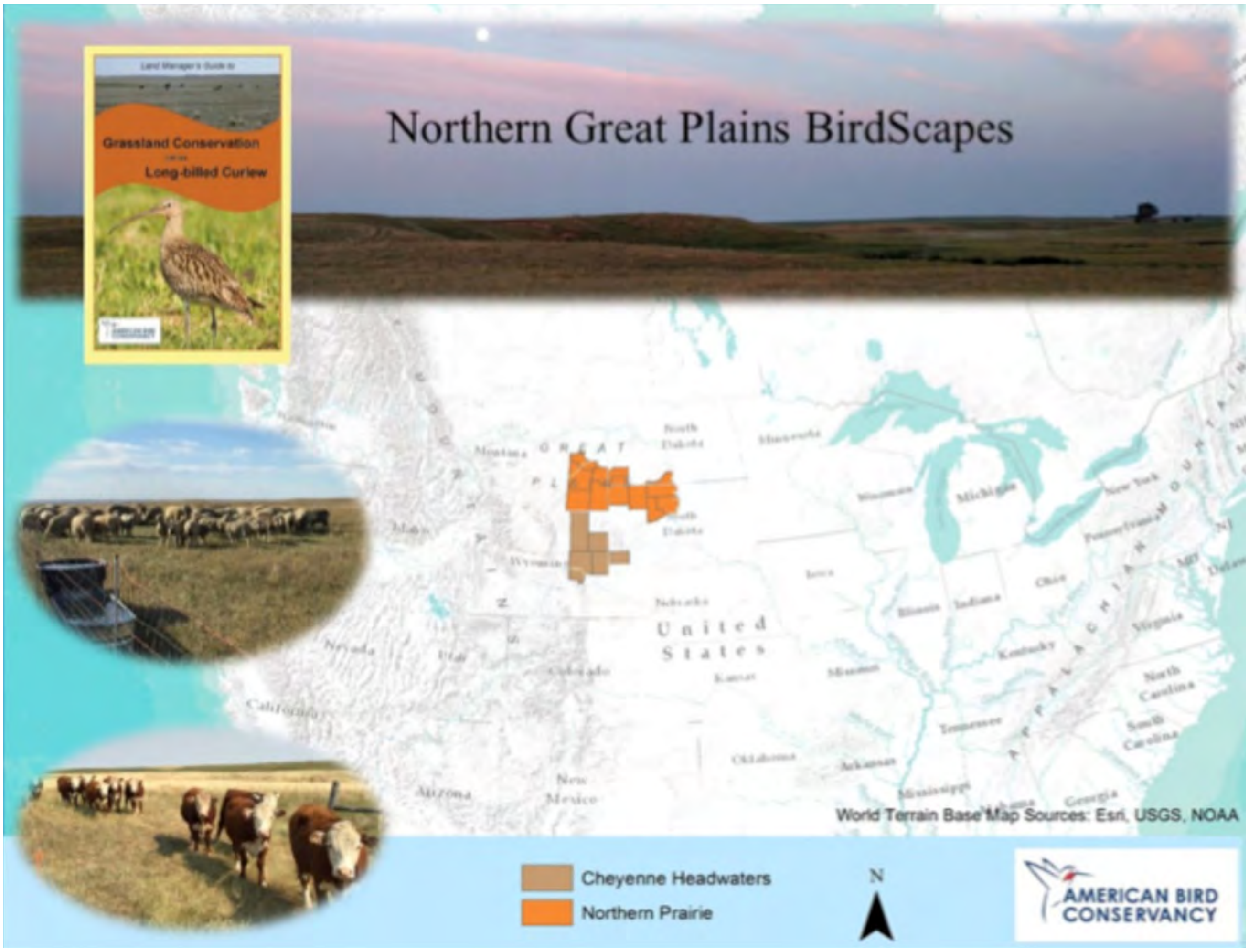


**Figure 1. Focus areas for ABC's conservation efforts to enhance habitat for grassland birds while maintaining sustainable land use.**

land stewardship practices on private lands that take into account their use of public lands. Doing so provides the opportunity for us to work in partnership with public land managers on ways to incorporate land stewardship practices on public lands. The 2011 State of the Birds report elaborated on the importance of our public lands and waters to birds, with approximately 13% of our grasslands being publicly owned. Overall, more than 1000 species rely on public lands in the United States and its territories for nesting, wintering, and migratory stopover habitat.

## Recommended Management Actions

Under a 2012 Neotropical Migratory Bird Conservation Act (NMBCA) grant, ABC worked with Canadian and U.S. partners to compile strategies for Long-billed Curlews on their breeding grounds (sagebrush, agricultural and grassland habitats) and improve management of a key wintering site for 30% of the curlew population.

Recommended management actions and guidelines were developed for implementation wherever practicable within the breeding range of the Long-billed Curlew in North America. They are adapted from Dechant et al (1999) and Cannings (1999) and are meant to also benefit other grassland species associated with native grassland habitats. These guidelines are summarized in ABC's "Land Manager's Guide to Grassland Conservation and the Long-billed Curlew" **(http://abcbirds.org/wp-content/uploads/2015/12/Land-Managers-Guide-to-Long-billed-Curlew-Conservation.pdf).** Implementation of these actions will be most effective on landscapes already known to be inhabited by breeding curlews. The timing of breeding, appropriate stocking rates, seed mixes and opportunities will vary regionally, as well as by site. The five main categories are to Manage Grazing Appropriately, Halt Habitat Conversion, Emphasize Native Grasses and Forbs, Avoid Disturbance during Sensitive Periods (e.g. nesting), and Adjust Certain Agricultural Practices (e.g. minimize the use of pesticides).

These are presented as overall guidance to land managers across the range of the species, but we urge local partner cooperation and consultation during their implementation. This will help ensure that local expertise and landowner management objectives are taken into account.

## Long-billed Curlew Monitoring

To further refine on-the-ground conservation efforts for grassland birds, ABC is recruiting volunteers to conduct Long-billed Curlew road surveys to collect data on curlew occurrence and dominant habitats. The curlew is easily recognizable so even novice birders can participate in the effort. With funding from partners sources, such as the North Dakota State Wildlife Grant, we are able to reimburse volunteers for mileage and lodging. When possible, volunteers are also asked to document occurrence data on other species of concern that are easily recognizable, such as the Marbled Godwit, Lark Bunting, Bobolink, Upland Sandpiper, American Avocet, Willet, and Western Meadowlark. We now have producers interested in conducting a survey route. This effort not only provides data we need to refine our efforts but also helps to increase the awareness between birds and their habitats.

## Benefits

This effort leverages the substantial expertise of a diverse partnership through the Northern Great Plains Joint Venture **(http://ngpjv.org/)** Conservation Delivery Network to assist producers in conservation planning and implementation of NRCS and state conservation programs and practices for sustainable ranching that benefits at-risk grassland birds, soil and rangeland health, and water resources. Multiple benefits to livestock and wildlife will be realized, including reduction of grassland loss, drought mitigation, soil health improvement, rangeland health, carbon sequestration, flood prevention, and water retention.

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# 3. SOUTHERN PLAINS PRAIRIE RESTORATION

## THE SOUTHEASTERN GRASSLANDS INITIATIVE (SGI): DEDICATED TO PRESERVING AND REBUILDING AMERICA'S FORGOTTEN SOUTHEASTERN GRASSLANDS

**Dwayne Estes, Austin Peay State University and Botanical Research Institute of Texas**

*Other Authors: Theo Witsell, Austin Peay State University; Clark Mitchell, BAND Foundation*

The vision for the Southeastern Grasslands Initiative (SGI), based out of Austin Peay State University's Center of Excellence for Field Biology (Clarksville, Tennessee), was established in late 2016. SGI aims to establish itself as a clearinghouse to identify priorities and focus future conservation efforts for southeastern U.S. grasslands across 23 states and nearly two-dozen ecoregions, stretching from Austin, Texas to Washington, D.C. and Joplin, Missouri to Tallahassee, Florida, an area that constitutes what we recognize as the Southeastern interior grasslands focal area. To ensure Southern grasslands not only survive, but flourish into the 22nd century and beyond, SGI will employ a multi-faceted approach that combines restoration, preservation, re-creation, research, rescue, seedbanking, education, and market-driven strategies. To support these strategies across our broad focal area, SGI is working to put into place a volunteer army guided by regional conservation coordinators working off of the Plant Conservation Alliance model. Over the next five years, SGI aims to prepare a "State of the Southern Grasslands Report" which will assess the present condition of our imperiled Southern grasslands in light of new data about their historical distribution, present range and composition, potential for future restoration and re-creation, and will prepare a blueprint to guide successful conservation over the next 20 years. By year five SGI will strive to become a philanthropic organization whereby we aim to offer grants, related to our eight strategies identified above, to all sorts of partners across our region.

## THE TEXAS COASTAL EXCHANGE–RESTORING ECOLOGY, LAND AND SOIL AT A SCALE THAT MATTERS

**Jim Blackburn, Rice University**

*Other Authors: Dr. Henk Mooiweer, Rice University*

Grasslands provide a vast, untapped means of removing carbon dioxide from the atmosphere, yet there are no grassland projects registered through the existing carbon sequestration protocols. TCX is looking to capitalize on this opportunity to the benefit of landowners, corporations, and the public. The TCX model provides long-term ecological, economic, and social benefits beyond hurricane surge, rainwater storage, and carbon dioxide removal. The native prairie system will be preserved and enhanced, while the rural areas of Texas and the United States will be revitalized through a new industry: the sale of ecosystem services. Industries with large carbon footprints will have access to options that will enable them a bridge into a carbon neutral future. Because TCX is driven by the free market rather than regulation, it is a solution to pressing ecological problems within states that abhor government regulation. The Texas Coastal Exchange seeks to develop and implement a system to restore and conserve ecology, land and soil at a scale that will make a real difference.

*Photo: Kirsti Harms*

In the process of researching potential non-structural projects that reduce flood damage risk, Rice University's SSPEED Center discovered a potentially revolutionary economic opportunity. The research focused on identifying additional sources of income for landowners that could be generated from land uses that do not require much infrastructure and could survive flooding inundation. From this research, Texas Coastal Exchange developed as a broad market based solution to the world's pressing carbon emission problem. TCX aims to provide a market for the sale of environmental services from landowners to corporations that want to offset their carbon emissions. These sales contracts use the free market to incentivize maximum carbon sequestration to the benefit of both the landowner, the corporation, and the public at large. The SSPEED Center's research was focused on a response to hurricane caused flooding; however, the TCX model is applicable across all of the United States grasslands as a potential solution to our country's pressing carbon crisis. The TCX model is simple: landowners will enroll by initiating an ecosystem services "measurements", such as stored carbon or water infiltration, that property is then registered, a second set of measurements would then be undertaken at a later date, and the difference between the first and the second measurement are generated eco-benefits that can be sold sold at market value.

## I. Carbon Sequestration in Soil

Nature's carbon cycle sees carbon dioxide in the atmosphere transformed via photosynthesis into the carbohydrates that plants use to grow. This carbon pulled from the atmosphere becomes biomass and some of it goes into the root system and the soil microbiome. Overtime, some of this biomass will decompose and transform back into carbon dioxide, which completes the carbon cycles. Because our current carbon emission far outweigh the natural carbon cycle's ability to remove carbon dioxide from the atmosphere. This carbon surplus is a primary cause for the world's rising atmospheric temperature. In order for companies emitting carbon dioxide to become carbon neutral they will have to avoid emitting, minimize their emission, or capture emissions. Carbon capture in soil is one of the most cost-effective and scalable methods for removing massive quantities of carbon from the world's atmosphere. Key to storing large vast amounts of carbon in soil is to create healthy soils thriving with plant and microbial activity. Landowners who restore native ecosystems are already storing carbon in their land. However, a carbon basepoint must be established in order to differentiate the increased carbon input from the pre-existing soil carbon. TCX's standards and independent verification procedures will ensure the buyer's purchase is valid and based on real carbon robustly stored in soil

## II. Altering Land Practices to Maximize Carbon Capture and Water Resilience

The Texas Coastal Exchange's key objective is to support landowners to migrate from conventionally managed lands to improved and restored lands that provide a portfolio of eco-benefits. Through corporate buy in to the system, TCX will provide landowners with grants to support the cost of the first eco-benefit land measurements and land management consultancy support to help landowners to maximize soil health and thus carbon capture in the soil. Healthy, carbon rich soils generally also adsorb much larger volumes of water. These lands increase their draught and flood resilience. Healthy soils can have a large impact on flood prevention in downstream watersheds. One of the key concepts of the Texas Coastal exchange is that various land management approaches exist that can enhance the ecosystem service potential of a landowner's property. In particular, actions such as adaptive multi-paddock (AMP) grazing and natural ecosystem restoration appear to increase the mass of carbon stored in the soil and enhance other ecological services as well. TCX will develop a portfolio of tools and affiliated organizations that support the network of landowners to deploy management practices that increase ecosystem service value and thereby help the landowner realize greater income. The landowner's incentive is maximized profit rather than regulation compliance; therefore, these land management adaptations are in the best interest of the landowner as well as the public at large. TCX will collaborate to provide hands-on support to landowners to optimize heathy soils and thus carbon dioxide removal and storage.

### III. Supporting Traditional Ranching

One goal of the SSPEED Center's research was to enhance the economic viability and resilience of the Texas Coastal agricultural community and maintain agricultural and ranching activities and culture. The Texas Coastal Exchange will use free market incentives to mutually benefit both land owners and carbon emitting industries. A long term existential challenge faces the agricultural community, as rural communities diminish and become economically insecure. By supplementing a landowner's baseline ranching income with a yearly carbon credit sale, traditional land management will remain viable in the 21st century. More impactful, a strong focus on soil health will boost the ranch productivity and economic resilience. Under the TCX model, the landowner may undertake any other activities on the property which are not inconsistent with carbon storage, including cattle ranching, hunting, eco-tourism, water supply enhancement, flood reduction and fish and wildlife enhancement. The landowner will be able to realize income from multiple ecosystem services on the same property and is encouraged to do so.

### IV. A Forward-Thinking Business Model

Today, there is a modest voluntary market for the purchase of soil carbon dioxide storage capacity. However, as more and more corporations, institutions and individuals move toward carbon neutrality, the demand is expected to raoidly increase. These current markets for the sale of ecological services as emissions offsets (either voluntary or mandatary) are distinguishable from TCX because they require onerous and landowner unfriendly project development requirement prior to sale. Whereas, TCX is a simplified, but robust and transparent, market driven approach; the key requirement prior to sale is a hard demonstration of eco-benefits based on measurement. TCX will provide a framework that is landowner friendly because of the ease with which a participant can join. The traditional industrial business model uses free market principles to maximize efficiency and profit. This has been successful for centuries; however, the impact on environmental resources has seldom been incorporated into this business economics. Climate change is forcing businesses to reconstruct their values. A call for carbon-conscience businesses will come from a consumer base, as the public at large has already begun to see the personal impacts of climate change. TCX's market will provide a means for businesses to get ahead of the curve and provide carbon neutral products and services at a scale that matters.

## INVASIVE GRASS SPECIES AT WELL PADS IN SOUTH TEXAS


### Forrest Cobb, Texas A&M Natural Resources Institute

*Other Authors: Forrest Smith, Texas A&M Kingsville Caesar Kleberg Wildlife Research Institute; Brian Pierce and Dr. Susan Stuver, Texas A&M Natural Resources Institute.*


As part of the Texas A&M Natural Resources Institute mission to conduct applied research in improving conservation and land management of natural

*Photo: Jaime Gonzalez*

resources in Texas, and given the scale of oil and gas development in South Texas and its implications for rangelands in this region, the institute conducted a study on invasive grass species at well pads in South Texas. The project was funded by the Houston Advance Research Center using a grant awarded by the Texas General Land Office. Invasive grass species are federally defined as noxious, non-native species that cause economic or ecological harm. Their adaptability, fecundity, and resilience allow them to establish quickly and form dense monocultures. Once established they can cause reductions in crop yields and forage quality (Ditomaso 2000), result in reductions of native plants, wildlife, and overall biodiversity (D'antonio and Vitousek 1992), and negatively impact endangered species habitat (Wilcove et al. 1998). Exotic species are responsible for an estimated 33 billion dollars lost in U.S. crop yields and an estimated 1 billion dollars lost in U.S. forage quality annually (Pimentel 2005). Severe negative impacts on native grass and wildlife species including bobwhite quail *(Colinus virginianus)* have been observed when their total cover in the landscape surpassed just 20% (Flanders et al. 2006).

Many of the characteristics that have made these exotic plants such a large land management and conservation challenge are the same qualities which have led to their widespread adoption in Texas for drought resistant forage and erosion control (Smith 2010). These species are very competitive. They grow rapidly, can often withstand high grazing pressure, are tolerant of a wide range of soil and climactic conditions, and are pioneer species which readily colonize after man-made disturbances. It is these qualities which have encouraged extensive plantings, and are often part of reseedings after road construction or well pad development (Pawelek et al. 2015). The implications for the economic and ecological health of areas within the Eagle Ford Shale are significant with over 23,000 new drilling permits issued since 2008 adding to over 434,000 well pads already present in Texas (Railroad Commission of Texas 2017a, 2017b). For each of these permits, associated roads, pipelines, storage facilities and other types of development magnify this impact (Rivas et al. 2010).

Well pad development creates large areas of bare ground and severe soil disturbance (Berquist et. 2007). The areas immediately surrounding pads have been found to have greater cumulative invasive plant species richness than primary roadsides and pipeline right of ways (Manier et al. 2014), and the effects on rangeland health and cover of invasive species have been reported to range from 25 m (Nasen et al. 2011), to 80 m (Preston 2015), distance from well pad sites. Development of well pads provides both a pathway for introduction of non-native grass species, such as in infested aggregates or in the tire tracks of vehicles. But perhaps more importantly for South Texas, where non-natives are often already present, the construction of pads creates areas of anthropogenic disturbance which favor and promulgate certain non-native species where they might otherwise be scare. For example, Nasen et al. (2011), demonstrated significant changes in soil pH, soil horizon thickness, compaction and conductivity near well pad sites, factors that may be conducive to the establishment of exotic vegetation.

In addressing this land management challenge, our study had three basic goals: to characterize non-native grass cover near well pads at a South Texas site, to assess how cover of non-native grass differed between species with respect to well pads, and to create and demonstrate a reasonably simple design for rapid assessments of non-native grass cover with respect to well pads. The study was conducted in Dimmit County, Texas on a privately owned bison ranch. Well pads were selected on one soil type to isolate the effects of well pad development on non-native grasses. Sites were also selected to avoid other possible confounding factors such as low-lying drainage areas, or areas with high woody coverage. Finally, 18 well pads and 18 control points were selected. The average age since construction of these pads was 34 years. Control points were also located in the same soil type and located (> 110 m) from any development on the ranch. Sites were sampled along three transects radiating out from the edge of the well pad or at control points. Along these transects, foliar cover of non-native species was visually estimated in quadrats at five distances: 3 m 18 m, 33 m, 48 m, and 63 m. The three species monitored were buffelgrass *(Pennisetum ciliare),* Lehman lovegrass *(Eragrostis lehmanniana),* and Kleberg bluestem *(Dichanthium annulatum),* all common, invasive exotic grasses in this locality. All data was analyzed using ANOVA tests at a significance level of 0.05.

We found total non-native grass cover was higher (33%) within 63m of well pads than at control points (26%; $P = 0.04$). However, this relationship was species specific. Whereas Lehmann lovegrass was abundant at both control and well pad sites, buffelgrass was 13-fold higher within 63 m of well pads (37%) than at control sites ( < 1%; $P < 0.01$). Additionally, Kleberg bluestem did not occur at control sites, and was only found within 33m of 3 of the 18 well pads sampled. These results indicate that non-native grasses were associated with well pad development and that, given the age of the pads, this development can have a significant and long-term impact on non-native grass distributions. These results affirm those found in other studies, supporting the contention that there is significantly greater cover and diversity of invasive grasses near well pad sites. However, our results suggest that broad generalizations and assumptions for individual non-native species may not be appropriate.

Efforts to mitigate this unintended function of well pad development would be judicious given the magnitude of the land management and conservation challenge posed from non-native invasions. Higher concentrations of non-native grasses near well pads results in the displacement of native vegetation, negatively impacts wildlife habitat, and such areas serve as a reservoir for the further spread of these grasses into surrounding areas. Of the many practices which can help to prevent the introduction and spread of these species, reseeding to provide native plant cover, and spot treatment of invasive grasses are suggested as the most effective. Combined with non-native grass control and proper seed bed preparation, reseeding with native seed has been shown to abate invasion of disturbed sites by non-native grasses (Falk et al. 2013).

In order to improve control, mitigation, and restoration efforts, we would like to expand this study in the future, and apply this methodology under different soil, management, and climactic conditions to generate site specific data to be used in project planning. In so doing we hope to provide, site, species, and distance specific information on non-native grass species distributions near well pads across a host of conditions in order to better target treatment and control in the future.

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# THE EFFECTS OF SOIL AMENDMENT USE ON AN URBAN PRAIRIE RECONSTRUCTION IN TEXAS

**Heather Bass, Botanical Research Institute of Texas**

In 2011 the Botanical Research Institute of Texas (BRIT) finished construction on a new building and began the process of rehabilitating an area of a little less than 3 acres behind it. The objective was to establish a functional tall grass prairie that could serve as a site for education about and celebration of the Fort Worth Prairie ecoregion in North Texas. However, the existing soil was of poor quality and compacted from construction. Furthermore, hydro-mulch and herbicide were both applied at rates that exceeded conventional recommendations.

As a result, during the first year there was very limited success in establishing a prairie. Invasive grasses fared better than the native prairie grasses and bare ground was abundant. In early 2012 BRIT Research and Administrative staff, Dr. Tony Burgess (TCU professor), and Bill Neiman (Native American Seed) formed a collaborative project team to address the concerns with the progress of the prairie restoration. Early discussions and observations revealed that the initial installation process did not adequately address the soil conditions or natural ecological processes.

Several options for soil remediation were identified and a research project was initiated to test the effects of two soil amendments; commercially sold biological amendments and a native soil tea. The biological amendments, also referred to as compost tea, were created by a company who prepare custom blends of soil microbes, humus, and nutrients for soil remediation. The living prairie soil was gathered from a native riparian prairie just south-west of Fort Worth. Substrates were applied directly to the top of the existing soil, and the soil was aerated.

Four research plots were established, each with a different treatment. Two plots were treated only with biological amendments (BA), one plot was treated only with living soil (LS), one was a control that got no treatment (NT), and one received both the biological amendments and the living soil (LSBA). To measure each treatment's effectiveness at facilitating native prairie restoration, the vegetative diversity and abundance of each plant species were observed over a 4 year period.

*BRIT Prairie, November 2016. Photo: Heather Bass*

Because of the way that the experiment was laid out, there were two plots that received the Biological Amendments (BA) alone, while all other treatments were only applied to one plot. Since the two BA plots are on opposite sides of the prairie from each other, they also may have received slightly different seed mixes, so they are treated as two different treatments in the analysis (BA-W and BA-E).

Four years after the treatments were applied, there were 62 plant species found on the entire prairie. Of those, eight species were not seeded for and were present at the soil removal site, so they likely came from the seed bank of the Living Soil. However, there was no significant difference in species diversity between any of the treatments.

At three years after the treatment, all treatments areas had more native grass cover than the areas with no treatment applied (P=0.036). All treatments containing Biological Amendments (BA-W, BA-E, and LSBA) had significantly greater invasive grass proportions (P=0.003) and significantly less forb proportions (P=1.28E-5) than both LS and NT. Similarly, all treatments containing Biological Amendments had greater Bermuda Grass *(Cynodon dactylon)* proportions (P=0.003) than both LS and NT, contributing to the greater proportion of invasive grasses.

At four years after treatment application, there was not much difference in the proportion of plants of different habits and origins between the treatments, except for in BA-W. In BA-W there was a significantly greater proportion of native grasses (P=0.012) and the proportion of invasive grasses was significantly less (P=0.014) than in all other treatments. When looking at proportions of individual plant species, the reason becomes clear. In BA-W, the proportion of Buffalo Grass *(Buchloe dactyloides)* is greater than all other treatments (P=0.010) and the proportion of Bermuda Grass *(Cynodon dactylon)* is less than in all other treatments (P=0.019). In LS, the proportion of Indian Grass *(Sorghastrum nutans)* is significantly greater than all other treatments (P=3.13E-5), while the proportion of Silver Bluestem *(Bothriochloa laguroides)* is less than in all other treatments (P=0.013).

At least in the first few years, addition of biological amendments and living soil facilitated grass growth both alone and together, indicating that both were effective in performing the task they were expected to do. The Living Soil alone facilitated the growth of almost exclusively native grass and forb species in the first three years, indicating that it may be more exclusive in the species it promotes growth in. During the same time period, Biological Amendments alone facilitated the growth of native and invasive grasses alike, but not forbs, indicating that it may be more targeted to general grass growth.

As for the prairie restoration as a whole, Silver Bluestem *(Bothriochloa laguroides)* is still the most common native grass in all plots, indicating that the prairie is in early succession. However, the increased presence of Indian Grass *(Sorghastrum nutans)* and Big Bluestem *(Andropogon gerardii,* data not shown here) after 3-5 years indicate that it is moving towards a climax native prairie plant community.

The large differences in invasive grass cover, particularly Bermuda Grass *(Cynodon dactylon),* between years three and four could be caused by several factors, but the fact that there was an overall increase in short grasses (Buffalo Grass, *Buchloe dactyloides,* in BA-W) points to a possible reason. The frequency of mowing increased between years three and four, except for patches of Indian Grass *(Sorghastrum nutans)* and Big Bluestem *(Andropogon gerardii),* which could be the reason why short grass coverage increased. BA-W is on the edge of the prairie and received more Buffalo Grass *(Buchloe dactyloides)* seeds at the time of seeding, so that is likely why it has a greater coverage of it. The lack of large differences in species diversity and cover type between treatments after 4 years could be due to soil and plant community mixing, as there were no physical barriers between research plots to prevent mixing.

Both the Living Soil and Biological Amendments promoted overall grass growth in the BRIT prairie, fulfilling the initial purpose for application. The Living Soil was likely more targeted to promoting native grasses, at least during the first three years, since that was the primary vegetation at the extraction site, and the microbial community likely primarily consisted of those that have relationships with those grasses. Thus, Living Soil from a native prairie similar to the restoration target performed the best at remediating soil to promote the growth of the desired native prairie plant species. Although the use of both Living Soil and Biological Amendments together and alone promoted the growth of native prairie grasses, they had different effects on the community composition, highlighting the complexity and importance of considering soil health in restoration practices.

## THE STATE OF NATIVE SEEDS IN TEXAS


### Forrest S. Smith, Texas Native Seeds Program, Caesar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville

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### Introduction

Commercial availability of ecotypic native seeds for use in restoration projects varies by region in Texas. Ecotypic native seeds are generally recommended as the best choice for native plant restoration projects (Jones 2005). Seed ecotypes are defined as those originating from the same or similar ecosystem as the restoration site (Johnson et al. 2010); and specifically, ecoregions in general have been suggested as useful boundaries for seed use zones (Miller et al. 2011). Furthermore, seed produced and sold under state level certification programs is suggested by many agencies to be the first choice for restoration seedings when available (USDA NRCS 2009).

In Texas, native seed demand for restoration has led to the development of ecoregional plant materials development initiatives that have improved ecotypic native seed available in some regions, such as in South Texas through the South Texas Natives Project (Smith

*Photo: Brian Early*

et al 2010). Furthermore, a significant number of native seed varieties with known origin from Texas ecoregions have been developed, released, and commercialized through the USDA Natural Resources Plant Materials Centers in Texas (Alderson and Sharp 1994). Even so, practitioners, agencies, and experience indicates that ecotypic native seed availability, especially of certified native seeds, varies greatly by region.

### Methods

To quantify current market availability of ecotypic and certified native seeds, we surveyed all known native seed companies in Texas in summer 2017. Current seed inventory by seed release name, species, and seed certification status was compiled based on seed company responses. Five native seed companies responded with current inventory, and we complied availability according to ecoregions as defined by Gould et al. (1960) and Major Land Resources Area designations by USDA (2006).

For purposes of this presentation, we considered the southern portion of the Gulf Prairies as analogous with the South Texas Plains, in part because of the delineation of the Sand Sheet portion of the Gulf Prairie as a separate ecoregion in the MLRA classification, but for which Gould includes as part of the South Texas Plains. We similarly considered the Eastern Edwards Plateau and Llano Uplift as a single collective region, and we considered the Western Edwards Plateau and Trans-Pecos as an ecotype region. For simplification of analyses, we considered the Rolling Plains and High Plains, and Blackland Prairie and Cross Timbers as similar regions for the purposes of this presentation.

Based on information provided by responding seed companies, and published origin information of named seed varieties by the respective developers (STN 2017, USDA NRCS 2017, Alderson and Sharp 1994), we compiled the number of commercially available ecotypic seed varieties for each region as defined for the presentation. Using the 2017 Texas Certified Seed Directory (TDA 2017), we determined which of those varieties reported as available by seed companies were being produced as certified seed.

## Results

Availability of known-origin, ecotypic native seeds varied greatly by region of Texas as of summer 2017. Certified Seed availability was poor for all regions but the South Texas Plains, which also had the greatest number of known-origin commercially available ecotypic seed sources. Number of commercially available, known-origin seed sources by region was (grass, non-grass, and certification status): South Texas Plains (including Lower Gulf Prairies and Sand Sheet Prairie): 25 (20 grasses, 5 non-grasses, 25 certified); Eastern Edward Plateau and Llano Uplift: 6 (2 grasses, 4 non-grasses, none certified); Trans Pecos and Western Edwards Plateau: 3 (1 grass, 2 non-grasses, none certified); High Plains and Rolling Plains: 5 (2 grasses, 3 non-grasses, none certified); Cross Timbers and Blackland Prairie: 8 (4 grasses, 4 non-grasses, none certified); Pineywoods: 0; and Upper Gulf Prairie: 4 (3 grasses, 1 non-grass, none certified).

## Discussion

Commercial, known-origin ecotypic native seeds availability varies considerably by region. The South Texas Plains region has the greatest reported availability of native seed sources at present, in large part because of efforts of the South Texas Natives Project and the USDA NRCS E. "Kika" de la Garza Plant Materials Center. Availability is fair in central, north, and the panhandle portions of Texas, in large part because of releases developed by the USDA NRCS James E. "Bud" Smith Plant Materials Center. Available ecotypic seed material for West Texas, the East Texas Pineywoods, and Upper Gulf Prairies is comparatively poor, and in the case of the East Texas Pineywoods, no known-origin native seed sources are reported available commercially. In part, sparse availability in many regions is likely related to the lack of effort to select and release plant selection for those areas, although historic lack of demand for native seeds is an undeniable factor as well.

Efforts to collect, increase, and commercialize ecotypic native seed sources are still needed in much of Texas. In many areas, only a half-dozen or less ecotypic native seed sources area available. For most habitats, restoring this few species would not come close to representing natural species composition of native plant communities, even in cases where dominant late seral plants such as little bluestem occupy these sites. For South Texas, a considerably more diverse array of ecotypic native seeds is available, and most all of these seed sources all are being produced as certified native seed, of benefit to consumers, agencies who desire to use such sources. In most of the state, certified native seed is not available, representing a deficiency in consumer's and practitioner's ability to meet the preferred requirements of some agencies for seeding projects.

Also apparent based on seed company responses, is the availability of "Variety Not Stated" (VNS) native seed. These seed sources may be local harvests, trade germplasm long produced commercially, informal releases, or casual selections by seedsmen. While widely marketed, and obviously used by consumers, these selections lack much if any proof of origin, lineage, or testing. Whether or not these selections are ecotypic to a potential planting site cannot reasonably be known in many cases. Use of the TDA's Site Identification Certification for seed origin could remedy this conundrum; however no seed has been certified under this program to date. Seed company responses indicated 242 native seed products were available commercially that lacked corresponding varietal or geographic origin information. A large number of other seed varieties with origin from adjacent and distant states are also marketed by Texas seed companies. In most cases, these seeds do not meet reasonable definitions under which to be considered ecotypic to most areas of Texas, except for those originating from New Mexico for portions of West Texas and the Panhandle, or from Oklahoma, Kansas, or Colorado for portions of the High Plains, Rolling Plains, Cross Timbers, and Blackland Prairies.

Greater effort to develop known-origin native seeds for much of Texas, and insurances that commercial provision of these seeds will follow TDA Certification programs to benefit consumers is suggested. Efforts to certify region of origin of many existing VNS or commercial selections of native seeds could also be beneficial to consumers. Additional research to determine commercial seed provision amounts of many reported available species would also be useful for consumers, agencies, and policy makers. Based on the lag time from and length of development effort required to successfully commercialized known-origin native seeds, current limitations related to the the availability of ecotypic native seeds is likely to continue to be a limiting factor to restoration of native plant communities through reseeding in Texas for some time.

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*Photo: Chris Emory, Sundog Art Photography*

# MESQUITE SAVANNA-TEXAS WINTERGRASS COMPLEX: BEST MANAGEMENT PRACTICES FOR CONVERSION TO NATIVE WARM SEASON GRASSES


**Darrel B. Murray, Tarleton State University**

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## Introduction

In much of the Cross Timbers and Rolling Plains ecoregions of Texas, diverse native grassland plant communities have given way to degraded rangeland. These are dominated by invading mesquite *(Prosopis glandulosa)* and a cool season perennial grass, Texas wintergrass *(Nassela leucotricha)*. These diversity-poor plant communities have been associated with the loss of native grassland bird populations. The primary goal of this research is to determine the best techniques or combinations of techniques from commonly recommended management practices, including grazing, prescribed burning, herbicide treatments, and reseeding, aimed at converting mesquite savanna-Texas wintergrass complex to native grasslands in a manner that would increase plant diversity and enhance grassland bird habitat.

In Texas, grassland birds, including bobwhite quail *(Colinus virginianus),* Grasshopper sparrow *(Ammodramus savannarum),* Loggerhead shrike *(Lanius ludovicianus),* Dickcissel *(Spiza Americana),* Field sparrow *(Spizella americana),* Spragues pipit *(Anthus spragueiie),* Northern harrier *(Circus cyaneus),* Sedge wren *(Cistothorus platensis),* Eastern meadowlark *(Sturnella magna)* and Le Conte's sparrow *(Ammodramus leconteii),* among others, have been designated as species of concern (Texas Conservation Action Plan, 2013). Beyond direct habitat loss and native or semi-natural grasslands conversion to tame pasture, there is substantial evidence that loss of structural heterogeneity is a strong contributor to degradation of grassland bird habitat (Fuhlendorf et al, 2006, Reynolds and Symes, 2013, Ransom Jr. and Schulz, 2007). This heterogeneity loss has largely been the product of fire suppression, overuse, or poor timing (Renwald et al, 1982; Ransom Jr. and Schulz, 2007), climatic variations, and intensive, continuous over-grazing by cattle (Brown 1984; Campbell-Kissock et al 1984). Texas wintergrass thrives in disturbed sites and dominates in April through May (Diggs, Jr. et al, 1999), a crucial time for warm-season perennial grass and forb seedling establishment. Although a minor component of the original prairies in these regions, it is now a common invader (Diggs, Jr. et al, 1999).

## Methods, Results, & Discussion

At two mesquite-invaded sites in north-central Texas dominated by Texas wintergrass, seeded and non-seeded plots were established in March 2015 following mesquite removal. These plots were subsequently divided into subplots to test herbicide, fire, and grazing singly or in combinations in March 2016 and March 2017. We used a generalized linear mixed model with repeated measures to determine treatment effects. Repeated measures were vegetation sampling times in March 2016, May 2016, March 2017, and May 2017, representing pre and post-treatment for 2 years. Differences ($P = 0.05$) were found among treatments for Daubenmire cover class categories of Texas wintergrass, litter, and bare ground. All treatments that included herbicide reduced ($P = 0.05$) percent Texas wintergrass cover 50%, whether as single treatments, or in combination with burning and/or grazing as compared to controls and all other treatments. Burning or grazing did not add to reduction of Texas wintergrass by herbicide application. Herbicide as a single treatment increased percent litter cover 23% compared to controls and all other treatments. Herbicide followed by burning and/or grazing reduced ($P = 0.05$) percent litter cover 58 % and increased ($P =0.05$) percent cover of bare ground 112%.

To investigate the benefits of litter versus bare ground for establishment of native warm season grasses (NWSG) and forbs, additional vegetation sampling from November 2016 and 2017 will be included in the overall analysis along with additional cover class categories that divide herbaceous species into functional groups, such as seeded warm-season perennial grasses. This will potentially answer the question of whether increased litter or increased bare soil better promote establishment and growth of NWSG and forbs and guide recommendations for best management practices for conversion of these mesquite-invaded areas dominated by Texas wintergrass in the herbaceous layer.

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## NORTH TEXAS TALLGRASS PRAIRIE REMNANT CONSERVATION; URGENCY AND FOCUS

### Ken Steigman, University of North Texas

Less than one tenth of one percent of Texas tallgrass prairies remain of the original 12 million acres. The remaining remnant prairies consist of relatively small acreages rapidly being lost to urban sprawl. Lewisville Lake Environmental Learning Area (LLELA) staff and volunteers collect local ecotype seed and rootstock from prairie remnants in danger of immediate destruction. The seed is germinated and rootstock propagated in LLELA's native plant nursery. Production beds produce well established plants that are transplanted onto restoration sites on LLELA where they are managed. Priority is given to those species with the highest floristic quality index. Strategies have been developed that provide for the establishment of plants even during extended periods of drought.

## USING GOALS AND PROFITABILITY TO DETERMINE WHAT TO PLANT IN PASTURES

### Megan Clayton, Texas A&M AgriLife Extension Service

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There are about as many reasons to replant a pasture as there are options for planting. Goals for the property generally guide the decisions of what to plant, but is it even worth it? The economics behind replanting a 250-acre pasture on a hypothetical ranch in Live Oak County, Texas, were recently evaluated. The model included three different enterprises: 1) owner grazing the land with their cattle, 2) leasing the grazing rights to another producer, or 3) haying the field. Three different plant covers were considered: 1) a mix of native grasses and forbs, 2) buffelgrass, or 3) Tifton 85 bermudagrass.

*Photo: Ken Steigman*

**Table 1. Comparison of costs for field preparation, establishment, and maintenance of different plant cover types (see publication for details)**

| | Field preparation (per acre) | Establishment costs (per acre) | Maintenance costs (for 10 yrs per acre) |
|---|---|---|---|
| Native plants | $63.40 | $107 | $33.78 |
| Buffelgrass | $63.40 | $88.70 | $97.78 |
| Tifton 85 bermudagrass for grazing | $63.40 | $151 | $516.54 |
| Tifton 85 bermudagrass for haying | $63.40 | $151 | $978 |

The Farm Assistance Risk Management Model was used for these analyses. Assuming 100-percent land ownership and several other standard variables, the model is able to calculate the average annual net farm income over a 10-year period post-planting.

Assume the field preparations for planting are the same—estimated at $63.40 per acre (Table 1). Costs for seed, planting, and maintenance were also estimated for each cover type. Maintenance can be quite different depending on what plants are selected. Our estimates varied from $34 for native plants to $978 for introduced grass species per acre over a 10 year period (Table 1). Stocking rates were determined based on cover type, effective long-term use, and estimated production values.

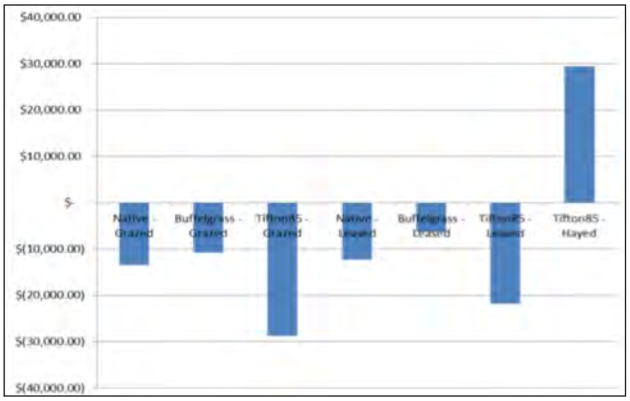


**Figure 1: Annual net farm income (10-year average) by plant cover type and practice for a 250-acre example pasture in Live Oak County, Texas.**

In the end, no grazing scenario paid for the planting and maintenance cost after 10 years (Figure 1). Careful evaluation of your goals and the motives behind replanting will help you decide which practice is best. Deferred grazing, chemical, mechanical, or prescribed fire techniques may help to improve the productivity of a pasture without the cost and risk of replanting. A full publication can be downloaded at SouthTexasRangelands.tamu.edu/useful-publications/ under 'seeding'.

## GRAZING MANAGEMENT AND WINTER STOCKPILING OF WARM SEASON GRASSES IN THE SOUTHERN PLAINS

**Brandon Carr, USDA-NRCS**

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The desire to conserve and restore the landscape of native grasslands while utilizing the forage for livestock production is a challenge for producers. Management decisions include the amount of forage available, stocking rates, and grazing expectations. A common practice for livestock producers in the southern great plains is to harvest and store forage as hay for winter-feeding. An alternative to managing forage as a hay is stockpiling the forage for grazing

*Photo: Deborah Clark*

during the winter months. This is achieved by deferring grazing for most, if not all, of the growing season so forage can be utilized later in the year. Understanding the nutritive quality and production of warm season grasses is crucial for their utilization as stockpiled forage. Objective of this study is to evaluate how forage yield and quality of native and introduced warm season grasses change from early fall to late winter under different forage management regimes. 'Alamo' switchgrass *(Panicum virgatum L.),* 'San Marcos' eastern gamagrass *[Tripsacum dactyloides (L.)* L.], 'Lometa' Indiangrass [*Sorghastrum nutans* (L.) Nash], 'Selection 75' Kleingrass *(Panicum coloratum* L.), 'WW-B.Dahl' old world bluestem *[Bothrichloa bladhii* (Retz) S.T. Blake], and OK Select germplasm little bluestem *[Schizachyrium scoparium* (Michx.) Nash] were evaluated in replicated plots on a Miles fine sandy loam soil at the James E. "Bud" Smith Plant Materials Center, Knox City, Texas. Forages were fertilized annually with 30 lb N/acre at green up. Forage production and quality estimates of percent *in vitro* dry matter digestibility and crude protein (CP) were determined annually beginning 15 October to 15 February 2013-2016 at 30 day intervals from simulated grazed and ungrazed plots. Forages clipped 1 July simulated early season grazing management compared to unclipped forages representing the ungrazed management regime. Results suggest these grasses have the potential to provide sufficient yield and digestibility as a stockpiled forage, but crude protein content was near or below the dietary requirement for all classes of beef cattle. Winter weathering did not affect yield of Indiangrass and little bluestem while eastern gamagrass and old world bluestem in the grazed management exhibited significant yield loss during the winter months (~48%). Eastern gamagrass crude protein was highest in the fall at 7% compared to the other forages that averaged ~5%, but CP decreased following the first killing frost. The digestibility of all forages remained near or above 50% in both grazing management regimes from October to February with kleingrass having highest digestibility of 54-63% and switchgrass the lowest at 48-56%. Native warm season grasses can provide an alternative to introduced species for winter grazing needs while also preforming other valuable services such as improving wildlife habitat, providing protection from soil erosion, and restoring the landscape to native grasslands.

# 4. GRASSLAND DEPENDENT WILDLIFE

## WORKING LANDS, CONSERVATION AND COOPERATION: AGRICULTURAL GRASSLANDS AND GRASSLAND BIRDS IN ONTARIO, CANADA

**Paul G.R. Smith, Ontario Ministry of Agriculture, Food and Rural Affairs**

Grassland birds breeding in Ontario include species such as Bobolink, Eastern Meadowlark, Savannah Sparrow, Grasshopper Sparrow, Upland Sandpiper, Vesper Sparrow and Loggerhead Shrike. But Ontario has a modest amount of native prairie ecosystem (Rodgers 1998), so the birds are largely dependent on "grasslands" that include working lands growing perennial forage crops like hay and pasture for livestock (McCracken et al 2013). Like much of North America, Ontario's grassland bird species are declining and perhaps more similarly, "farmland" birds of Europe show the same downward trends.

Specific drivers for grassland bird declines in Ontario are complex (Ethier & Nudds 2015, 2017; McCracken et al 2013). But changing crops over many decades are certainly one of the drivers (Smith 2015). Increasing area devoted to annual crops is a major trend, especially soybeans and corn, as is decreasing acreage of perennial forages, hay and pasture. Pasture and hay acreages and cattle numbers in Ontario have declined 62%, 40% and 49% since 1976. High land prices, modest or worse returns for beef producers and high annual crop prices during 2008-13 all contributed to these trends.

Ontario passed a new Endangered Species Act in 2007, updating a 1975 statute. The new law emphasizes science in identifying species at risk and employs a unique legislative structure for species designation. A Government appointed Committee on the Status of Species at Risk in Ontario determines the status of species and legal listing occurs through a regulation filed after the committee decides on the status ("automatic" listing). No ministerial or Cabinet input goes into species listing and no public consultation occurs related to listing of species. Legal habitat and species protection then "automatically" take effect unless specific regulations take precedence. Passage of the legislation involved significant advocacy and controversy among stakeholders (Olive 2016).

Bobolink and Eastern Meadowlark were designated threatened in 2010 and 2012. Both species nest in hay and pasture May-July. The estimated Ontario population of Bobolink is 570,000 (2010) birds and Eastern Meadowlark is 130,000 (2010). Before European settlement, both species had limited populations in Ontario. Populations declined significantly since 1960s, triggering the percentage decline criterion for threatened species, regardless of population size or breadth of distribution (McCracken et al 2013).

The nesting period for the Bobolink and Eastern Meadowlark overlaps with normal hay harvesting and grazing activities (May to mid-July; Diemera & Nocera 2016; McCracken et al 2013). Concern arose that the "automatic" habitat protections might prevent normal hay harvest and pasture grazing. Over 30,000 Ontario farmers grow forages on about 1.5 million hectares, so Bobolink and Eastern Meadowlark may nest on thousands of farms. This was perhaps the first threatened species designated in Ontario that depends so directly on working agricultural lands for its habitat, and yet where blanket prohibitions would so directly conflict with production activities and the livelihoods of producers. This apparent paradox belies how a voluntary stewardship approach might better suit the coexistence of both forage-based livestock agriculture and grassland birds.

*Photo: Steve Maslowski*

A major concern is that nutritional value of late harvest hay and pasture is much lower that earlier harvest (McCracken et al 2013; Mussell et al 2013) and the potential economic impact of reduced animal growth and production with lower quality forages. Another concern was about future potential of land for development might be compromised (important for non-farm landowners) and this has led many non-farm landowners renting farmland (about one third of all farmland is rented) to disallow the growing of hay (Luo, 2015). This counter-productive effect reduces the hay acreage available to grassland birds for nesting, as well as negatively impacting livestock and forage producers. Further, this detracts from soil heath by reducing the use of perennial hay and more diverse crop rotations that build soil health. This is an example of a perverse incentive, often documented as resulting from unanticipated effects of implementation of some public policy interventions (Byl 2015; Olive 2014).

The Ontario government responded to the Bobolink and Eastern Meadowlark situation in 2011 with a temporary exemption from species protection to allow normal farming activities while a longer term solution was developed. A multi-stakeholder advisory committee (Bobolink and Eastern Meadowlark Round Table) was set up to provide advice and recommendations on ways to protect the species and their habitat, while still allowing agricultural operations to continue. This was co-chaired by the President of Ontario Federation of Agriculture and an avian biologist from Bird Studies Canada. Compromise and consensus-building was needed to reach agreement while the agriculture temporary exemption in place. Government staff provided advisory and secretariat support to the round table.

In 2013, a species recovery strategy was completed (McCracken et al 2013) and the Round Table recommendations were released for comment (McCracken & Crews 2013). The Roundtable proposed a package of stewardship incentives, research and monitoring, education and outreach, along with a 10-year exemption extension for agriculture. This analysis led to the government decision in 2015 to endorse a package of initiatives including education, incentives and research, along with a regulatory amendment that extended the agricultural exemption to 2025. A significant Grasslands Stewardship Initiative is a key commitment that is still under development (Ontario Ministry of Natural Resources and Forestry 2015).

In parallel with the activities noted above, new agri-environmental stewardship programs aimed at species-at-risk on Ontario farms were being developed and implemented using Canadian federal and Ontario provincial funding. A farm organization, Ontario Soil and Crop Improvement Association, is the delivery agent for these initiatives which include the Species-at-Risk Farm Incentive Program, Grassland Habitat Farm Incentive Program and the Species at Risk Partnership on Agricultural Lands. This development of new programs helps deliver on the need for voluntary stewardship education and incentives for grassland bird conservation. The related educational best management practice documents (e.g. Kyle & Reid 2016), funding programs and communications work have helped change the nature of the discussion and attitudes about species-at-risk and farming.

The changing attitudes and gradually reduced controversy between 2010 and 2017 result from the compromise solution developed and also growing knowledge and interest in species-at-risk among some farmers. It also reflects evolution of thinking in approaches to implementing this type of legislation and learning from experience. The stewardship funding from governments reflects that evolution. Having a farm organization promoting species at risk programs is a significant change in the range of organizations addressing these issues. All these factors contribute to the changing attitudes and social norms and illustrate the importance of multi-stakeholder consensus-building.

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# HOME RANGE AND HABITAT USE OF BAIRD'S AND GRASSHOPPER SPARROWS IN THE MARFA GRASSLANDS, TEXAS

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Populations of grassland birds that winter in the Chihuahuan Desert of northern Mexico and the southwestern United States are declining faster than any other bird group in North America. Habitat loss and degradation are thought to be the main drivers of population declines. However little information exists on grassland bird winter ecology. Baird's and Grasshopper sparrows are two migratory birds that overwinter in the Chihuahuan Desert Grasslands and have lost between 70–80% of their total population since 1966. Bird Conservancy of the Rockies (BCR) with the aid of partners is conducting an ongoing 5-year study across three sites in northern Mexico that aims to determine limiting factors for these species on the wintering grounds. In winter of 2016-2017, we added a fourth site to this study near Marfa, Texas. There, our specific objectives are to 1) Monitor winter survival rates of Baird's and Grasshopper sparrows in the Marfa Grasslands, 2) Determine home ranges for the two species, and 3) evaluate bird-habitat use relative to habitat conditions. Grasshopper and Baird's sparrows were trapped using an active mistnetting technique. We placed between 2-4 mistnets in a straight line in patches of tall and dense grass and flushed birds towards the net from a semicircle of up to 200 m around each side of the net. Birds were banded with USGS aluminum bands and 66 VHF transmitters were deployed on Baird's (n =40) and Grasshopper (n=26) sparrows using a figure-eight leg loop harness. Birds were tracked and located 1×/day at different times of day between 07:30–18:00 hrs for the winter seasons of 2016 and 2017 (mid-December to mid-March). A total of 1,855 bird locations were obtained. We obtained visual estimates of ground cover within 5 m radius circular plots of at least 10 radio telemetry locations per bird, resulting in vegetation estimates for a total of 837 bird locations. We also collected habitat data across a grid of 420 points spaced every 100 m within the study area. This study is ongoing and will be repeated during the winter of 2017-2018. Here we present preliminary results from the 2016-17 winter season. To estimate home ranges and core areas, we used Program R package adehabitatHR (R Core Team 2015), calculating the fixed kernel density (at 95% and 50% respectively) with least square cross validation

*Photo: Denis Josefina Perez-Ordonez*

*Photo: Denis Josefina Perez-Ordonez*

as a smoothing parameter. We were able to determine home ranges and core areas for 33 of 66 birds that had a minimum of 30 tracking locations.We compared the size of home ranges and core areas between species using ANOVA, and we compared vegetation data between bird locations and the grid with MANOVA to determine habitat preferences. Preliminary results of the first season show that home range size varied from 1.0 to 54.9 ha with a mean of 7.6 ha. Core area varied from 0.18 to 11.46 with a mean of 1.04 and there was a strong correlation between home range and core area ($r = 0.99$). Bird species did not differ in size of home range ($P = 0.342$) or core area ($P = 0.353$), and both preferred sites with a higher percentage of grass cover ($P < 0.001$) and less bare ground ($P < 0.001$) compared to grid points. Data from this site will contribute to full annual cycle models that will help guide grassland management to benefit grassland birds.

## GLOBAL REDUCTION IN GREENHOUSE GAS EMISSIONS DIMINISHES CLIMATE CHANGE VULNERABILITY OF GRASSLAND BIRDS IN NORTH AMERICA


### Chad Wilsey, National Audubon Society

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For more than 40 years, grassland birds in North America have been in decline due largely to land conversion. However, the highest North American climate change velocities are predicted for the Great Plains, making climate change an emerging threat. We assessed that threat using a model-based, climate change vulnerability assessment of 35 grassland bird species under greenhouse gas reduction commitments in the Paris Agreement. We found that 63% of North American grassland bird species have moderate to high vulnerability to climate change under the Agreement, but that this could be reduced to 40% with further emissions reductions. Therefore, continued policy actions to reduce global greenhouse gas emissions are urgently needed to protect this suite of grassland birds in addition to continuing government-funded and market-based grasslands conservation schemes.

## BIRD AND MAMMALIAN CARNIVORE RESPONSE TO PLAGUE IN PRAIRIE DOG COLONIES


### Reesa Yale Conrey, Colorado Parks and Wildlife

*Other Authors: Daniel W. Tripp, Colorado Parks and Wildlife; Erin N. Youngberg, and Arvind O. Panjabi, Bird Conservancy of the Rockies*


Prairie dogs (*Cynomys* sp.) are highly susceptible to plague, a disease caused by the non-native bacterium *Yersinia pestis*, introduced to the Great Plains of North America in the 1940s–50s. Plague epizootics may have cascading effects on species associated with black-tailed prairie dog (*C. ludovicianus:* BTPD) colonies, such black-footed ferrets *(Mustela nigripes),* burrowing owls *(Athene cunicularia),* and ferruginous hawks *(Buteo regalis).* Colorado Parks and Wildlife has completed a study of plague management in prairie dogs, in which oral vaccine treatments were compared to placebo baits and insecticidal dusting of burrows (Tripp et al. 2017). Our objective is to quantify the effects of plague and plague management on avian species and mammalian carnivores associated with colonies of BTPD and Gunnison's prairie dogs *(C. gunnisoni).* Working at sites receiving vaccine, placebo, insecticidal dust, and no treatment, we have sampled colonies before, during, and after plague epizootics. For preliminary analyses, colonies have been categorized as active or post-plague (extirpated or severely reduced prairie dog populations). We report here on avian point count, raptor count, and remote camera data collected on BTPD colonies. Research is ongoing, so all results should be considered preliminary.

Study colonies were located in shortgrass and mixed-grass prairie east of the foothills of the Rocky Mountains in Larimer and Weld Co., Colorado, adjacent to the Wyoming border. Located at 1700 – 1900 m (5600 – 6200 feet) and receiving ~400 mm (16 inches) of annual precipitation, this site is grazed by cattle and native grazers, especially prairie dogs, pronghorn *(Antilocapra americana),* black-tailed jackrabbits *(Lepus californicus),* and desert cottontails *(Sylvilagus audubonii).* Soapstone Prairie Natural Area and Meadow Springs Ranch are managed by the City of Fort Collins and are dominated by grasses (blue grama *Bouteloua gracilis* and buffalograss B. *dactyloides*) with smaller amounts of native (scarlet globemallow *Sphaeralcea coccinea)* and non-native forbs, shrubs, and cactus.

Over a 3-year period starting in fall 2013, plague epizootics occurred over ~75% of the study area. Some colonies, particularly those receiving dust or vaccine, have had increasing prairie dog numbers since initially declining during the peak of the epizootic, while others, especially untreated areas, have continued at severely reduced acreage (Tripp et al. 2017). Precipitation has varied greatly over the three years of this study, from slightly dry to very wet, compared to the 30-year average. This plague cycle began during a dry period but peaked during two wet years.

We detected more Brewer's blackbirds *(Euphagus cyanocephalus)*, vesper sparrows *(Pooecetes gramineus)*, and horned larks *(Eremophila alpestris)* during point counts in active colonies, and more grasshopper sparrows *(Ammodramus savannarum)* and lark buntings *(Calamospiza melanocorys)* in colonies impacted by plague (which intersected with wet years). Grasses were taller and plant cover generally higher following epizootics, which likely contributed to higher densities of species that prefer taller vegetation structure and lower densities of those that prefer shorter stature vegetation. In both summer and winter raptor counts, during which we recorded time spent within colonies, ferruginous hawks showed the strongest preference for foraging on active vs. post-plague colonies, with a use rate six times higher on active colonies. American kestrels *(Falco sparverius)*

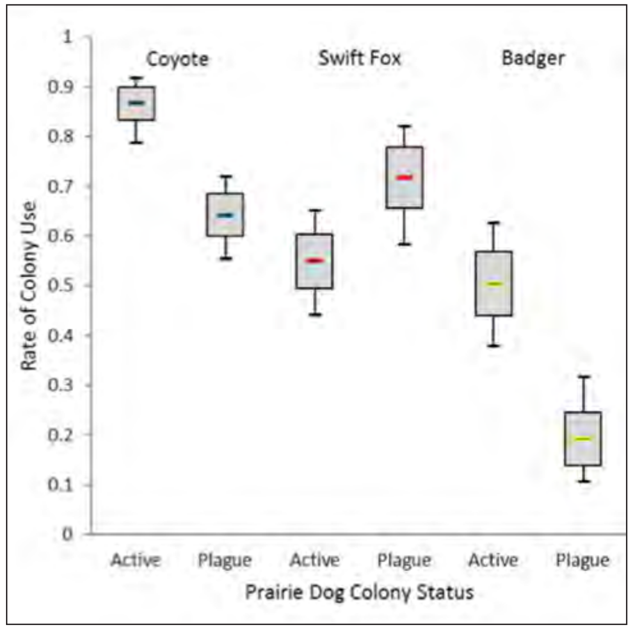


**Figure 1. Rate of black-tailed prairie dog colony use by coyote, swift fox, and badger for active and post-plague colonies. Occupancy was estimated from remote camera data in northern Colorado from 2013–2016, with results shown for the top ranked (minimum AICc) model per species. Boxes are standard errors and bars are 95% confidence intervals around estimates.**

and golden eagles *(Aquila chrysaetos)* had use rates 2 – 4 times higher on active colonies. In contrast, burrowing owls, which are known to be associated with BTPD colonies (e.g., Butts & Lewis 1982, Tipton et al. 2008) and were by far the most commonly detected raptor in our summer surveys, had use rates ~2.5 times higher on post-plague colonies. Although seemingly counterintuitive, this confirms results from Conrey (2010), who found high densities of burrowing owls nesting on post-plague colonies where small numbers of BTPD occurred. Looking across raptor species, the pattern of higher use of active vs. post-plague colonies was stronger in winter than in summer. Additional analyses of bird data are planned, with the inclusion of covariates related to colony characteristics, weather, vegetation, and for raptors, alternative prey such as lagomorphs.

Badgers and coyotes had 20 – 30% lower usage of colonies following plague events (Fig. 1). Swift fox showed the opposite pattern, but prairie dog activity had a weaker effect on fox occupancy, and this species may be responding more strongly to coyotes, which prey upon swift fox (Kamler et al. 2003, Karki et al. 2006). Occupancy models containing prairie dog activity had 99.9% of model weight for coyotes and badgers and 82.7% for swift fox. Detection rates for all three species were higher when more cameras were deployed and during August – April (compared to May – July). Coyotes and badgers appear to respond negatively to plague in prairie dogs, which dramatically reduces abundance of an important prey item. Future analyses of camera data will incorporate additional years of data and more covariates and may include multi-species models (allowing coyote-fox interaction) and relative abundance models.

Plague management via vaccine delivery and insecticidal dust can reduce the impact of plague on prairie dogs (Tripp et al 2017) and their associates. Smaller scale applications within larger BTPD complexes did not eliminate plague but helped to maintain pockets of live prairie dogs and promote population recovery. This mosaic of active and plague-affected areas retains habitat for species associated with colonies. Not surprisingly, species that prey upon prairie dogs or preferentially forage in short stature grasslands are the most likely to benefit from plague management.

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## USE OF GPS COLLARED PRONGHORN TO INFORM FENCE MODIFICATION EFFORTS IN NORTHERN ARIZONA

### Jeff Gagnon, Arizona Game and Fish Department

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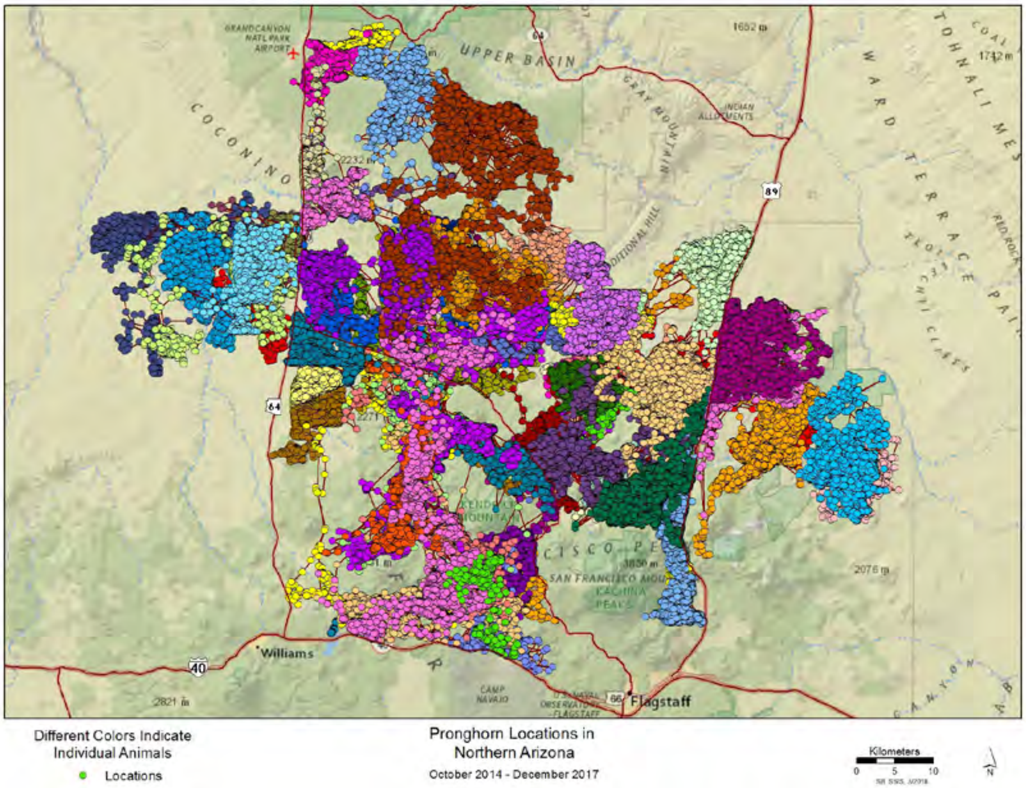
Arizona Game and Fish Department worked with partners (Arizona Antelope Foundation, ADOT, NPS, Babbitt Ranches, USFS) to prioritize fence modifications in Northern Arizona using data collected from GPS collared pronghorn. Data intermittently collected from 1992-2010 was used for identification of problem areas

*Photo: Arizona Game and Fish Department*




**Map from our collared pronghorn, each color is and individual pronghorn and each dot is a location taken every 2 hours, approximately 350,000 gps locations.**

to begin modifications. To evaluate effectiveness of these modifications and inform ongoing management, the Department collared an additional 70 pronghorn from October 2014 through December 2017 and will obtain an additional 250,000 GPS locations. These data continue to inform fence modification efforts and will also ultimately be used to guide grassland restoration efforts across Northern Arizona and elsewhere.

## EVALUATING THE USE OF MODIFIED FENCE SITES BY PRONGHORN IN THE NORTHERN SAGEBRUSH STEPPE

**Paul F. Jones, Alberta Conservation Association**

*Other Authors: Andrew Jakes, Mark Hebblewhite, Daniel R. Eacker, University of Montana; Blair Seward, Alberta Conservation Association; Brian Martin, The Nature Conservancy.*

The pronghorn *(Antilocapra americana)* is the most specialized and representative large mammal that is considered to be endemic to the grasslands of North America. At the northern fringe of its range in Alberta and Montana, pronghorn have adapted to many anthropogenic activities, such as cultivation, grazing, oil and gas field development, roads and pipelines, rural acreage development, and urban expansion, that fragment habitat (Alberta Environmental Protection 1997). Fences along transportation corridors (right-of-way) or for pastures are often an overlooked cause of fragmentation. Numerous studies have indicated that fences can impede pronghorn movement (see Yoakum et al. 2014) and can lead to mortality either from entanglement (Harrington and Conover 2006) or by restricting movements to stay ahead of winter storms

(Yoakum et al. 2014). In addition, fences can cause physical injury to pronghorn by removing hair and leaving scars and open wounds (Photo 1; Jones 2014).

Within wildlife friendly fencing guides for landowners (Paige 2012, 2015) there are many recommendations to make fences friendly for pronghorn by allowing easier passage under the bottom wire, as pronghorn crawl under, rather than jump over fences. No studies have critically evaluated suggested modifications to ensure they function as proposed. The objectives of our project were: 1) to determine the minimum bottom wire height required to allow safe passage by pronghorn, 2) evaluate whether modified fences (goat-bars, smooth wire, and clips) are used more in comparison with non-modified fences, and 3) the length of time it takes pronghorn to habituate to modified fences. We used a Before-After-Control-Impact design to assess the functionality of modified fences. The design allowed for comparison between crossing rates at modified sites before and after modifications were installed to crossing rates at control sites that remain unchanged from the before to the after period. We used remote camera traps to record the interactions of pronghorn and fences in two study sites. The first site was on Canadian Forces Base Suffield in Alberta, Canada and the second study site was on The Nature Conservancy's Matador Ranch in Montana.

Our results indicated that pronghorn consistently selected for a minimum bottom wire height of 18 inches across both study sites, which was significantly higher than typically available at those sites. We found that clips and smooth wire are most effective, while surprisingly the commonly proposed goat-bar was ineffective and created a negative behavioral response by pronghorn. Lastly, it appeared that for clips and smooth wire, it took 4 times as long for pronghorn to habituate to using these modified fence sites when compared to crossing rate observed at known-crossing sites before any modifications were installed (designated as the crossing rate threshold). Pronghorn use of goat-bars never achieved a similar crossing rate comparable to the rate achieved at known-crossing sites during the before period. We recommend

*Hair loss on the back and side of a male pronghorn as a result of barb wire fences. Photo: Alberta Conservation Association*

clips and smooth wire at a bottom wire height of 18 inches as modifications to fences to allow movement by pronghorn.

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# 5. GRASSLANDS AND POLLINATORS

## ALL HANDS ON DECK: CONSERVING A FLAGSHIP SPECIES

**Laura Lukens & Kyle Kasten, Monarch Joint Venture**

The Eastern monarch butterfly population has declined by 84 percent during the last 20 years (Semmens et al., 2016). A major cause of this decline has been the loss of habitat throughout the breeding range, primarily in the upper Midwest. Urban development and changing agricultural practices have significantly reduced the amount of milkweed on the landscape. It is estimated that 1.3 billion stems of milkweed need to be replaced in order to restore and maintain a viable population of migratory monarchs (Thogmartin et al., 2017). However, while we know that milkweed needs to be added to the landscape, there gaps remain in our knowledge about monarch ecology and habitat availability.

In order to address these gaps and combine conservation efforts throughout the monarch's breeding range, a consortium of scientists and conservation professionals have formed the Monarch Conservation Science Partnership (MCSP). The goals of the MCSP are to: update estimates of abundance and habitat availability in demographic models and threats assessments, gain information about how conservation practices may affect monarchs and their habitat, and to track the spatial and temporal distribution of monarchs and habitat resources on the breeding grounds over time. In order to reach these goals, the MCSP has developed an Integrated Monitoring Strategy (IMS) that uses a spatially balanced sampling scheme to generate an unbiased representation of these data throughout the monarch's range. The IMS protocols capture information about habitat quality and availability, monarch use of the habitat, and threats facing monarchs. During 2017, the protocols were implemented by both paid field technicians and citizen scientists in six states with plans to expand nationally in future years.

The IMS protocols were also adapted in a project to assess the value of Conservation Reserve Programs lands to monarchs and to evaluate the effectiveness of restoration processes. We monitored 39 grasslands during 2017 in Minnesota, Wisconsin, and Iowa, measuring milkweed density and diversity, blooming nectar plant richness and abundance, and the density of monarch eggs and larvae at each site. In the next few months, we will analyze how seed mix design and management techniques influence the establishment of species over time and monarch use of those habitats. We will then publish our findings in order to better inform monarch conservation and habitat restoration efforts.

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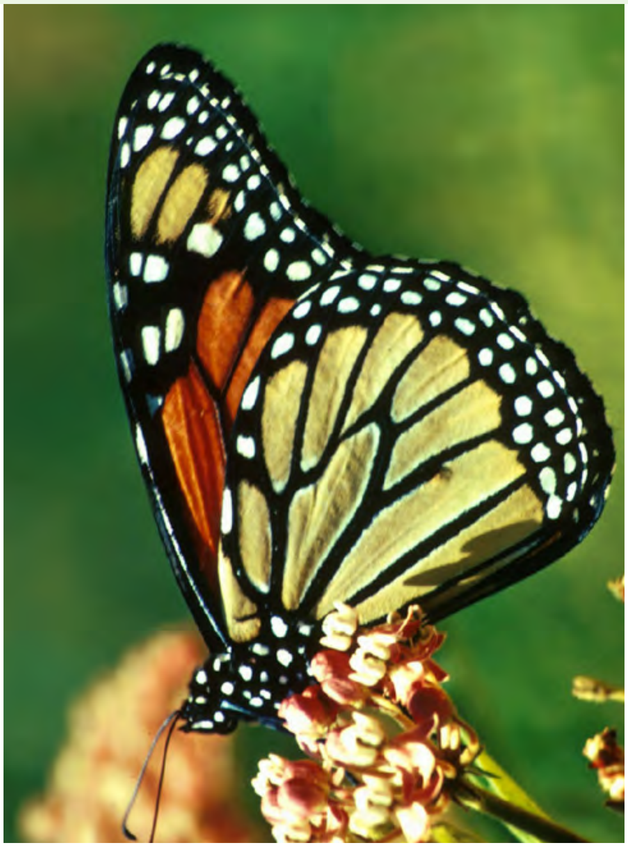


Photo: Glen Smart/USFWS

## MID-AMERICA MONARCH CONSERVATION STRATEGY

### Claire Beck and Ed Boggess, MAFWA

Eastern monarchs (those found east of the Rocky Mountains) have declined by more than 80 percent over the past 20 years. The population decline is believed to be primarily caused by loss of habitat, including reduced milkweed required for reproduction and fewer nectar plants to provide food for monarchs and other pollinators. In 2014 the monarch was petitioned for listing under the federal Endangered Species Act, and a decision on whether listing is warranted is expected in 2019. In order to catalyze and quantify monarch conservation prior to the listing decision, MAFWA, in collaboration with National Wildlife Federation, Pheasants Forever and AFWA, is developing a Mid-America Monarch Conservation Strategy that will provide a framework for implementing, coordinating, and tracking monarch conservation efforts across 16 states in the core monarch migratory and breeding range. The conservation strategies included in this document focus on grassland restoration across the monarch butterfly range designed to prevent the need to federally list the monarch while also benefiting a suite of other grassland-dependent species. The strategy provides a structure for adaptive management of monarch conservation goals and approaches over the 20-year duration of the plan as new biological and management information becomes available.

## PROVIDING URBAN PLANNERS WITH TOOLS TO POSITION GRASSLAND HABITATS FOR SOCIAL AND ECOLOGICAL VALUES

### Gwen White, U.S. Fish & Wildlife Service

*Other Authors: Kelley Myers, U.S. Fish & Wildlife Service*

Monarch butterflies are best known for their mass migration from Canada to Mexico—sometimes traveling up to 3,000 miles. Each spring and fall they work their way across North America searching for milkweed to lay their eggs on and nectar sources to fuel up for their journey. Along the route, the monarch butterfly plays the critical role of a pollinator and ensures our flowers come back next year.

Many pollinators, including the monarch butterfly, are in trouble. Monarch populations have decreased by over 80 percent during the past twenty years. Part of this population loss can be attributed to the drastic decline of monarch habitat—milkweed host plants and nectar food sources— throughout North America. Together, we can save the monarch and other pollinators that also benefit from flowering resources by restoring prairie and wetland habitat, planting natives in our gardens, and protecting the natural spaces that already exist, but it will take everyone to do so. It requires an “all hands on deck” conservation strategy that relies on every land use type to provide monarch habitat.

The role cities can play in monarch recovery—and in providing habitat for pollinators and other wildlife—is more important than previously recognized. In fact, a large metropolitan region such as Chicago has over 16 million stems of milkweed already on the ground, and through strategic outreach with different land users, that number could jump to over 38 million stems. While the prospects for adding more milkweed to the landscape will vary from city to city, the potential for cities to make a difference in monarch conservation is apparent.

Multiple Landscape Conservation Cooperatives partnered with the Keller Science Action Center at the Field Museum in Chicago and the U.S. Fish and Wildlife Service, to answer key questions about how best to conserve monarchs in urban areas located along the monarch's migration flyway. The partnership worked closely with four urban areas along the central flyway: Austin, Chicago, Minneapolis/St.Paul, and Kansas City. Within each urban area information was collected about, the amount and types of potential habitat (from residential backyards to turf-dominated corporate campuses), how much of this green space is likely to be converted, and best practices for engaging different stakeholder groups to increase the overall amount of habitat. This information was compiled to create mapping tools and an Urban Monarch Conservation Guidebook.

## Products for planners to use from the Monarch's View of the City project

**General**

• Urban Monarch Conservation Guidebook
Social Science and Outreach

• Social Survey and Interview Guide (English and Spanish)

• Best practices by land use type

• Guide to creating monarch habitat in your Midwestern garden

**Geospatial Tools**

• Urban Milkweed Baseline Tool

• Urban Scenario Planning Tool

**Biological Sampling Protocols**

• Metro transects methodology and sampling protocol

• Natural areas sampling protocol

## Urban Monarch Conservation Guidebook

The Urban Monarch Conservation Guidebook is intended to support the efforts of people like city planners and conservation practitioners who are interested in identifying the best places and methods to create people- and pollinator-friendly habitat in urban areas. All you need to use the Guidebook is a motivation

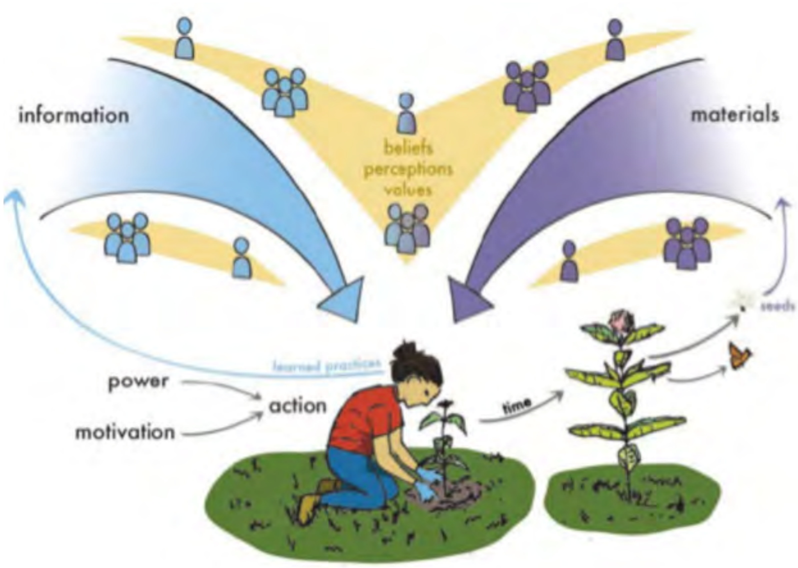



**Figure 1. Figure from Guidebook: A monarch butterfly "supply chain": What does it take to "produce" a monarch butterfly? Flows of information and materials, mediated by groups and individuals, make monarch conservation actions possible. These flows and exchanges are shaped by the individual and cultural values, perceptions, and beliefs that people bring to their participation in networks. Values, perceptions, and beliefs--which are particularly diverse in cities--motivate people to act on behalf of the monarch. People must also have the power to make decisions about a given piece of land in order to take action to make it more habitable for monarchs.**

to do something for monarchs, some familiarity with how city space is organized, and comfort with using maps (or know someone who is comfortable). You can select from a suite of tools and resources that will provide help in developing new habitat or expanding existing habitat as small as backyard butterfly gardens or as large as multi-acre comprehensive prairie restoration.

In the Guidebook you will find six sections that walk you through all of the tools created for the project with additional details that can be found in the appendices. If you are wondering how this might apply to your situation, the guidebook also walks you through three different scenarios:

- We have just signed the Mayors' Monarch pledge and are otherwise new to monarch conservation. We are a municipality with a lot of single-family homes. How can the tools help us to prioritize actions?
- We'd like to integrate monarch conservation into other important regional planning discussions such as stormwater management. How do we make the case?
- Our locality has a number of vacant lots. Where should we focus our efforts so that a monarch conservation program has a chance to succeed?

## Mapping and Analytical Tools

Two mapping tools to help municipalities set goals and priorities for establishing monarch habitat were created. The first is the Urban Milkweed Baseline Tool which provides an estimate of existing milkweed density and stem count for a metropolitan area. This helps a you understand what a city is currently doing for the monarch. This tool creates a snapshot in time, but can be updated to reflect the work done in the community. The second tool available is the interactive Urban Scenario Planning Tool which allows users to model anticipated increases in milkweed density and

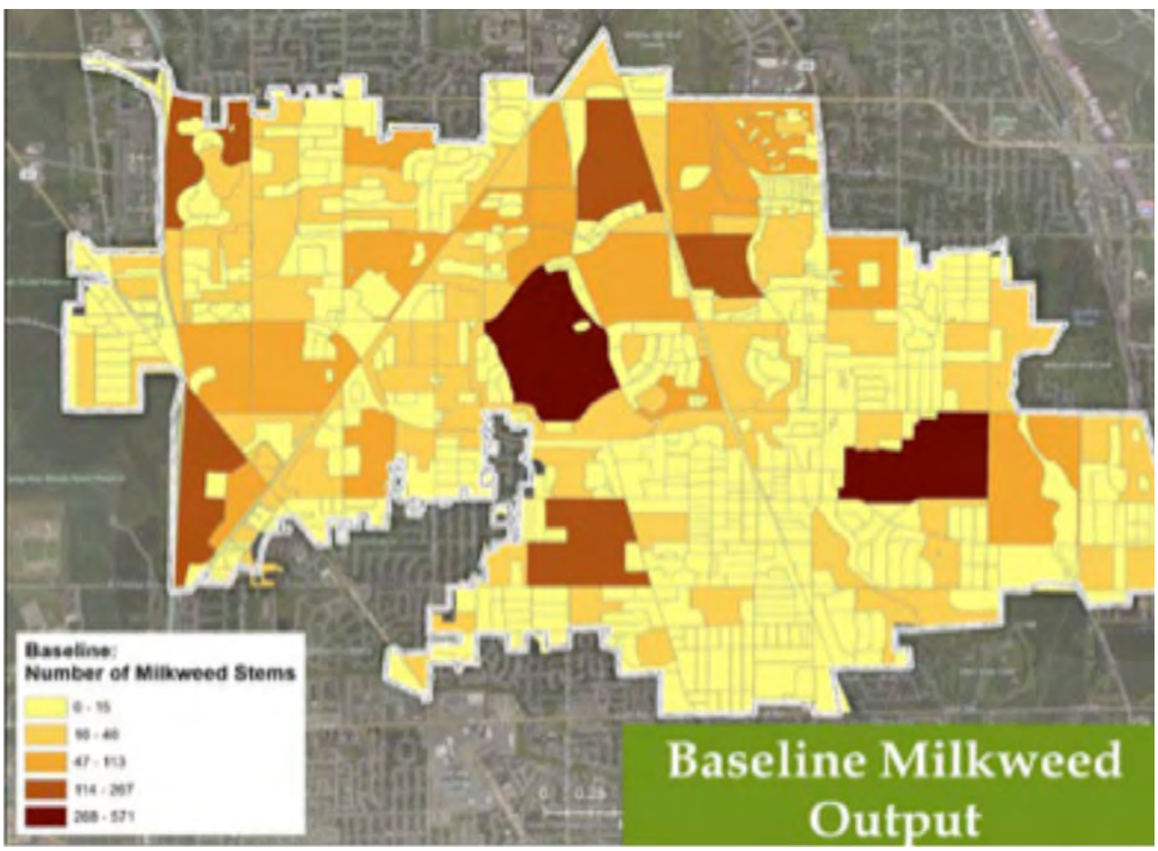



**Figure 2. An example map of a smaller town found in the Chicago Metropolitan area that illustrates the output from the Baseline Milkweed Geospatial Tool.**

total stem count for any sub-geography based on user scenarios across land-use types. Your local partnership can look at your town and understand where there are opportunities for working with different land uses to convert a small portion of their land to multi-beneficial habitat. This tool helps marry your local needs with creating wildlife habitat; so you have something that is not just good for wildlife, but for people too!

For more information and access to the products, visit the websites at: **https://tallgrassprairielcc.org/issue/monarch-butterflies** or **http://fieldmuseum.org/monarchs**

*Cattle grazing in a paddock with common milkweed* (Asclepias syriaca) *that has been released by past grazing.*

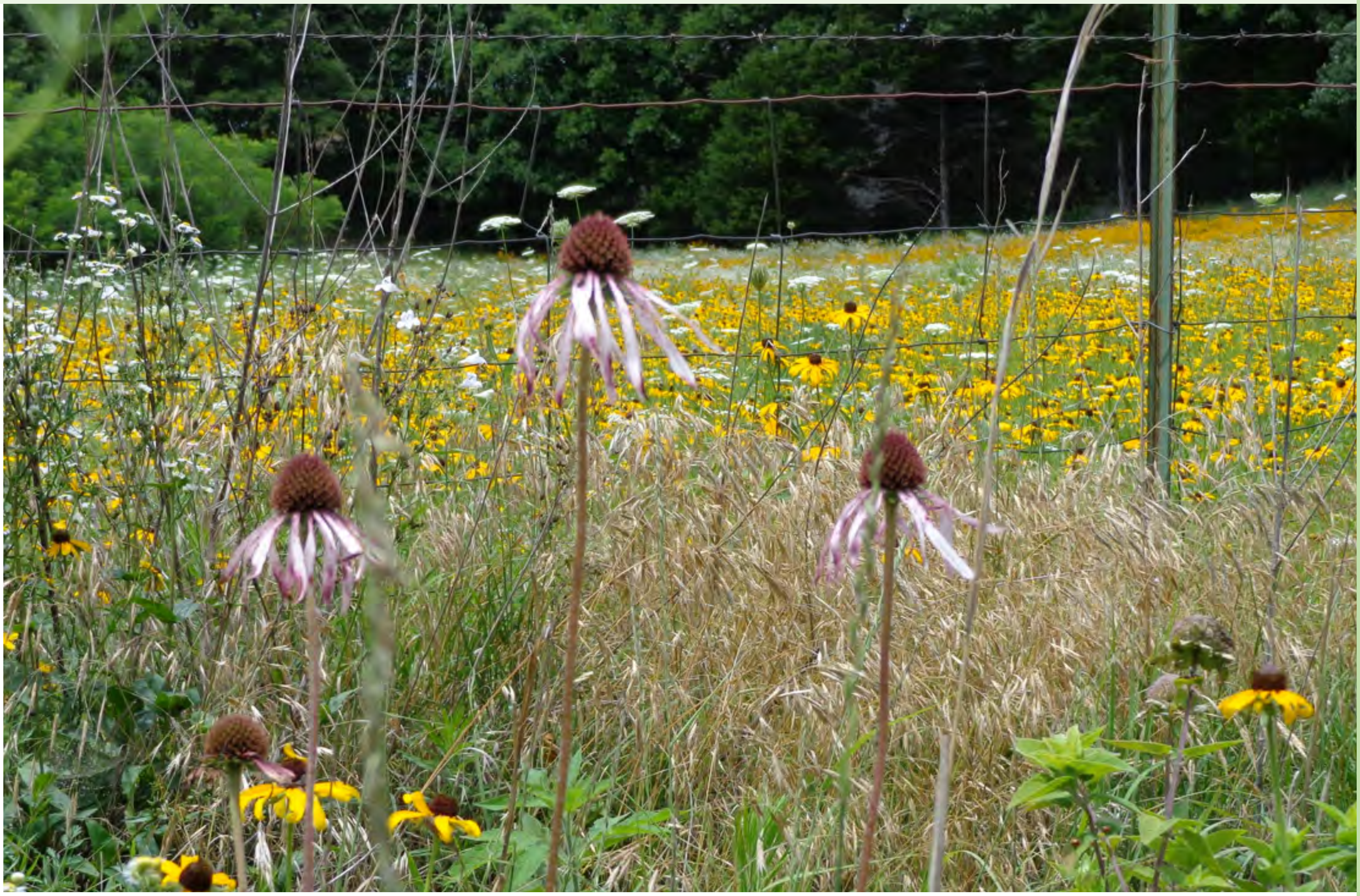
## USDA PRACTICES THAT BENEFIT POLLINATORS


### Ryan Diener, Pheasants Forever, Inc. & Quail Forever


Population declines of native pollinators and other insects have been at the forefront of conversations between landowners and conservationists for several years. Charismatic species like the Monarch Butterfly and Rusty Patched Bumblebee have brought the issues that pollinators are facing to popular culture. There are likely many factors that have contributed to these declines, but the effect of the continual loss and degradation of native grasslands cannot be overstated. The forbs and grasses associated with these communities are needed to sustain healthy ranches, livestock, and populations of pollinators. The United States Department of Agriculture (USDA) has developed many programs and practices in the last few years to help landowners improve pollinator habitat and grassland function on their properties. FSA and NRCS have developed programs and practices to help landowners plant cropland and other non-native grasslands back to pollinator habitat. These practices are beneficial, but can result in small patch size restorations. To make a larger impact on the landscape, we should also focus on two of our traditional NRCS grassland practices; prescribed grazing and prescribed burning. The acres of habitat restoration needed to make significant impacts on Monarch populations

*A diverse native pasture that has abundant native forbs to benefit pollinators.*

are in the 10's of millions. To accomplish that level of restoration, we must improve our working grasslands. Conservationists and landowners should collaborate to develop prescribed grazing programs that improve rangeland for livestock while increasing plant diversity for pollinators and other wildlife. Prescribed grazing programs that include rotations and rest periods of pastures do just that. Many forms of rotational grazing or rest grazing systems have been developed around the country, each with degrees of positive impact on range condition and habitat. Allowing conservation professionals to work with the landowners to find the best fit for their operation will lead to the highest



*Abundant forbs on both sides of the fence after prescribed grazing to benefit forb diversity in native pastures.*

success. Increasing the adoption of prescribed burning in rangeland would have a significant beneficial impact as well. This practice is already used in many places to reduce brush and tree growth and improve range condition. Implementing prescribed fire with a frequency and seasonality that stimulates increased forb production could benefit pollinators to a greater extent. Using prescribed grazing and fire together in a patch burn grazing system has shown to be very effective in creating quality pollinator habitat in the year after a particular patch is burned and grazed. Examples of the effective use of this practice can be found throughout the central and southern great plains from Nebraska to Texas, as well as in Missouri and Tennessee. The development and use of new practices geared towards pollinators is important, but we should also look toward traditional practices and implementing them with a shared goal of improving production and pollinator habitat.

## THE EFFECTS OF CATTLE GRAZING ON PRAIRIE POLLINATORS AND FLORAL RESOURCES: A REVIEW

**Ray Moranz, Xerces Society**

Some conservationists seek to use cattle grazing as a tool for pollinator conservation in the Central Grasslands of North America. They assume that grazing disturbs grassland vegetation in a positive way, by reducing grass dominance and increasing abundance of forbs. There is evidence to support this, particularly at conservative stocking densities. However, cattle grazing at moderate and high rates can reduce floral resource abundance, which in turn can reduce abundance of some pollinator species. I review existing research on the effects of grazing on pollinators and floral resources, and suggest the need for future research on the effects of grazing duration, grazing season, grazing system, recovery time, and stocking density.

# 6. CONSERVATION STRATEGIES AND COLLABORATIVE PARTNERSHIPS

## RECOVERING THE AMERICAN SERENGETI IN THE SOUTHERN PLAINS

**Nicole Rosmarino, Southern Plains Land Trust**

The Southern Great Plains is a biodiversity hotspot that is under-represented in land protection efforts, and wildlife refuges are few. Given the scarcity of public land in the region, efforts to protect and restore native flora, fauna, and natural processes must necessarily focus on private property. However, land acquisition can be costly. This combination of factors motivates the Southern Plains Land Trust (SPLT) to employ creative funding approaches in establishing and protecting a network of shortgrass prairie preserves that provide a future for native plants and animals in the region.

SPLT uses the term "American Serengeti" to describe the Great Plains. While the comparison to the African Serengeti is imperfect, invoking this description of America's mid-continent grasslands aims to remind the public of the abundance and diversity of wildlife that once existed on the Great Plains (Flores 2016). Observers such as John James Audubon were dazzled in the 1800s by the presence of abundant large wildlife species on the Great Plains, including bison *(Bison bison)*, pronghorn *(Antilocapra americana)*, elk *(Cervus canadensis)*, grizzly bears *(Ursus arctos horribilis)*, and

*Bison restored to Southern Plains. Photo: Southern Plains Land Trust*

*Black-tailed prairie dog. Photo: Lauren McCain*

wolves *(Canis lupus).* These species were subsequently reduced or extirpated due to concerted extermination and market hunting efforts (Id.).

Smaller, but ecologically important species, such as the black-tailed prairie dog *(Cynomys ludovicianus)* and North American beaver *(Castor canadensis)*, also experienced dramatic declines due to lethal control (Savage 2011). The loss of beaver has adverse impacts on a variety of wildlife species, given the substantial ecological roles this ecosystem engineer plays in river ecosystems. Beaver dams and water impoundment lead to beneficial effects for water tables, floodplains, wetlands, water quality, and habitat complexity (Pollock et al. 2015). The diminishment of prairie dogs has led to the imperilment of associated species. An example is the black-footed ferret *(Mustela nigripes),* which is one of the most endangered mammals in North America and is almost entirely dependent on prairie dogs as prey and on prairie dog burrows for shelter (Miller et al. 1996). Prairie dogs benefit a variety of other species, as well, due to their provision of a prey base, creation of vast underground burrow networks that provide habitat for numerous species, and effects on soil structure and vegetation through prairie dog digging, clipping, grazing, and fertilizing activities (e.g., Miller et al. 2000).

Apparent taming of the wildness of the American Great Plains leads much of the public to regard the region as "flyover country" (Flores 2016). Protection of both native grassland and the wildlife within is a combination under which nature can often rebound quickly. While challenges remain for recovering grizzly bears and wolves in the region, due to current prevailing attitudes toward native carnivores, there is much hope for biodiversity preservation and species recovery on the whole. Species such as elk, pronghorn, and black-tailed prairie dogs, can feasibly be recovered at sites in the Southern Plains through land acquisition and subsequent wildlife protection. These native animals and others might enjoy significant improvements in population levels within just a few years of protection. Bison and black-footed ferrets can be recovered through reintroduction. While bison may increase quickly in numbers, the establishment of self-sustaining ferret populations requires large and healthy prairie dog complexes and may therefore be a longer-term project.

The work of bringing back the wild in the Southern Plains requires a private lands focus, as much of the region lies in private ownership, with the U.S. Forest Service National Grassland System as the main exception. Ranchers can play an important role in providing protection on their land to species in need of recovery. However, there is also a need for core refuges, where the requirements of native animals, plants, and natural processes take priority.

This has led SPLT to a land purchasing strategy designed to maximize ecological impacts and leverage limited resources. The organization strategically targets southeast Colorado because of the presence of the Comanche National Grasslands, which is the largest National Grassland in the Southern Plains. Additionally, the counties where the Carrizo and Timpas Units of the Comanche are located have some of the lowest land prices in the state at $200-300 per acre, declining human population numbers, extensive intact native grasslands remaining, and are a stronghold for black-tailed prairie dogs in the region.

The organization currently protects over 18,000 acres and is on track to grow to 25,000 acres in 2018. Conservation financing, conservation easement tax deductions and/or credits, and the sale of carbon offset credits are promising ways for entities to do more with less to advance grassland conservation.

According to The Conservation Fund, below-market conservation loans can allow organizations to protect much more land while taking calculated risks (Martin 2017). Since its inception in 1998, SPLT would have protected only 2,000 acres if it waited until all funds were in hand before acquiring a given property.

*Black-footed ferret. Photo: Richard P. Reading*

Program-related or impact investment loans have played a substantial role in the organization's success, as well as private philanthropic support.

Conservation easements should be conveyed first and foremost for their benefits to conservation (for example, wildlife habitat, open space, and other natural values). In addition, financial incentives vary, but states such as Colorado have programs to purchase conservation easements from landowners or utilize a transferable tax credit in the case of donated conservation easements. The Texas Land Trust Council (2009) offers a guide for landowners to consider the financial benefits of conservation easements alongside the legacy of permanently protecting one's land. Elsewhere in the Great Plains, landowners should consult with the land trust community in their respective states to explore financial benefits that may accrue from conveying conservation easements to protect grasslands.

Additionally, the Grassland Protocol under the Climate Action Reserve can provide a substantial financial incentive for landowners to permanently protect native grassland from cultivation and undertake other measures to curtail carbon footprints. SPLT is poised to begin offering carbon offsets for sale under a pilot project by the Environmental Defense Fund.

SPLT's largest preserve is its Heartland Ranch, which will cover 18,000 acres in 2018. At nearly 30 square miles, it will be larger than the City of Boulder, Colorado and any one of Colorado's State Parks. The organization has introduced a herd of bison to the property, which also hosts several prairie dog colonies that provide the potential for future black-footed ferret reintroduction. Habitat restoration is an important component of the work to bring back the American Serengeti, and SPLT has planted thousands of cottonwoods and willows along streams on its preserves in order to recover stream health and help beaver to re-establish on their own.

The Southern Plains possesses much promise for recovering the American Serengeti. As Candace Savage puts it, “There are people who think of the prairie as boring, and it is hard not to pity them” (Savage 2011: 1). This is not flyover country, but rather, a land of superlatives, with the fastest land animal in North American: the pronghorn; the largest native mammal in the Western Hemisphere: the bison; the most poignant bird song: the western meadowlark; and hands-down the best sunsets. It is a region well worth preserving.

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## A COMMUNITY-BASED APPROACH TO CONSERVING NORTH DAKOTA’S BADLANDS


### Martha Kauffman, World Wildlife Fund, Northern Great Plains Program

*Other Authors: Claire Hood, World Wildlife Fund*


The Badlands of western North Dakota were identified as a priority conservation area in WWF’s 2005 ecoregional analysis. It contains the largest USFS national grassland in the country with highly concentrated public lands, high species richness, and a protected core area in the form of Theodore Roosevelt National Park. The intact grasslands in this region also support local livelihoods through ranching and hunting operations. The Bakken and Three Forks oil-bearing formations underlay these grasslands, and new technologies in the oil and gas industry have allowed developers to tap into previously inaccessible resources and alter the landscape on a massive scale. The state had roughly 4,500 producing wells in 2009[1] and over 14,100 in 2017.[2] Projections before the current slump in oil prices indicated the potential for nearly 40,000 new wells by 2035.[3] Development of the Bakken and Three Forks shale formations has propelled North Dakota to become the second-leading oil producing state in the nation.

1 2009 Monthly Statistical Update. Industrial Commission of North Dakota, Oil & Gas Division. Updated August 14, 2013.
2 2017 Monthly Statistical Update. Industrial Commission of North Dakota, Oil & Gas Division. November 15, 2017.
3 Director’s Cut, North Dakota Producing Counties Update. North Dakota Industrial Commission, Department of Mineral Resources. September 18, 2014.

To be successful in North Dakota, where conservative communities are wary of conservation interests and out-of-state organizations, collaborating with local partners is essential. Furthermore, the public lands in western North Dakota are interspersed with state and private lands; this means landscape-scale conservation requires public-private partnerships. WWF also recognized that to be successful a clear understanding of North Dakota culture around oil and gas development and lands conservation was needed. In June 2015, WWF with a group of conservation partners hired a well-respected, Bismarck-based consulting team to conduct a stakeholder assessment to look for areas of common ground as well as possible strategies to address concerns with oil development, plan future development, and protect the badlands. The team developed confidential questionnaires and surveys to ascertain the views of stakeholders. They interviewed 71 North Dakotans across four key sectors, namely ranching, oil industry, government agencies, and conservation and recreation groups. The stakeholder assessment was released in August 2016.

The interviews revealed widespread support for protection of surface assets, not just in the Badlands, but throughout North Dakota. At the same time, the consulting team found no one who wanted to stop oil production. The common response was "produce oil, but do it in a way that protects valuable surface resources and recognizes the rights and concerns of those who own the surface." Most respondents feel the recent Bakken oil boom is a blessing to the state and has brought prosperity and growth that North Dakotans have been looking for. At the same time, because of its rapid development, some participants pointed out that the Bakken boom created duplicate infrastructure. Other participants believe there was not enough concern for surface resources, upfront planning, or reclamation. The fast pace of development has stressed infrastructure and local communities. While few participants were critical of any individual, government entity or even the oil industry, most recognized the boom came fast and North Dakota was simply not prepared for such an acceleration in activity over such a large area. With that experience to draw on, most feel there is room for improvement in building out future oil development.

*Photo: Chuck Kowaleski, Trans-Pecos*

The stakeholder assessment concluded with three recommended strategies to achieve the project's goal of developing mineral resources with responsible stewardship of the Badlands: 1) a collaborative process including all parties; 2) regulatory and statutory changes; and 3) a landscape-level pilot project that includes all parties. A recommended next step was to form an advisory committee to develop specific, practical action steps from the three recommended strategies. The decreased oil prices and development slowdown that began in 2015 also provided a unique opportunity for the advisory committee to have constructive conservations, build trust between often opposing sectors, and improve future development through planning.

In September 2016, WWF worked with conservation partners and its consulting team to form the Badlands Advisory Group (BAG). BAG is comprised of five knowledgeable, respected thought leaders from western North Dakota, each from a different sector (a rancher, retired oil executive, retired game warden, county commissioner, and legislator). Their objectives were to 1) think at the landscape level; 2) prioritize the key issues that are most important and achievable; and 3) identify practical, achievable action steps that would promote land stewardship. After six meetings, BAG released its Action Plan in May 2017. The Action Plan focused on three strategies: a state-driven long-term strategic plan for oil development; a habitat mitigation program for oil developers; and a pilot project to test landscape-scale planning of wells, roads, and other infrastructure.

This community-based approach has built trust between its members, produced locally-developed ideas, and gained buy-in from key decision makers, namely the Governor's office. BAG is meeting with the Governor in December 2017 to discuss the advisory committee becoming a task force within the Governor's office. BAG members are also in talks with NP Resources to develop a pilot project on landscape scale planning. Lastly, BAG members from Dunn and McKenzie County are working on developing a habitat mitigation program with state government and conservation partners.

## THIRTY YEARS OF SPECIES CONSERVATION BANKING IN THE U.S.: COMPARING POLICY TO PRACTICE

### Ted Toombs, Environmental Defense Fund

*Other Authors: Maria Jose Carreras Gamarra, Inter-American Development Bank*

Thirteen years after the release of the U.S. Fish and Wildlife Service's 2003 conservation bank guidance, a new draft "Endangered Species Act Compensatory Mitigation Policy" has been launched. Understanding whether it improves upon the existing Guidance requires a review of the structure and function of currently approved banks. We assess species conservation banking practices, compare them with the 2003 Guidance and international biodiversity offset standards, and assess the degree to which the draft Policy fills the identified gaps. Results show that banks have been well aligned to the 2003 Guidance, but fall significantly short when compared to other offset standards. The draft Policy fills some gaps, but future policy updates that provide clear minimum standards, together with pilot projects that demonstrate new approaches are important.

## NATIVES FIRST - A NATIVE VEGETATION STANDARD FOR THE CONSERVATION TITLE OF THE FARM BILL

### Jef Hodges, National Bobwhite Conservation Initiative

Several federal agencies, both in the Departments of the Interior and Agriculture have policies which address native vegetation or limitations using non-native vegetation. The US Fish and Wildlife Service does not allow refuge uses or management practices that result in the maintenance of non-native plant communities unless it can be determined there is no feasible alternative for accomplishing the refuge purpose(s). The National Park Service more specifically addresses use of native vegetation stating, "Landscape revegetation efforts will use seeds, cuttings, or transplants representing the species and gene pools native to the ecological portion of the park in which the restoration project is occurring." The US Forest Services takes a more inclusive approach in its policy. Excerpts from policy manuals or handbooks read:

- Ensure genetically appropriate native plant materials are given primary consideration,

- Promote the use of native plant materials for the revegetation, rehabilitation and restoration of native ecosystems, and;

- Restrict the use of persistent, non-native, non-invasive plant materials.

The Bureau of Land Management (BLM) has the most comprehensive approach, incorporating policy for native vegetation use and limiting use of non-native plant materials, stating that it's their policy to manage for biologically diverse, resilient and production native plant communities. . . Uses and activities will be conducted to favor the health and persistence of native plant communities. . . and rehabilitation or restoration actions will be undertaken to improve their diversity, resiliency and productivity.

Of the federal agencies, the BLM has taken the lead on the issue of using genetically appropriate material for the location and as a result were instrumental in developing their Seeds of Success national native seed collection program which eventually led to the development of the National Seed Strategy. The National Seed Strategy seeks to identify native seed needs and ensure the reliable availability of genetically appropriate seed and identify research needs and to conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration.

In February of 2017, the Botanical Sciences and Native Plant Materials Research, Restoration, and Promotion Act, otherwise known as the Botany Bill was introduced in the House of Representatives. This bill directs the federal land management agencies to give a preference for locally adapted native plant materials also directing the National Fish and Wildlife Foundation to ensure that a program of activities which is focused on conservation and protection of native plants is incorporated into its existing programs and activities. All those efforts are important and significant, however are all focused on federal land. Federal land ownership in the US is approximately 30% with roughly another 10% in state, tribal or other government entity, leaving 60% privately held. Natives First is the first and only effort to impact private lands.

The Conservation Title of the Farm Bill is a vehicle to get more native vegetation established on private, working lands in the US. When looking at the impact, and in only the 25 NBCI states, also excluding fish and wildlife habitat practices because they already heavily favor native vegetation, The Environmental Quality Incentives Program (EQIP) enrolled and average of 1.9 million acres annually in the years 2009-2014. It is estimated that over 65% of that, 1.25 million acres in 2014, were planted to introduced grasses.

Currently the Conservation Reserve Program (CRP) is capped at 24 million acres. There is a strong effort underway to increase the cap in the new Farm Bill. If successful, there could be an opportunity for millions of acres more to be planted to native vegetation. However, without Natives First, those acres could easily be planted to introduced grasses.

*Photo: Michelle Villafranca*

There are some cultural challenges to overcome. In a recent conversation with a private lands biologist, they related an experience with a wetland project where the local county NRCS office would only allow bermudagrass or tall fescue to be planted on the levees, despite there being a standard which allows for native vegetation to be planted in such a situation. These kinds of stories are all too common. Without a native vegetation standard in the Farm Bill, those kinds of prohibitions will continue to occur. The landowner should be given the option and voluntarily chose. Natives First makes that option policy.

A summary of the Natives First vegetation standard; . . . We propose that the Farm Bill direct USDA to adopt a standard for native vegetation that would apply to private conservation and working lands, where feasible and appropriate. Such a standard would:

- Be voluntary and non-regulatory;

- Promote the adoption and use of native plants for most purposes;

- Allow flexibility for using select non-aggressive introduced plants that do provide habitat benefits; and

- Prioritize financial assistance for native plants in new USDA program enrollments.

The Natives First policy proposal was developed by a working group representing 9 different stakeholder segments; conservation organizations, sportsmen's groups, agricultural producers, agricultural industry representatives, pollinator community, seed trade, subject matter experts, state fish & wildlife agencies and federal agencies.

Integral to the strategy to promote Natives First is the formation and activation of a Natives First Coalition. The Natives First Coalition's purpose is to continue to promote native vegetation, not just for wildlife habitat and restorations, but also in working lands for soil and water conservation, air quality, soil health, livestock forage and biomass, its many ecosystem services and consequently wise investment of taxpayer dollars.

The USDA has a history of getting behind a cause and creating a strong public relations campaign, some recent examples are, pollinators, Monarch butterflies and soil health, and most notably, the US Forest Service Smoky Bear campaign. The long-term vision is for USDA, with encouragement and support from the Natives First Coalition to adopt a new campaign featuring Burnie Bison as the spokesperson promoting native vegetation.

To join the Natives First Coalition or learn more about Natives First, visit the Natives First webpage at **https://bringbackbobwhites.org/conservation/natives-first/**.

## GRASSLAND CONSERVATION: A WICKED PROBLEM


### David Wolfe, Environmental Defense Fund

*Other Authors: Audrey Archer, Kevin Bracy-Knight, Ted Toombs, Environmental Defense Fund*


Healthy grasslands provide many ecological services including wildlife habitat, water quality improvement, and carbon sequestration, yet grassland conservation and related conservation issues (e.g., Gulf hypoxia and pollinator declines) are "wicked problems" with no clear solutions. One part of the solution might be natural capital markets. We suggest that key barriers to establishing an ecosystem services market that would encourage more sustainable farming practices are a comprehensive approach to measuring combined services in a single metric and policies that would drive investment in such services. We plan to test this hypothesis by developing (a) a comprehensive approach to measuring wildlife habitat and other ecosystem services as part of our work on monarch conservation and (b) policies that support broad-scale ecosystem restoration and conservation.

# LESSER PRAIRIE CHICKEN INITIATIVE: A COLLABORATIVE PARTNERSHIP OF WORKING LANDS FOR WILDLIFE IMPLEMENTING VOLUNTARY CONSERVATION ACROSS THE FIVE STATE RANGE

**Jordan Menge, Pheasants Forever/ Quail Forever**

The Lesser Prairie Chicken Initiative (LPCI) is collaborative partnership between Natural Resource Conservation Service (NRCS), Western Association of Fish and Wildlife (WAFWA), State wildlife departments and various NGO's. Lesser Prairie Chicken *(Tympanuchus pallidicinctus)* are one of seven species of concerns designated under the Working Lands for Wildlife (WLFW) model. The WLFW initiative is based upon a model of voluntary conservation of agricultural producers across its five state range to help improve rangeland and agricultural sustainability for species that are not currently listed under the Endangered Species Act, but are candidates for listing.

Conservation practices are applied by producers across the Lesser Prairie Chicken range using innovative tools backed by sound science. There are two core conservation practices being implemented towards improving Lesser Prairie Chicken habitat; prescribed grazing (528) (see Fig.1) and Upland wildlife habitat management (645) through LPCI Environmental Quality Incentive Program through NRCS. Along with these are facilitating practices of brush management (314), prescribe fire (338) (see Fig. 2), cross fence (382), range planting (550). We target landowners that are within LEPC landscape to develop and improve LEPC focal and connectivity zones and its habitat across the five state range.

Natural Resource Conservation Service along with it various partners developed a three year Fiscal conservation strategy for FY 2016-2018. Within the states, goals were developed to approach the threats that are limiting Lesser Prairie Chickens that are a win-win, benefitting the bird while improving the long-term sustainability of agricultural operations. Across its

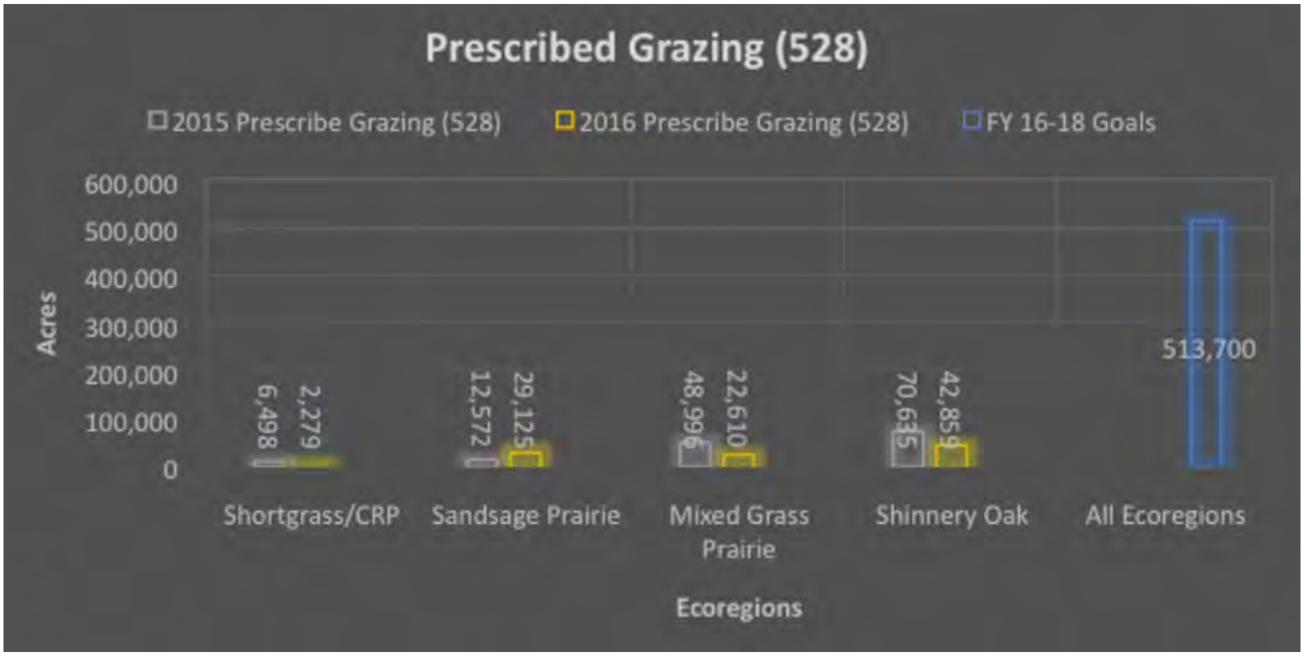



**Figure 1: Current Prescribe grazing applied acres through LPCI EQIP through FY15-16.**

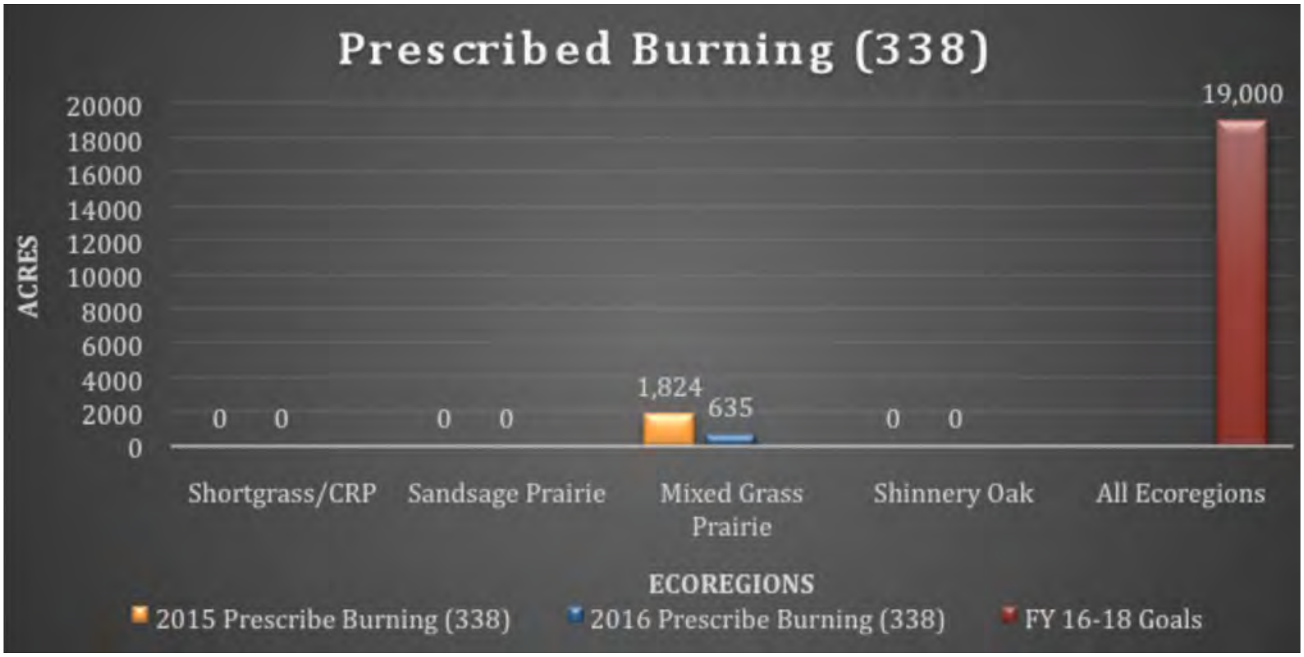



**Figure 2 Current Prescribe burning applied acres through LPCI EQIP FY15-16.**

range, prescribed grazing and prescribe burning were two objectives identified. The priority areas identified by WAFWA CHAT Focal Areas and Connectivity Zones (FACZs) to target for financial and technical assistance across the five states.

Other opportunities that landowners can obtain through LPCI is Predictability. This is a voluntary effort between the WLFW partnership of NRCS and U.S. Fish and Wildlife Services (FWS) and private landowners. This provides farmers, ranchers, and forest managers with Endangered Species Act (ESA) predictability options. A predictability plan is a Resource Management System (RMS) conservation plan that is provided to the producer by NRCS that allows protections from incidental take as long as they are following their plan in accordance to LEPC Biological opinion. So “Take” is defined: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect or attempt to engage in any such conduct. Thus “Incidental Take”, is Take that results from, but is not the purpose of, carrying out an otherwise lawful activity. A producer that is enrolled in a plan, has the opportunity to apply for financial assistance to implement there conservation practices that will benefit the bird as well as their agricultural operations.

With continued participation through WLFW model, voluntary conservation from agricultural producers, we will continue to improve grasslands across the five state range of LEPC and their current habitat needs.

## ENGAGING LANDOWNERS IN INCENTIVE PROGRAMS FOR THE RESTORATION OF GRASSLANDS

**Sergio Fernandez, Simon Fraser University, Canada**

Governments and other organizations offer numerous incentive-based programs addressing habitat loss and degradation on agricultural land. Some of these incentives aim to engage landowners in efforts for restoring grasslands; however, little is known yet about the potential contribution of these private owners to habitat recovery. Aiming for cost-effective conservation, it is uncertain yet how much money should be invested in these programs, or what groups of society should these incentives target?

Therefore, my research concentrates on understanding how the configuration of these programs affects enrolment of acreage and landowner participation, using the monarch butterfly as a case of study. With this project, I will use choice experiments to assess the optimal use of funding to restore grassland habitat using efficient incentives that take in to account the interests of landowners.

The scope of this research aims to understand the landowners in two locations along the eastern population of the monarch butterfly in North America: Texas and Ontario. In order to recruit participants, I will distribute 6000 postcards with the invitation to the online survey. Rewards will be provided to the 600 first participants in each location, and any other participants will be part of a random draw of other rewards.

With this approach, I attempt to understand the similarities and differences between individuals in a US State and a Canadian Province. This international perspective will allow me to measure the importance of the social context in a conservation issue of continental scale, studying sites from two major subregions in the monarch butterfly range:

- Ontario as part of the northern US/southern Canada central subregion that is essential during the summer for the reproduction of the eastern migratory monarchs.

- Texas as part of the south central US subregion that is of critical importance in the flyway for both the spring and fall migration, and also hosts the first generation in the year.

In order to understand the heterogeneity in preferences between groups within our sample, I will use Latent Class Analysis. The segmentation of the sample into latent classes aims to obtain two major outcomes: The identification of characteristics of landowners that define groups that share similar preferences and intended behavior. In addition, the estimation of their reaction to different incentive designs will help to predict potential participation in these programs. With such segmentation approach, I will be able to distinguish those groups in the population that can be targeted with specific features of the incentive programs. Similarly, I will be able to characterize the groups that are not interested and are not likely to be motivated by incentives to engage in conservation practices. Those lessons are critical to designing efficient conservation strategies that take in to account landowners' interests and motivations.

The expected results of this research project will go beyond the design of incentives created based on the understanding the demand of incentive programs; since the predicted participation in this type of programs will provide estimates of the potential grassland restoration in private land. These estimates will inform the direction of conservation efforts at a regional and international level, which ideally will help in more successful programs for the restoration of monarch butterfly habitat.

## HOW LARGE SCALE PARTNERSHIPS ARE SUPPORTING CONSERVATION IN THE GREAT PLAINS THROUGH INNOVATIVE LANDSCAPE PLANNING AND DESIGN

### Jon Hayes: Great Plains Landscape Conservation Cooperative

*Other authors: Anne Bartuszevige, Alex Daniels, Kyle Taylor, and Mike Carter: Playa Lakes Joint Venture*

The loss of North American grasslands has occurred at a scale that surpasses both political boundaries and organizational capacities. Major drivers of landscape change such as conversion of grasslands to croplands, energy production, and climate change all present challenges too large to be addressed by any single organization or government body. Landscape Conservation Cooperatives (LCC) and Joint Ventures are providing large scale collaborative frameworks for conservation innovation that reach across jurisdictions, moving away from local opportunistic models of conservation delivery and planning towards more adaptive and strategic models which take into account the social and economic as well as the ecological drivers of landscape change.

Landscape Conservation Cooperatives were formed following the issuance of Department of Interior (DOI) Secretarial Order Number 3289 which recommended that "Interior bureaus and agencies must work together, and with other federal, state, tribal, and local governments, and private landowner partners, to develop landscape-level strategies for understanding and responding to climate change impacts." In the Great Plains ecoregion those agencies and organizations included the state fish and game agencies, a number of DOI and USDA bureaus, as well as private non-governmental organizations. Joining together as the Great Plains LCC (GPLCC) steering committee, these groups designated three habitat types as priority for GPLCC research and conservation projects; grasslands, playa wetlands, and prairie rivers and streams. GPLCC supported projects address multiple large scale drivers of habitat loss on the landscape including but not limited to climate change.

Since 2010 the GPLCC has directed over $4.7 million in USFWS funding to over 40 applied research and tool development projects aimed at improving the strategic effectiveness of conservation efforts in the three priority habitat types identified by the steering committee. A number of these projects have had the effect of improving the biological planning, conservation design, and outcome-based monitoring abilities available to partners who are working to restore grasslands in the Great Plains.

The expansion of improved land cover mapping into Kansas and Nebraska will drastically improve the ability to design ecosystem specific conservation delivery strategies. The Integrated Monitoring in Bird Conservation Regions being supported by a number of organizations, including PLJV and GPLCC, will provide bird population data with enough statistical power to track outcomes of conservation efforts, build better species distribution models and improve the development of future population objectives. The Bureau of Land Management Rapid Ecological Assessment expansion into the Great Plains was funded largely by the GPLCC and provides an ecoregion level assessment of available habitat and current and future threats from development that can be used to identify large regions where conservation efforts should be focused.

The cost and technical expertise needed to implement any one of these projects is unlikely to be met by a single statewide agency or non-profit conservation organization. In order to continue to have these type of projects made available to the conservation community, supporting large scale partnerships such as the LCC's is going to be essential. Unfortunately the DOI, under the current administration, has indicated that support for the LCC is likely to cease in the future. Therefore if large scale partnerships are going to continue rely on sound science and design to guide landscape level conservation, conservation partners are going to need to fill the void of leadership being left by DOI.

## GRASSLAND ROLES IN ECOSYSTEM SERVICES: PRECISION CONSERVATION BLUEPRINT V1.5

**Gwen White, U.S. Fish & Wildlife Service**

*Other Authors: Kelley Myers, U.S. Fish & Wildlife Service*

### Farming for Fish & Shrimp

Watersheds across the Midwest and the Mississippi Alluvial Valley currently contribute the greatest nutrient load to the Gulf of Mexico hypoxic zone, an area where oxygen levels can decrease to the point of no longer supporting aquatic species—or the fishing industry that depends on them. Reducing nutrient loading from these agricultural lands may significantly address hypoxia issues at multiple scales, from harmful algal blooms in local waters to the recovering resources of the Gulf.

## Multi-Sector Stakeholder Strategies

Modifying the design or shifting the location of conservation practices could make program dollars go farther and appeal to more land managers by producing multi-sector benefits for wildlife, water quality, energy and agriculture. Landscape Conservation Cooperatives (LCCs) were organized as regional collaborations of states, federal agencies and nongovernmental organizations that build connections across their boundaries to tackle large scale and long-term conservation challenges. Through a stakeholder-driven decision support process, the Mississippi River Basin / Gulf Hypoxia Initiative (GHI), led by seven LCCs, created an integrated framework consisting of resource management objectives, a tiered set of conservation strategies within five agricultural production systems (corn and soybean, grazing lands, floodplain forest, rice, and cotton), and a Landscape Conservation Design spatial analysis to align work in four ecological systems (headwater fields, upland prairies, mid-sized riparian streams, and mainstem floodplains) in water quality priority zones across the Mississippi Basin.

## Tools for Precision Conservation

Work Teams are preparing *Practice Fact Sheets* for a dozen standardized and emerging practices that describe design, configuration, benefits, installation costs, performance metrics, relevant programs and recent research with simplified illustrations to guide technical assistance and consideration by land managers. The teams will refine this portfolio with additional practices.

Based on this framework, The Conservation Fund developed a prototype GIS spatial analysis that identifies "green infrastructure" opportunity areas for conservation investment at the basin scale and at a higher resolution for use by local conservation planners. The LCCs and Climate Science Centers support related research on human dimensions and ecosystem services that will inform conservation delivery and adoption. Additional scenario planning could forecast conditions for adaptation strategies that respond to ecological or economic drivers, evaluated with landscape-level metrics. A recent workshop reconvened researchers and technical program managers to guide refinement and implementation of these tools. The Gulf Hypoxia Initiative is designed to complement related ongoing efforts including the Gulf of Mexico Hypoxia Task Force, NRCS Mississippi River Basin Initiative, and state nutrient reduction strategies—but *with an emphasis on the ecological and social values of wildlife habitat* that help upstream communities connect to downstream impacts. The Gulf Hypoxia Initiative is focused on two main components: **what** to do and **where** to do it, forming a holistic precision targeting approach that allows resource managers and policy makers to identify both the conservation actions needed and the best places to target efficient and effective conservation investment on the landscape.

## What To Do

The component of "what to do" consists of a set of *Conservation Practice Fact Sheets.* Currently, there are twelve practices identified by expert teams as having the highest potential for benefiting water quality, wildlife, bioenergy and agriculture. Fact Sheets describe the design and application of practices with multisector benefits. Grassland and prairie habitats are key components or settings for most of these multifunctional practices.

***Basin-wide multifunctional practices***

- Buffer Strips
- Wetlands
- Grassland and Grazing Management
- Biomass Production
- Cover Crops
- Uplands Prescribed Fire

***Upper Mississippi Basin / Midwest multifunctional practices***

- Hydrologic Restoration
- Drainage Water Management

• Two-Stage Ditches

***Mississippi Alluvial Valley multifunctional practices***

• Water Diversion
• Vegetative Diversity

Programs can highlight these practices in conjunction with other conservation activities to efficiently invest in a multifunctional landscape.

## Where To Do It

A critical component of any landscape design is mapping opportunities for conservation delivery. In the multi-LCC Gulf Hypoxia Initiative, this spatial analysis takes the form of the *Precision Conservation Blueprint v1.5* developed by The Conservation Fund. This analysis synthesizes over 200 layers to identify where there is an intersection in existing interests to achieve multi-sector objectives. At a regional scale, the *Precision Conservation Blueprint v1.5* combines watershed projects, wildlife conservation priority areas, water quality concerns, nutrient loading models, and more to identify a series of priority areas where opportunities for fish and wildlife, water quality, and agricultural productivity broadly overlap. At a local scale (30m), the *Blueprint* uses soil type, field grade, contiguous habitat, cropland value, and more to identify site specific targeting for conservation actions in HUC4 pilot watersheds where multi-sector interests are highest in the water quality priority zone of the Midwest and Mississippi Alluvial Valley.

## Pilot Project: Lower Wabash River

These tools should be practical and pragmatic for program targeting and land management decisions. Several groups are "test driving" application of these tools in on-the-ground pilots. As the longest free-flowing river east of the Mississippi, the Wabash River forms the border between Indiana and Illinois, is surrounded by highly productive farmland, and contributes a hugely disproportionate nutrient load to the Gulf of Mexico. At the same time, this river corridor forms a critical pathway for a unique combination of species and habitats such as migratory birds, monarch butterflies, cane brakes and bald cypress swamps, and extraordinary fish and mussel diversity. After being approached by the Patoka River National Wildlife Refuge, the LCC facilitated a locally-led stakeholder partnership to develop a landscape design for the lower Wabash floodplains and associated uplands. Other local

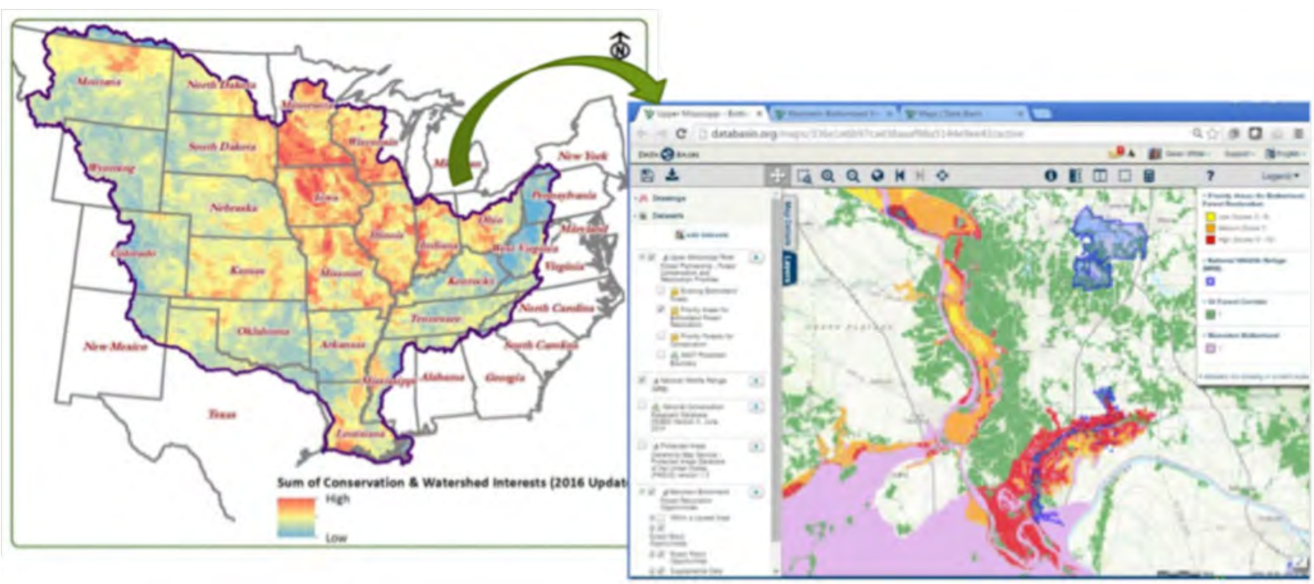



**Figure 1. Spatial analysis showing the convergence of water quality concerns, wildlife conservation interests, and watershed management at the Mississippi Basin scale. Higher resolution maps with conservation opportunity areas for grasslands, wetlands and forest are available at the 30m scale for site level planning in select HUC4 Pilot Basins across the Midwest and Mississippi Alluvial Valley.**

uses of the spatial analysis include identification of priority conservation areas within the Decatur County (IN) comprehensive plan revision, Sycamore Land Trust wetland corridor planning, and similar applications.

### We Need Your Help

The development of these tools and frameworks has been collaborative from the very beginning, and we are not done yet. Next steps include integrating population objectives and models, tracking collaborative action, and supporting social capacity for implementing these practices in key locations. Help us improve these tools! The multi-LCC online spatial analysis Precision Conservation Blueprint v1.5 with over 200 data layers is available for visualization and download after registering (free of charge) for the site and joining the group at the online sites below.

Learn more at: **<https://tallgrassprairielcc.org/issue/gulf-hypoxia>**

***Practice Fact Sheets:***
**<https://tallgrassprairielcc.org/resource/gulf-hypoxia-conservation-practicesheets>**

***Data Basin – to view data layers***
**<http://databasin.org/groups/d52de40d017e4ce98c3914dba1bc4ee7>**

USGS ScienceBase – download data layers
**<https://www.sciencebase.gov/catalog/item/54e37c9ce4b08de9379b51e3>**

## NRCS AREA WIDE PLANNING OPPORTUNITIES TO MAINTAIN AND ENHANCE AMERICA'S GRASSLAND ECOSYSTEMS

**Kyle Wright, USDA NRCS**

Area wide conservation efforts of the USDA Natural Resources Conservation Service (NRCS) in Texas are being utilized to maintain and enhance America's Grassland Ecosystems. These will include the Monarch Butterfly Habitat Development Project, National Water Quality Initiative and the Working Lands for Wildlife (WLFW) partnership for the Lesser Prairie Chicken.

### Helping People Help the Land

The USDA NRCS works with landowners to develop conservation plans implementing conservation practices such as nutrient management, cover crops, prescribed grazing, grassed waterways, fences and livestock pipeline. The Environmental Quality Incentives Program (EQIP) is available for financial and technical assistance to implement planned conservation practices.

The USDA NRCS delivers conservation programs through the Farm Bill. The current Farm Bill, The Agricultural Act of 2014 includes the following NRCS programs.

- The Agricultural Conservation Easement Program (ACEP) provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the Agricultural Land Easements (ALE) component, NRCS helps American Indian tribes, state and local governments and non-governmental organizations protect working agricultural lands and limit non-agricultural uses of the land. Under the Wetlands Reserve Easements (WRE) component, NRCS helps to restore, protect and enhance enrolled wetlands.

- The Conservation Stewardship Program (CSP) helps agricultural producers maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. Participants earn CSP payments for conservation performance—the higher the performance, the higher the payment.

- The Environmental Quality Incentives Program (EQIP) provides financial and technical assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, reduced soil erosion and sedimentation or improved or created wildlife habitat.

• NRCS delivers conservation technical assistance through its voluntary Conservation Technical Assistance Program (CTA). CTA is available to any group or individual interested in conserving our natural resources and sustaining agricultural production in this country.

• The Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements.

## Monarch Butterfly Habitat Development Project

In an effort to restore and enhance Monarch habitat in Texas, the USDA-NRCS is offering financial and technical assistance to help landowners and conservation partners develop butterfly-friendly improvements on private lands. Through a systems approach, NRCS will help landowners on the conservation and enhancement of diverse native plant communities and ecosystem management to encourage the production of important plant species required for brooding and nectar during migratory periods. Twenty-eight Texas counties have been selected as focal areas for Monarch butterfly habitat development because of their strategic location within the butterfly's flight zone during spring and fall migrations.

## National Water Quality Initiative

Through the National Water Quality Initiative (NWQI), NRCS and partners work with producers and landowners to implement voluntary conservation practices that improve water quality in high-priority watersheds while maintaining agricultural productivity. NWQI provides a means to accelerate voluntary, private lands conservation investments to improve water quality with dedicated financial and technical assistance and to focus water quality monitoring

*Lesser prairie chicken. Photo: Flickr*

and assessment funds where they are most needed. Water quality-related conservation practices enhance agricultural profitability through reduced input and enhanced soil health, which results in higher soil organic matter, increased infiltration and water-holding capacity and nutrient cycling.

## Working Lands for Wildlife (WLFW) Lesser Prairie Chicken

The lesser prairie-chicken is a nationally identified target species of the Working Lands for Wildlife (WLFW) partnership, a collaborative approach to conserve habitat while keeping working lands working. Through WLFW, NRCS targets conservation efforts where the returns are highest by targeting threats to the bird. For the lesser prairie-chicken, the loss and fragmentation of habitat is caused by invading mesquite and red cedars, poor grassland and prairie health and conversion to cropland. WLFW is able to provide technical and financial assistance through the Environmental Quality Incentives Program and Agricultural Conservation Easement Program, two programs funded through the Farm Bill.

When landowners improve their grasslands through these targeted programs, not only are they able to improve the targeted resource concern whether it is pollinator habitat, wildlife habitat or water quality, but additionally their efforts will lead to other natural resource benefits, such as improved water quality, healthier soils and more productive working lands.

# 7. LANDOWNER PERSPECTIVES

## BAMBI AND BEVO: RESTORING WILDLIFE HABITAT THROUGH CUSTOM GRAZING IN SOUTH DAKOTA

**Tracy Rosenberg, Producer, Abbey Grasslands of the Prairie Coteau, Marvin, SD**

While once eight-five percent tall grass prairie, today less than one-tenth of one percent of Iowa land remains a virgin remnant. In 2012, I sold 120 acres of Iowa cropland in hopes to buy 100 acres of Iowa prairie. I discovered fifteen acres of remnant land for sale near my family's century farm, but was outbid by my father, a commodity farmer, who swiftly and cleanly broke sod, and planted it to eleven acres of soybeans. He is a farmer, like many others in Iowa, who already holds thousands of acres of Iowa cropland.

My story is unique in that I knew little about grasslands or prairie when my search began. Though raised on an Iowa farm I'd lived an urban life for over thirty-five years. My restoration journey commenced when I suddenly found myself in a mid-life circumstance change.

In search of the best remaining prairie land tracks, I looked in nearby states and found nearly a thousand acres of native prairie in South Dakota, land held by fourteen Benedictine monks of the former Blue Cloud Abbey. Since the monastery had recently closed, the monks asked that I lease their grasslands while they looked for a successor for their monastery complex and adjoining land. Their request came with a caveat—there could be no grazing, haying, or income-generating activity. I took a leap of faith and agreed, wrote them a check, and moved into a small hermitage on the land in the spring of 2013. In this grassland story, restoration began with a year of rest.

The land, heavily grazed for several decades, was degraded to a short mat of brome turf and bare dirt. Yet, native forbs managed to emerge that spring—Pasqueflower, Prairie Smoke, Wild strawberry, Wild onion, Prairie turnip, and Spiderwort to name but a few. But in June, the forb emergence wilted when stung by pesticide drift as the neighbor's pastures were aerial dusted. Later that month lepidopterists came in search of the Dakota skipper butterfly, which had nearly vanished in recent years. They found none. The skipper would soon join the IUCN Red List. By July the leased rangeland yielded little but a monoculture stand of invasive Smooth brome grass. While the land rested, I immersed myself in learning about prairie ecology, swept for leafy spurge beetles as a biological control method, and attended symposia and conferences—South Dakota Grassland Coalition's grazing school, a bio-blitz, a patch/burn/grass workshop, a Leopold Award tour, a Grassfed Exchange tour, and various birding events.

In late summer, grass clippings were cut and sent to SDSU lab where each was analyzed for dry weight matter to determine appropriate AUM stocking rates. In August, burn lines were mowed and the litter removed in anticipation for spring prescribed fire. All these preparations were done without knowledge of who would become the next land steward.

In November, the Blue Cloud Abbey monks asked me to present them a "respectable offer". My offer was accepted and in December 2013, the land changed hands. My search for one hundred acres of remnant prairie had manifested into my purchase of just under a thousand acres of grasslands in the Pothole Region of South Dakota on the Coteau des Prairie.

The root words of "restoration" is rest and action. The rest year complete, action soon followed. To date I've burned over 350 acres, installed eight water crossings, rebuilt a dam and a dugout, added a small duck pond, installed 22,000 feet of above ground pipeline, and added thirteen 700-gallon stock tanks. I've added two solar pumping stations, and a rural water system to distribute water to where the cattle are needed. I've cleared over 2200 invasive red cedars, and use pesticides against wormwood sage and non-native thistles. The old barbed-wire interior fences were removed (pulled and rolled by hand to discard, never buried on the land), and new single-strand high tensile cross-fences with wildlife-friendly composite posts were installed for a twenty-six paddocks custom-grazing operation.

And here are the results: at first there came Meadowlarks, Grasshopper sparrows, and Godwits. Then came Bobolinks—it's not uncommon to see a dozen in a single paddock. There are now turkey clutches of varying sizes meaning lots of staggered hatches, there are broods of sharp-tail. More recently came pheasant—previously only a few birds had been seen on the land in the last twenty-five years. There are Skinks, Leopard frogs, and Smooth Green snakes, and perhaps most encouraging is the most recent find—the Dakota skipper butterfly was found on my land. These are all indicators of a healthy habitat.

What I know now, but didn't know in 2012, is that restoring fifteen acres of Iowa remnant would not have much mattered if surrounded by monoculture fields. I love the symbolism of terms. While Iowa is often referred to as a breadbasket, South Dakota's pothole region is sometimes called an ark. But, lately I've adopted a better word—the grassland prairie of South Dakota is a *womb*. It creates life—plants, soil microbes, pollinators, waterfowl, songbirds, wildlife. It gives birth through diversity. Converted land breeds little but grain—in conservation terms—monoculture is barren. Saving the prairie is saving life.

## BIRDS, HERDS, AND STEWARDS: FROM GRAZING ALTERNATIVES TO GRASSLAND SUSTAINABILITY


### Jerome Schaar, Schaar Farms

*Other Authors: Sandra Schaar, Schaar Farms*


Who are we to be talking to you about targeted grazing and temporary fencing in order to have your cows eat the grass or weeds that you want them to do instead of picking and choosing?

So here goes with a little background. I grew up on a diversified farm where we raised small grain and registered Polled Herefords. Through most of those years my folks were doing whatever they could to raise 6 kids and make ends meet. I attended Dickinson State University and North Dakota State University. I interned with the Soil Conservation Service in 1977 and then continued my career with them after graduation.

**Figures depicts pre-purchase condition in 2012 to current condition in 2017.**

*Photo: Michelle Villafranca*

I spent over 35 years in several locations, states, and capacities as a soil scientist with the now Natural Resources Conservation Service (NRCS). In 2008, Sandy and I returned to the family farm with Sandy being here all the time and I returning on weekends until I retired at the end of 2011.

At one location in South Dakota, we raised Dorset sheep. This was the first time we really used livestock to manage our grass. We used the sheep to graze foxtail barley early so that we could get some good use out of the paddock. As we observed our pastures, we began to see native grasses reinvigorating.

In 2011 we purchased some Hereford heifers and then a Hereford bull. At that same time we began to work with the Natural Resources Conservation Service (NRCS; Lori Bloom and Darrin Olin) and learned about the Wetland Reserve Program (WRP). We submitted an application and in 2012 we were accepted. We had 145 acres enrolled and this consisted of three land uses. In 2013 we worked with NRCS to establish a compatible use agreement to utilize some of the WRP for grazing in order to try to manage the plant community. The agreement was to address the degraded plant community, water and soil quality. Also that year we seeded the crop land acres to native grasses and forbs. We only grazed half of the old pasture and soon realized the effect the cows had on the sow thistle. This was pretty easy to assess as there were no sow thistle flowers on the side grazed and the ungrazed side was yellow with the sow thistle flower.

In 2014 we began working with Cheryl Mandich of the American Bird Conservancy (ABC). Cheryl, NRCS (Darrin Olin, Jody Forman, and Cindy Zachmeier) and us worked on a grazing plan and continued with the compatible use agreement. We also revamped our goals to improving rangeland health and habitat for wildlife and birds. Emphasis was placed on habitat for the Long-billed Curlew. That year we grazed all of the old pasture, but we did not get the grazing impact that we needed. The group then talked about dividing the acreage into seven smaller paddocks in order to get grazing impact. The impacts we wanted were to decrease the overabundant thatch, less vigor in the less desirable grass and weed species, and improved wildlife habitat, especially for birds. We also discussed grazing the foxtail barley area earlier to stunt it and to graze it prior to the foxtail barley heading out.

In 2015, Cheryl Mandich worked with the North Dakota Outdoor Heritage Fund in order to provide funding for temporary fencing for the producers. We applied and were accepted to receive funding for temporary wire, posts, and energizers. That year we grazed five of the seven paddocks. In one paddock the cattle got trapped on the smaller side of the creek and spent the grazing time frame there. We contacted Cheryl and the NRCS to come and see our misfortune. As it turns out, this is where we were better lucky than good. NRCS said we had grazed it correctly getting rid of the extra thatch that had built up over time. So instead of getting reprimanded, we realized that we needed to either dramatically increase our herd size or cut our paddocks into sub-paddocks in order to achieve the desired affects. This is also the year we saw we could not keep up with the Canadian thistle. We had to spray it. We don't work with enough of a profit margin to spray the weeds, so again increase our herd or decrease the paddock size. Also learned in 2015 was that the temporary fencing did not need big corner posts and did not need to be straight. We began using temporary water sources in order to graze the paddocks more evenly. Thirsty cattle would rather laze by the tank then roam around grazing!

We also started working with Pheasants Forever (PF) to seed an area of the old hay land to a pollinator planting. Since we grazed that without great impact we hayed it to reduce the remaining thatch for easier planting in 2016.

In 2016, we attacked the foxtail barley area with smaller sub-paddocks. The targeted Canada thistle area had been greatly reduced, so a sub-paddock could be used for that. We learned that we didn't need nice straight fences and my corners could be curved without sharp corners for the cattle to congregate in. Pheasants Forever sprayed the 5 acre pollinator planting and then seeded it. We were very dry and our rain came in the form of hail in August, but still pollinator plants begin to emerge. Cheryl Mandich, ABC, worked with NRCS to provide a 10 year compatible use agreement. She also worked with the National Fish and Wildlife Foundation for additional temporary fencing and temporary water supply funding.

2017 started as another dry year. This year we targeted the brome grass in the PF plot in late March early April to try to set back the brome grass. The cattle did their job, but we should have left them in a little longer to get more impact. The dry weather had us a little unsure and a little hesitant to leave them in the area for too long. As May rolled around we targeted the foxtail barley area and then proceeded to the Canadian thistle area. We added two temporary water tanks over four locations to enable the cattle to utilize the grass without having to travel any great distances. We continued to use the smaller sub-paddocks to maximize the impact of our cattle numbers. We finally received some welcome rain in August, a little late for where we were grazing, but helpful for the areas we had previously grazed.

This year we worked with the Cheryl Mandich, ABC, to provide a workshop on "Targeted grazing for Drought and Weed Management". We headlined the workshop with Kathy Voth, Livestock for Landscapes, who discussed training your livestock to eat weeds. We had many other speakers and the Workshop was well attended. One of the big items we came away from the workshop with was just because we label a weed as noxious, it does not mean it is not high in nutrition and especially protein.

Sandy and I continue to learn and put to use the ideas we are hearing and learning about. We greatly appreciate all the assistance we have received whether it be experiences shared, financial or technical assistance. A special shout out to the following agencies or groups: American Bird Conservancy, Natural Resources Conservation Service, North Dakota Outdoor Heritage Fund, National Fish and Wildlife Foundation, Pheasants Forever, and the Northern Great Plains Joint Venture.

# BUILDING SHARED SUCCESS FOR COMMUNITY AND CONSERVATION IN NORTH CENTRAL MONTANA


## Leo Barthelmess, Rancher and Rancher Stewardship Alliance

*Other authors: Brian Martin, The Nature Conservancy; Martha Kauffman, World Wildlife Fund*


Conservation efforts can often appear to be ad-hoc, with agencies and organizations pursuing complementary, but not coordinated efforts. The example presented demonstrates how local, landowner collaboratives can serve as a bridge between the ranching community and conservation interests, in order to enhance communications, more quickly build trust, and deliver positive outcomes for people and nature.

The Great Plains in north central Montana consist of largely intact grasslands and provide habitat to perhaps the most intact faunal assemblage in the biome. Multi-generational ranch families have greatly contributed toward maintaining the natural habitats that support the diverse wildlife assemblage. The Ranchers Stewardship Alliance (RSA) was created in 2003 in response to land management agency and non-profit conservation organization interest in further conserving habitat in north central Montana. RSA has worked with conservation organizations and agencies to ensure that the local community and grassland conservation would be successful and built upon shared priorities. It has also supported educational forums on a variety of topics, including ranch succession planning, grazing management, and low-stress livestock handling.

In 2017, RSA received a grant from the National Fish and Wildlife Foundation to coordinate and implement conservation projects in north central Montana. RSA coordinates and approves projects, while a conservation committee comprised of staff from the U.S. Fish and Wildlife Service, Montana Fish, Wildlife and Parks, The Nature Conservancy, World Wildlife Fund, and Montana Association of Conservation Districts provides technical support. The committee reviews projects to ensure that they are strategically located in areas that will contribute to the integrity of the grasslands. Partners also contribute toward on-the-ground implementation in coordination with participating landowners. To help meet the financial obligations of the grant, landowners also provide in-kind contributions of supplies and labor toward the projects.

To enhance grassland function and connectivity, funds are directed toward three general practices: 1) installing infrastructure required to graze expiring Conservation Reserve Program (CRP) lands, so that they are retained as grassland, rather than converted to cropland; 2) reseeding marginal cropland to native grassland; and 3) reducing the spread of crested wheatgrass through enhanced grazing management. In the past six months, grazing management infrastructure has been implemented on 2,960 acres of expiring CRP (with another 1,100 acres planned), 3,960 acres grassland has been seeded to native restoration plantings, and 1,700 acres of crested wheatgrass has come under intensive treatment. In less than one year, RSA projects met or exceeded acreage goals for the 2017 grant (4,000 acres expiring CRP, 3,000 acres of grass seeding, and 1,000 acres of crested wheatgrass management) for all three management treatments.

From the ranching community perspective, completing these projects serves an unmet need to enhance management and potentially improve profitability of ranch operations by making more forage available to producers and reducing operational costs. Transitioning CRP lands and restoring highly erodible cropland to native grassland cover allows producers to increase their forage base, without having to absorb all costs of making these lands available for livestock production. Without the cost-share assistance, many of the CRP acres would likely be put back into crop production and cropland would remain in crop production or seeded to a non-native mix that has lower value for wildlife. Enhanced grazing management of crested wheatgrass stands reduces spread of the species to native grasslands, and also improves its palatability to livestock. Because crested wheatgrass is resilient to very high utilization levels and is most valuable as a forage resource when native grasses are most susceptible to defoliation, this practice makes more forage available at a critical time of growth, allowing grazing to be deferred from native pastures.

# SUSTAINABLE BEEF PRODUCTION ON NATIVE GRASSLANDS

**Karl Ebel, Grasslands Manager/ Producer, Sulphur Bluff, Texas**

## History and Ranch Description

In 2003 a grassland restoration project was initiated on 645 ac in NE Texas. In 2012, 360 additional acres were added to the restoration project. All of the 1057 total acres was "go-back" farm land, farmed starting about 1834. Through local photographs, testimonials and site assessment by a prairie botanist, at least 780 acres was originally tall grass Silveus dropseed prairie. About 277 acres was riparian, dominated by oak and hickory species. The prairie areas were farmed in cotton and other row crops until the soil was exhausted. About the 1950s, the land was simply let go-back to what ever began to grow. Cattle were then grazed on a set stocked / continuous graze. It was severely overgrazed and overtaken by woody species. Lower successional grass species and abundant broadleaf weeds (wooly croton, ragweed, marsh elder) were the dominant non woody plants present.

• Location: NE Texas, 25 miles NE Sulphur Springs Texas

• 1057 contiguous acres; approximately 780 ac open grassland, 277 ac savannah and woodland.

• Today about 70% of grassland acres are native prairie, 30% are introduced species.

• Watered with surface catchment ponds, and water troughs (installed in 2014). Soil is a grey loam, with a slight slope.

In 2003-2004, a continuous graze beef producer leased parts of the acreage that were not yet in the restoration process. Then in 2005, after the broad-based planting was mostly complete, a stocking of 12 cows and a bull and 600 goats was initiated. Cattle numbers were increased on an average of about 9 cows per year. As brush and large weed infestations were pushed back, goat numbers were decreased. Today the goat herd is maintained at about 35 mother goats (about 70 kids goats are sold each November). The cow herd is at about 120 mother cows. Adjusted by weight to AU (animal units) the stocking rate is now about 1 AU / 6 acres, grazed in rotational grazing management.

## Re-enter the Buffalo

Rotational grazing is probably the single best management tool we use for both the economics and grassland ecology. Pastures are of various sizes with permanent and temporary fencing used.
Pasture rotations are based on:

- minimum gazing height of species being managed/grazed
- adequate recovery period for forage species
- nutritional requirements of cattle
- stockpile forage requirements
- logistical constraints for moving livestock

## Prescribed Burning

Prescribed burning was initiated in 2004 and is carried out on various acreages in February of each year. Some pastures are burned every year, some are burned every 3-4 years, depending on the dominant grass species and the desired woody species control.

## Restored to a More Productive Land

Grass is viewed as the resource and livestock simply offer a means to turn this resource into profit. One of our primary goals is continual improvement in the grassland.

The first 645 acres was divided into pastures of various sizes. Restoration began with a textbook approach - native grass broad based planting. A mix of Indian grass, big blue stem, little blue stem and switch grass was planted. Some areas were recognized as possibly never having been plowed and were not plowed and planted in this broad based planting. Proper grazing management, brush removal / control facilitated restoration of these areas.

At the start of restoration, a proper assessment is very important. Identifying which species and their present state, and possible areas that were never plowed will greatly facilitate a restoration plan. Leaving these originally unplowed areas out of the broad based plantings resulted in a valuable seed source from plants in this ecoregion. This is critical since this seed is unavailable commercially.

About 25% of the grassland acreage is managed as introduced species getting fertilized primarily with periodic applications of chicken litter. As soil health improves through rotational grazing, the fertilizer applications are decreasing.

Another 360 acres were added to the ranch in 2012. No broad based plantings have been done on these acres. Rotational grazing and prescribed burning have been carried out along with a trampling method of planting.

Herbicides have been used with discretion, to speed establishment of pastures and remove /control brush. Herbicide use is decreasing as grassland establishment improves.

## No Hay

In 2009, it was decided that the native grass pastures had progressed enough to take the hay supplementation out of the wintering plan. Hay supplementation is substituted with stockpiled forage. A 38% protein cotton seed cube is fed as supplement. About 40 bales of hay are kept under covered storage, and over the last 8 years, hay has been fed to the cattle for 3 two-day periods, during extreme snow and ice conditions. During severe drought periods, small bales are used to supplement during calf weaning. The elimination of hay from the wintering program has been a huge benefit to our economics.

## Planting by Trampling

The initial broad based native grass plantings were somewhat successful, with about half of the planted acreage having somewhat established plant populations. In 2009, after observing how the cattle were disturbing the ground as they fed on the supplement cubes, a native grass planting method was developed and is continued to be used with very good success. A simple description of this planting method is as follows. During winter feeding of supplement cubes, permanent markers are used to mark off a planting site in the pasture about 50 x 100 feet in size. The size of this planting site can be adjusted as needed for the number of cattle being fed. Native seed is broadcast by hand, 3/4 lb. (1.8 lb coffee can) on planting site. With an ATV towed cube feeder, cubes are fed on the planting site 1-4 times depending on the soil moisture and litter cover. The desired soil disturbance is a slight to moderate mixing of the plant liter with soil. Two or 3 sites are seeded in areas of differing soil moisture / water retention characteristics. This facilitates planting during various moisture / rainfall conditions. The time to create each planting area is about 20 minutes. With these planting sites spaced out across the desired planting area, they create seed producing colonies which will in turn be spread / trampled further by grazing cattle, through hair coat and manure dispersal.


### Economics

In order to achieve sustainable economics, some basic beef production goals / assumptions should be made.

• Adjust stocking rates / grazing plan as needed to protect the grazing resource.

• All forages require rest periods. Introduced species can, in general, stand periods of higher grazing pressure.

• Longer rest during seed producing periods will greatly enhance native plant restoration.

• A cow's "Body Condition Score" at calving must be a 5 or higher.

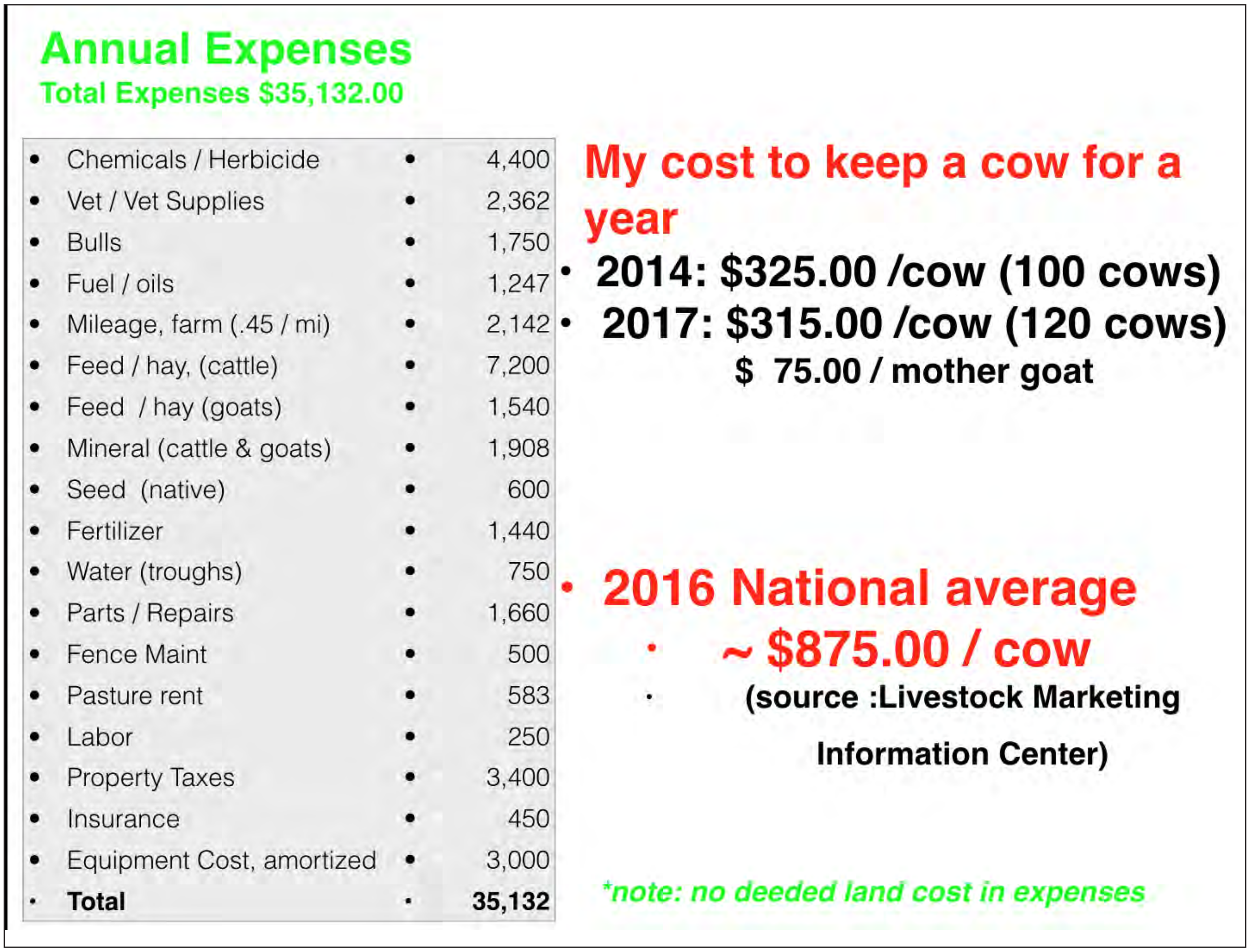
• A "weaned calf crop" of 90% is an attainable and economical goal.

• A variety of forages will greatly aid in management options and the success of the economics.

Annual cost to keep a cow at Ebel Ranch
2014: $325.00
2017: $315.00

National US average to keep a beef cow:
2016: $875.00*

*Source: Livestock Marketing Information Center




**List of expenses in annual cost calculation (2014)**

## Summary

The economics for beef production on native grasses are very good. With proper management, using rotational grazing and prescribed burning, the grassland ecology can be improved, restored and maintained to near original condition.

With proper management and patience, the results of this effort both economically and ecologically can be nothing short of amazing.

# 8. THE ETHANOL MANDATE AS A DRIVER OF CONVERSION AND CARBON EMISSIONS

## LAND USE AND ENVIRONMENTAL IMPLICATIONS OF THE RFS

**Tyler J. Lark, University of Wisconsin-Madison**

The Renewable Fuel Standard (RFS) provides a valuable example case to study the impacts of federal policy on grassland conservation. It has been suggested that the RFS is a potential driver of grassland conversion to crop production, but the extent and magnitude of its contribution is uncertain, with many insights left to be learned. In addition, the RFS might be useful as a tool for grassland conservation, since the original legislation included land protections aimed at preventing land conversion.

Furthermore, any improvements in biofuel feedstock supply chain monitoring manifested through the RFS could have spillover benefits to other crops and land uses, particularly by enabling chain-of-custody transparency and associated sustainability improvements throughout U.S. commodity crop supply chains. Thus, the RFS provides ample research and action opportunities related to grasslands conservation.

Since the passage of the updated RFS in 2007, total actively cultivated cropland area in the U.S. has increased (Lark et al., 2015; USDA, 2015). There

*Photo: Tyler Lark*

has been well-identified conversion of previously uncultivated land to biofuel feedstock crops such as corn and soy, but newly "cleared or cultivated" lands should be ineligible for renewable biomass feedstock production according to the land protections written into the RFS (Federal Registrar, 2010). However, converted lands have not been explicitly monitored under the program and consequently have not yet been restricted for use in feedstock production.

There has also been recent widespread conversion of other types of land to active crop production including pasture and previously idled cropland (USDA, 2015). These lands are eligible for renewable feedstock production under RFS definitions. Regardless, any conversion of land for the crops commonly used for biofuel production may have led to negative environmental outcomes. Examples include degradation of water quality that engenders both environmental and human health repercussions, direct emissions of carbon dioxide and other greenhouse gases to the atmosphere, loss of wildlife habitat and declines in plant and animal biodiversity, and the potential impairment of endangered species.

A growing body of economic and statistical research has shown a direct causal link between the RFS, increased crop prices, and resultant effects on land use and natural resources. The available findings indicate that the RFS has stimulated national corn prices and total cropland area expansion (Barr et al., 2011; Carter et al., 2016), and that land conversion and increased corn cultivation is locally concentrated around ethanol refineries (Motamed et al., 2016; Wright et al., 2017). The influx of recent evidence that ties the RFS to documented land use changes and ensuing environmental consequences stresses the need to update comprehensive assessments of biofuel production impacts.

In 2011, the U.S. Environmental Protection Agency (EPA) completed its first triennial report to congress on the environmental and resource conservation impacts associated with increased biofuel production and use in the United States (U.S. EPA, 2011). At the time, many of the impacts were uncertain and had been estimated using predictive models of anticipated land use change and potential responses. Since that report's release, sufficient time has passed to quantify the observed changes and document them in scientific literature and government reports. An updated review of available data and research on the potential effects of the RFS would thus enable better quantification of the land use changes associated with biofuels production and associated impacts on the environment and conservation. Such a review would also help improve accurate and timely evaluation of the merits and drawbacks of existing renewable fuel volumes and policy. To support these efforts, the scientific and regulatory communities can continue to conduct research on these topics and should work to disseminate the results among the many stakeholder groups.

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## CARBON BALANCE EFFECTS OF BIOFUEL EXPANSION

### John M. DeCicco, University of Michigan

Established by the Energy Policy Act of 2005 and expanded by the Energy Independence and Security Act (EISA) of 2007, the Renewable Fuel Standard (RFS) has driven U.S. biofuel production from 4 billion gallons in 2005 to 16 billion as of 2016. A premise of the expanded RFS was that replacing petroleum fuels such as gasoline and diesel with biofuels such as ethanol and biodiesel would reduce carbon dioxide (CO2) and other greenhouse gas (GHG) emissions. For example, a recent U.S. Department of Agriculture study concluded that corn ethanol reduces GHG emissions by 43% compared to petroleum gasoline (USDA 2017).

Such results are based on computer modeling using lifecycle assessment (LCA). These models assume that biofuels fully recycle carbon, e.g., that the CO2 emitted when ethanol is burned is fully balanced by CO2 uptake on cropland when its feedstock (such as corn) is grown. This assumption that biofuels are inherently carbon neutral, so that assessments need only account for GHG emissions during their production and can omit the biogenic CO2 released during biofuel combustion, has been widely used to guide research and policy.

Nevertheless, the assumption was never tested against field data. It seemed intuitively obvious and an extensive literature developed based on models that hard-code biofuel carbon neutrality into the analysis. However, as researchers examined the induced effects of biofuel production, particularly the CO2 released due to land-use change, the scientific uncertainties became very large and impossible to resolve empirically. These irreducible uncertainties can be traced to how the carbon neutrality assumption neglects the rate of carbon uptake on land.

### Real-world Carbon Flows

All productive land removes CO2 from the atmosphere. Here, *productive* is used in an ecological rather than commercial sense of the word; any land that supports plant growth is ecologically productive whether or not the biomass is used for crops, grazing or forest products. From the vantage point of the atmosphere, productive land takes up carbon by removing CO2 through photosynthesis. On cropland, carbon uptake depends on yield. A typical corn field removes carbon from the air at a net rate of about 4,000 pounds per acre per year; wheat and soybean fields remove about 1,000 pounds per acre annually. When managed to build soil carbon, grasslands can remove a few hundred pounds per acre of carbon per year depending on local conditions. The rate of carbon uptake depends only on what is growing on the land, not what becomes of harvest. Thus, a corn field removes CO2 from the air at the same rate regardless of whether the corn is used for food or fuel.

Looking next at motor vehicles, CO2 is emitted when burning any carbon-based fuel. As shown in Figure 1, the CO2 emission rate per unit of energy varies little among similar fuels. Ethanol emits a bit less CO2 than gasoline; diesel and biodiesel emit a bit more than gasoline. Thus, when looking at the flows of carbon in and out of the atmosphere, no less CO2 is emitted when burning liquid biofuels instead of petroleum fuels and no more CO2 is removed from the atmosphere when using crops for fuel instead of food.

Thus, to a first approximation, biofuel use is not carbon neutral at all. Any potential climate benefit requires more rapid carbon uptake on land (DeCicco 2013). In terms of carbon accounting, the uptake must be additional, meaning that it must be greater than what it would be under business-as-usual. Repurposing crops

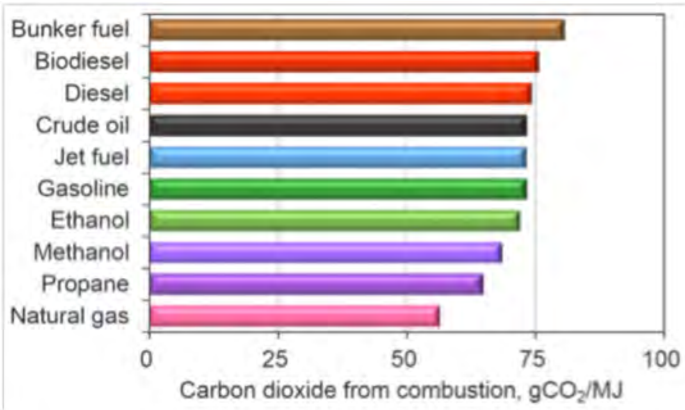


**Figure 1. CO2 emissions per unit of energy for various fuels.**

from food to fuel offers no climate benefit but incurs many disbenefits, including higher costs for consumers and environmental impacts. Moreover, the diversion of cropland to produce biofuels leads directly or indirectly to land conversion, which results in large, one-time carbon releases.

## Retrospective Evaluation of the RFS

Our recent study (DeCicco et al 2016) quantified CO2 uptake on U.S. cropland from 2005-2013, comparing the amount of "old" fossil carbon from petroleum displaced by "young" carbon from harvested crops. Carbon uptake increased somewhat, rising from 196 teragrams per year (TgC/yr; same as a million metric tons) to 215 TgC/yr in 2013, largely because more corn was grown. Over the same period, biofuel use rose 9

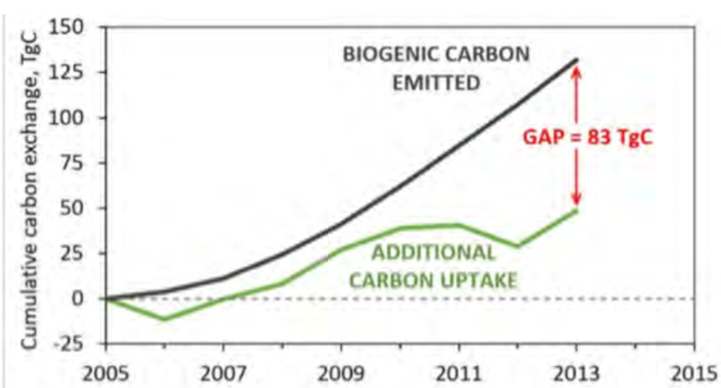


**Figure 2. Cumulative carbon emitted due to U.S. biofuel use compared to cumulative additional carbon uptake on cropland.**

billion gallons, displacing an energy-equivalent amount of petroleum fuel. But the gain in carbon uptake was not enough to neutralize the CO2 emissions from fuel use.

The analysis is summarized in Figure 2. The steadily rising black curve shows the biogenic (young) carbon emitted instead of fossil carbon as ethanol and biodiesel displaced gasoline and diesel fuel. The green curve shows the corresponding change in carbon uptake on cropland. It does not increase steadily; there were up years and down years, such as the drought in 2012. Carbon uptake trends upward overall, mainly because more corn was planted. However, the gain falls well short of the increase in biogenic CO2 emissions; the gap reached 83 teragrams by 2013. Comparing this shortfall in uptake to the biogenic carbon emitted shows that, over this period, biofuel use was only 37% carbon neutral instead of fully (100%) carbon neutral.

This finding provides one key lesson from the analysis: just because biofuel use reduces oil use does not mean that it leads to an equivalent reduction in CO2 emissions. In short, keeping it in the ground does not guarantee keeping it out of the air.

Studies claiming CO2 reductions for biofuels rely on the assumption of 100% carbon neutrality to compensate for the higher emissions associated with biofuel production, including those from farming and biorefining but especially those due to land conversion. As shown in Table 1, adding in these effects reveals that biofuel use greatly increased net CO2 emissions rather than decreased them. Net direct emissions did fall by 38 TgC, partly due to the increase in carbon uptake on cropland. But the carbon released from cropland expansion plus the very large release due to international land-use change (tropical deforestation) results in much higher cumulative emissions than if petroleum fuels had been used. The 431 TgC increase in CO2 emissions from 2005 to 2013 is similar in magnitude to a year's worth of CO2 emissions from the U.S. transportation sector, which is now the nation's largest source of CO2.

**Table 1. Estimated change in GHG emissions over the period of U.S. biofuel expansion from 2005-2013, relative to a constant reference baseline of 2005 conditions.**

| Cumulative GHG emissions increase, 2005-2013 | TgC* | Source |
|---|---|---|
| Directly from vehicle-fuel system | -38 | DeCicco et al (2016) |
| Domestic land-use change** | 36 | Lark et al (2015) |
| International land-use change | 433 | EPA (2010) |
| Total increase in emissions | 431 | |
| *Teragrams of carbon; 1 TgC = 1 million metric tons of carbon (carbon-equivalent mass basis) | | |

## What to do Instead

Although a correct carbon balance analysis is bad news for biofuels, the principles behind it point the way toward what to do instead. Addressing CO2 emissions from petroleum use, which is the largest source in the United States and second largest world-wide, is an urgent need. But the solutions need to be valid, as are improving vehicle efficiency, limiting travel demand and using chemically carbon-free fuels such as electricity.

The insight related to our analysis is that when liquid fuels are of concern, what mitigates emissions is increasing carbon uptake on land. There are many ways to do that which do not involve converting biomass into fuel and then burning it. An good overview is given in the recent "Natural Climate Solutions" paper by Griscom et al (2017). It quantifies ways to sequester carbon in the biosphere that, if pursued globally, could offset a large portion of excess CO2 emissions. A number of the opportunities involve pasture and grasslands as well as reforestation If pursued collectively and with determination, natural climate solutions could provide over one-third of the CO2 emissions reductions needed by 2030 for a strategy to limit global warming to no more than 2°C. Such solutions entail managing carbon on land, something that can be done as part of grassland conservation efforts.

In fact, large-scale terrestrial carbon management is a prerequisite for biofuels to perhaps one day be sustainable. Given the limitations of existing land management programs and the lack of economically viable ways to produce fuel from biomass obtained without competing with the needs for habitat and for existing farm and forest products, it is premature to promote biofuels and likely to remain so for many years. The focus should instead be on pursuing ecologically and economically sound ways to increase terrestrial carbon uptake, which is the foundation for effective bio-based climate mitigation.

## Conclusions

To conclude, here are the main lessons from our analysis:

- Biofuels are not automatically carbon neutral; in other words, one cannot simply assume that biofuels recycle carbon. Unfortunately, the models used for renewable fuel policies build in this invalid assumption, leading to flawed findings that biofuels are beneficial.

- Correct carbon accounting shows that the expansion of biofuel use in the United States to date has made CO2 emissions far worse. This harm to the climate compounds the other environmental and economic harms caused by the policy.

- Instead of pursuing biofuels, we should be protecting and restoring ecosystems that store carbon, including grasslands and forests. Using productive land to make fuel is a mistake.

Finally, much more needs to be done to educate the public and policymakers about the value of sequestering carbon in our landscapes and to correct the misleadingly positive impression of biofuels that sadly has taken hold in energy policy.

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# US CROPLAND EXPANSION RELEASED 115 MILLION TONS OF CARBON (2008-2012)


### Seth A. Spawn, University of Wisconsin-Madison

*Other Authors: Tyler J. Lark and Holly K Gibbs, University of Wisconsin-Madison*


## Introduction

Nearly 30,000 km2 of cropland expansion was documented in the United States between 2008 and 2012 (Lark et al. 2015), coinciding with a period of high crop prices and new federal policies incentivizing the production of biofuel feedstocks. Cropland expansion causes a range of effects on ecosystems and the services they provide, including the release of the carbon stored in the converted natural vegetation and soils (Fargione et al. 2008, Searchinger et al. 2008, Gelfand et al. 2011). This emitted carbon re-enters the atmosphere as carbon dioxide via combustion or decomposition, thereby strengthening the greenhouse effect. Consequently, emissions from clearing land to accommodate biofuel production could significantly undermine the carbon savings that biofuels seek to attain (Gibbs et al. 2008, Elshout et al. 2015). To estimate the likely impacts of cropland expansion on natural carbon stocks and implications for biofuel efficacy, we combined high resolution maps of newly cleared croplands with spatially-explicit maps of vegetation and soil organic carbon pools. Our method, for the first time, enables us to identify specific carbon stocks effected by cropland expansion and to identify hot spots of potential C emissions.

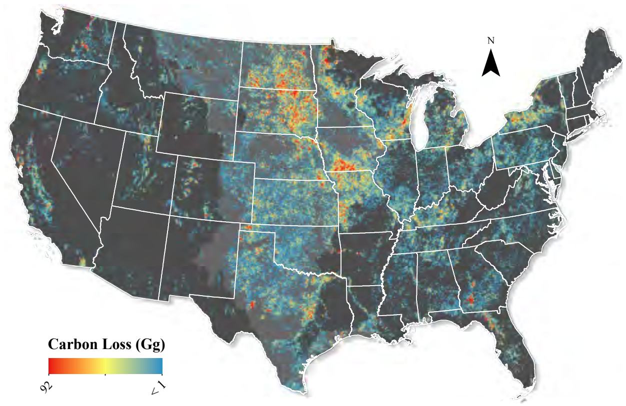


**Figure 1. Potential total emissions from cropland expansion (2008-2012) estimated from initial vegetation and soil organic carbon stocks. Pixels represent aggregate sum of emissions resulting from all expansion with each 5.6 km2 grid cell.**

## Preliminary Findings

We find that cropland expansion likely resulted in carbon emissions of nearly 30 Tg yr-1 (SD = ± 10 Tg yr-1) during the period 2008-2012 (Fig. 1). Overall, most expansion occurred throughout the Corn belt, the Great plains, and in States along the upper Great Lakes, with western New York and the central valley of California being notable exceptions (Appendix 1). The highest emissions per unit area, though, resulted from expansion in New England, States along the Eastern Seaboard and those along the Upper Great Lakes, where expansion was more likely to occur on carbon rich forests and wetlands. Taken together, these data highlight Minnesota, New York, Wisconsin, Michigan, and the Dakotas as states with the highest rates of expansion onto particularly carbon rich land. Indeed, these six states represent more than 35 percent of total annual emissions resulting from cropland expansion.

The majority (87%) of emissions resulted from cropland expansion onto grasslands where soil carbon was the largest source of emitted carbon (Fig. 2). Expansion onto wetlands resulted in the highest potential emissions per unit area, but represented only 2% of new cropland area. Approximately 75% of all potential emissions originated from soil organic carbon pools, which take longer to both emit and restore than vegetation biomass. This implies that compensating for these carbon losses could require significantly more time than if this carbon had originated from plant matter since the mechanisms of soil carbon accumulation occur over much longer times scales (10s to 100s of years) compared to photosynthesis (1s to 10s of years).

Field crops occupied the majority of newly converted land. Corn, soy, and wheat – all potential ethanol feedstocks – represented the three most prominent field crops and contributed to 85% of all potential annual emissions (Fig 3). Other potential feedstocks including sorghum, rice, sugarcane, and sugar beets also occupied new cropland but represented only a small fraction of overall expansion and emitted carbon.

We further estimated the length of time required for the expected carbon savings of specific biofuels to offset the initial carbon debt incurred from land clearing by considering local crop-specific yields reported by USDA NASS. This analysis assumes the energy equivalence of ethanol and biodiesel to petroleum based gasoline and diesel to be 1.38 and 1.09, respectively (Gibbs et al. 2008). For corn ethanol, we predict a median payback time of 54 years, though the range is wide (1 – 300 years) due to county level differences in natural carbon stocks and corn yields. Payback times for biodiesel

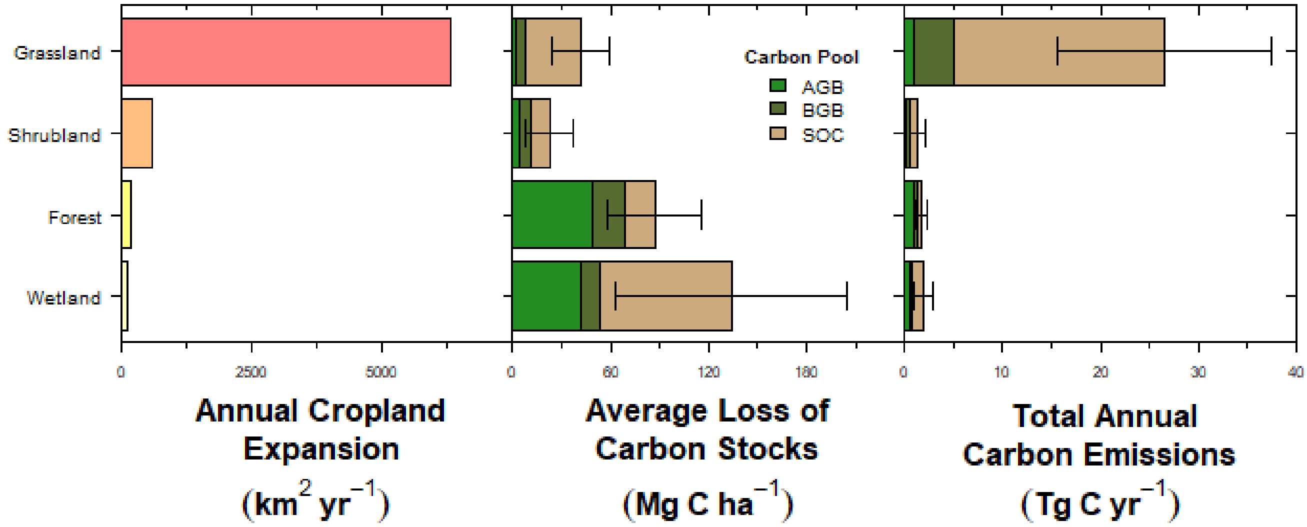


**Figure 2. Annual extent of cropland expansion, average loss of carbon stocks and total annual carbon emissions from cropland expansion (2008 – 2012) by pre-cultivated land cover. Carbon loss is further stratified by the carbon pools from which emissions originated. AGB represents carbon lost from aboveground biomass, BGB represents carbon lost from below ground biomass, and SOC represents organic carbon lost from the top meter of soil.**

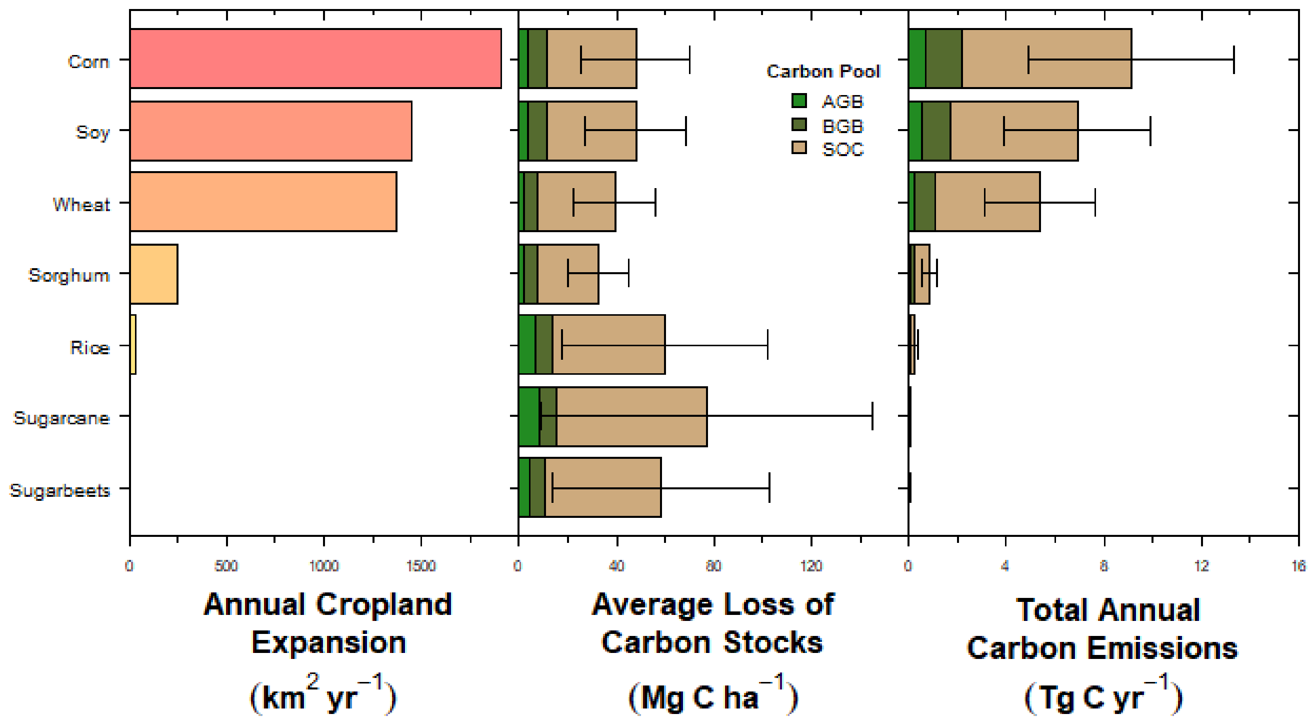


**Figure 3. Annual extent of cropland expansion, average loss of carbon stocks and total annual carbon emissions from cropland expansion (2008 – 2012) for seven potential biofuel feedstock crops. Carbon loss is stratified within each crop by the carbon pools from which emissions originated. AGB represents carbon lost from aboveground biomass, BGB represents carbon lost from below ground biomass, and SOC represents organic carbon lost from the top meter of soil.**

produced from soybeans grown on newly cleared land are significantly longer (Median: 556 years) because of the relatively low attainable fuel yields from a hectare of soybeans. Wheat is not widely used as an ethanol feedstock in the US but has been proposed as an alternative to corn when corn prices are high. We find the median payback times for wheat-based ethanol to be 88 years.

Our estimate of potential carbon emissions is 30% higher than the median estimate reported by Lark et al. (2015) though it remains within the upper range of their estimate. The approach presented here is a significant improvement because it relies on the most recent and highest resolution maps to explicitly considering the initial carbon stocks on a given piece of land. In doing so, we are able to identify hotspots of carbon emissions at the sub-county level which provides opportunities for targeted conservation and management.

## Methods Summary

We combined high resolution maps of new croplands with maps of above and below ground vegetation biomass and soil organic carbon stocks to estimate the potential committed emissions of biomass and soil carbon resulting from conversion of natural land cover to cropland. Data sources used to determine carbon stocks are summarized in Appendix 2. For biomass carbon emissions, we assume complete loss of biomass carbon stocks upon conversion under the assumption that all biomass is burned (instantaneous emissions) or decomposed (prolonged emissions over 1-100 years; Houghton, 1999). For soil, we estimated potential emissions using land-cover specific emissions factors representing the proportional loss of soil carbon over time (Appendix 3; Sanderman et al. 2017, Nahlik et al. 2016), and a new, high resolution map of soil organic carbons stocks to a depth of 1m (Hengl et al. 2017). Like decomposition of plant matter, soil carbon losses

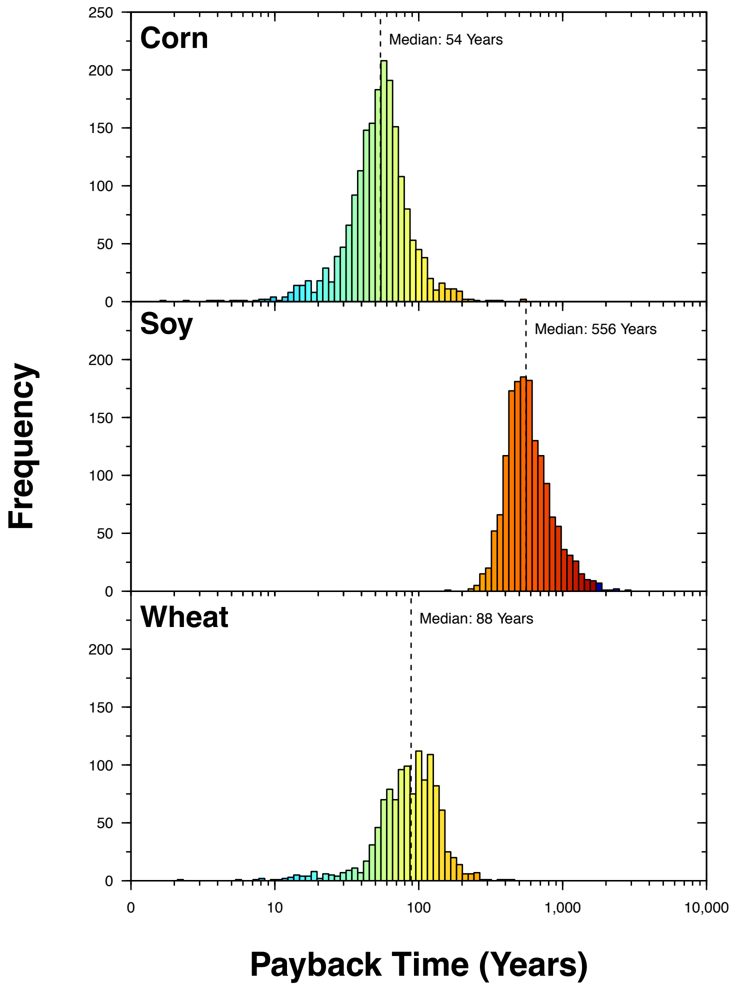


**Figure 4. Ecosystem carbon payback times by county for corn, soy, and wheat grown on new cropland by county. Payback times represent the duration of biofuel feedstock production necessary to offset the initial carbon debt incurred from land conversion.**

occur over to course of 10s to 100s of years and our estimates should therefore be interpreted as potential ‘committed’ emissions.

To quantify the impacts of land clearing on biofuel carbon balance, county level carbon debt was calculated by subtracting the mean peak standing crop biomass carbon from the aggregate mean of pixel-level committed C emissions. The peak standing crop biomass carbon was estimated from mean crop- and county-specific yield data reported in the 2007 and 2012 Census of Agriculture (USDA NASS) and crop specific parameters reported in West et al. (2011).

Carbon debt was then used to calculate the ecosystem carbon payback times for corn, soy and wheat following the methods of Gibbs et al. (2008) with more recent yield-to-biofuel volume relationships reported in Elshout et al. (2015).

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**Appendix 1. Annual extent of gross expansion, mean carbon stock reduction and total annual carbon emissions by state .**

| State | Annual Gross Expansion (km2yr-1) | Mean Carbon Stock Reduction (Mg ha-1 ± SD) | Annual Carbon Emissions (Gg yr-1 SD) |
|---|---|---|---|
| Alabama | 79 | 37 ± 19 | 288 ± 153 |
| Arizona | 15 | 31 ± 28 | 47 ± 43 |
| Arkansas | 27 | 52 ± 43 | 136 ± 114 |
| California | 184 | 39 ± 28 | 724 ± 523 |
| Colorado | 214 | 28 ± 14 | 599 ± 291 |
| Connecticut | < 1 | 61 ± 26 | 1 ± 1 |
| Delaware | 1 | 83 ± 55 | 8 ± 5 |
| Florida | 60 | 77 ± 52 | 459 ± 312 |
| Georgia | 109 | 56 ± 35 | 603 ± 380 |
| Idaho | 66 | 31 ± 19 | 207 ± 123 |
| Illinois | 135 | 40 ± 15 | 532 ± 206 |
| Indiana | 51 | 51 ± 27 | 260 ± 134 |
| Iowa | 362 | 44 ± 8 | 1600 ± 285 |
| Kansas | 438 | 35 ± 10 | 1524 ± 425 |
| Kentucky | 143 | 40 ± 16 | 573 ± 223 |
| Louisiana | 44 | 53 ± 44 | 231 ± 192 |
| Maine | 4 | 70 ± 27 | 24 ± 9 |
| Maryland | 9 | 47 ± 21 | 42 ± 18 |
| Massachusetts | 1 | 74 ± 41 | 4 ± 2 |
| Michigan | 80 | 87 ± 46 | 700 ± 370 |
| Minnesota | 263 | 62 ± 34 | 1639 ± 890 |
| Mississippi | 42 | 40 ± 26 | 165 ± 108 |
| Missouri | 413 | 42 ± 12 | 1718 ± 511 |
| Montana | 149 | 37 ± 14 | 554 ± 207 |
| Nebraska | 308 | 43 ± 11 | 1313 ± 337 |
| Nevada | 20 | 29 ± 28 | 59 ± 57 |
| New Hampshire | 1 | 63 ± 14 | 2 ± 1 |
| New Jersey | 2 | 55 ± 36 | 13 ± 8 |
| New Mexico | 84 | 22 ± 12 | 186 ± 97 |
| New York | 157 | 61 ± 24 | 960 ± 376 |
| North Carolina | 46 | 50 ± 51 | 230 ± 233 |
| North Dakota | 516 | 48 ± 12 | 2478 ± 616 |
| Ohio | 70 | 52 ± 22 | 364 ± 152 |
| Oklahoma | 275 | 32 ± 13 | 877 ± 363 |
| Oregon | 57 | 40 ± 30 | 226 ± 173 |
| Pennsylvania | 78 | 51 ± 22 | 395 ± 174 |
| Rhode Island | 0 | 0 | 0 |
| South Carolina | 8 | 59 ± 44 | 49 ± 37 |
| South Dakota | 689 | 47 ± 11 | 3262 ± 778 |
| Tennessee | 83 | 37 ± 21 | 309 170 |

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*Photo: Michelle Villafranca*

# 9. EDUCATION AND COMMUNICATION ABOUT GRASSLANDS

## CREATING AWARENESS OF GRASSLAND ECOLOGY THROUGH CONSERVATION EDUCATION

**Angelica F. Arredondo, Rob and Bessie Welder Wildlife Foundation and Janel L. Ortiz, Caesar Kleberg Wildlife Research Institute, Texas A&M University–Kingsville**

*Other Authors: Selma N. Glasscock, Rob and Bessie Welder Wildlife Foundation and April A.T. Conkey, Caesar Kleberg Wildlife Research Institute, Texas A&M University–Kingsville*

Grasslands make up one of the earth's major biomes by covering up to a quarter of the land surface (Blair et al. 2014). However, less than eight percent of these grasslands are protected (DOW 2017). Grasslands are important ecologically and economically as they act as a biodiversity reserve, a natural carbon sink assisting in regulating the earth's temperature, and they serve as a water catchment (WHF 2017). These lands are very productive, making them important for agriculture because of their ability to provide a feed base for grazing livestock. They also serve important roles culturally, aesthetically, and recreationally. Diminishing grasslands has left our society with critical habitat loss due to afforestation, fragmentation, and the replacement of grasslands with agricultural and crop lands (Boval and Dixon 2002). The drastic decline has left our plants and animals, particularly those that are grassland-associated, with limited resources. One of the most notable effects of decreased grasslands is the widespread and ongoing decline of grassland-associated North American bird populations (Brennan and Kuvlesky 2005).

Conservation education aims to alleviate disconnect to our land by providing experiences that allow people to gain knowledge, skills, positive attitudes, participation in nature, and awareness to address environmental issues (UNESCO 1978). Conservation education is defined as "helping people of all ages understand and appreciate our country's natural resources—and learn how to conserve those resources for future generations" (USDA FS 2017). Because of the ecological and economical importance of grasslands, it is crucial to educate the public in conserving remaining grasslands. Conservation education programs can be geared towards educating people of all ages and backgrounds on the importance and benefits of grasslands. Creating awareness of grasslands begins with hands-on and in-field activities that provide the community with a connection to the land so they can become part of it. These activities must be sculpted in a way to be beneficial for all, and particularly for grade school children, activities must reinforce classroom material and align with state and/or national standards.

Landowners may get involved with conservation education by offering their own programs or partnering with existing programs. Partnerships such as with your state fish and wildlife agency, state extension program, local service center of National Resources Conservation Service (NRCS, USDA), local environmental organization, or school can be the stepping stone to getting the ideal conservation education program started. Partnerships can have varying levels of involvement depending on the goal in mind (Figure 1). These partnerships can provide the support and resources that may not be easily accessible to landowners, such as volunteers or material kits to conduct activities. Building, executing, or merely participating in established conservation education programs is largely volunteer based. Landowner roles may vary. For example, a landowner may be interested in providing a place (i.e., land) for educational activities

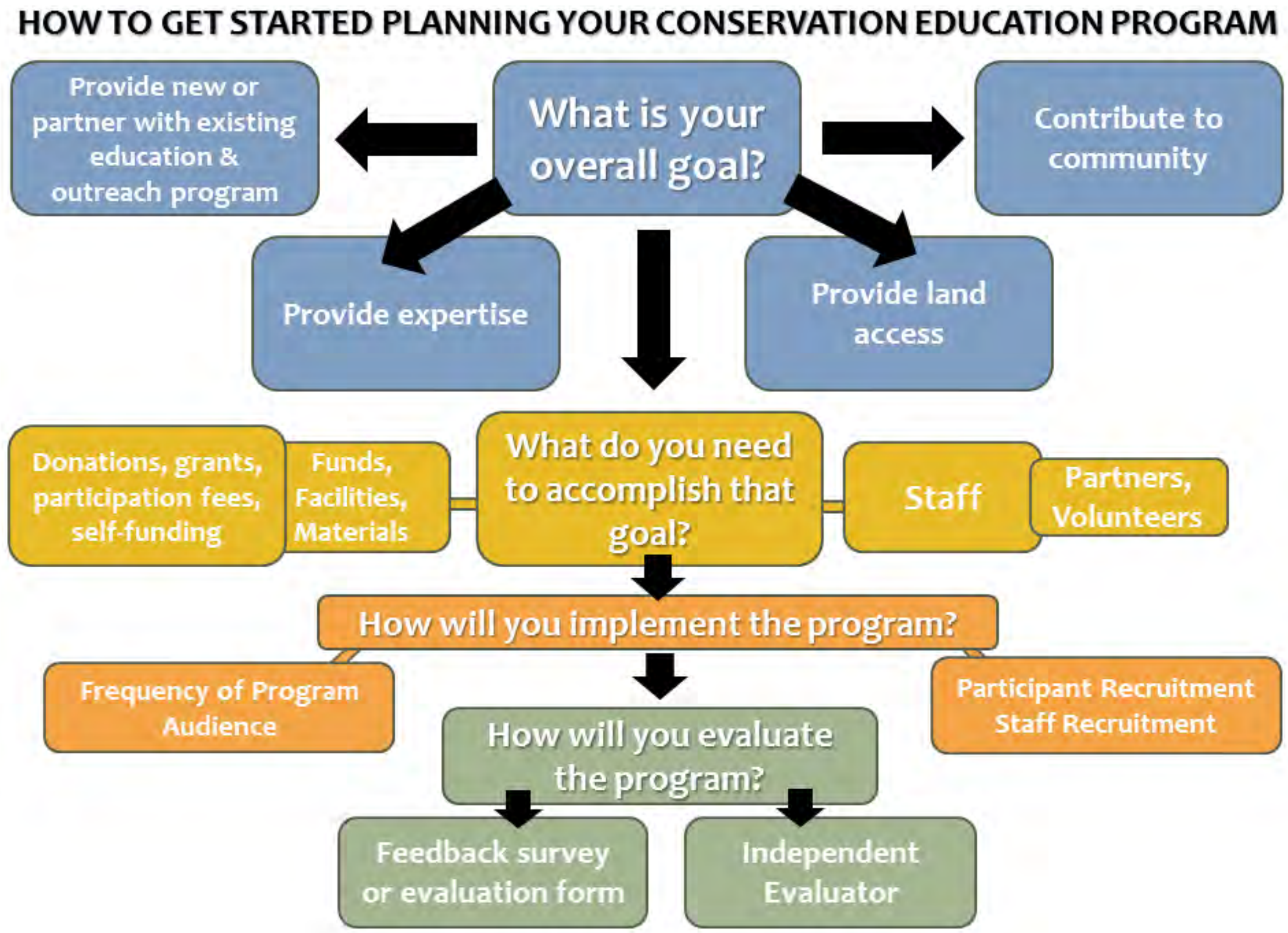


**Figure 1: Framework for starting your own conservation education program or becoming involved in one as a landowner or natural resource professional.**

to occur but may need the help of education or natural resource professionals to design and implement the outreach activities. Depending on the goal of the program, you may need to fill knowledge gaps to ensure you achieve the desired results. This may lead to recruiting natural resource professionals and/or environmental educators with expertise in wildlife, botany, hydrology, and other fields as partners. The commonality among all participants is the shared goal in conserving natural resources and educating the community.

There are a variety of things you can do to share your expertise or program and educate the public on the conservation of grasslands:

- Offer opportunities for field trips for schools, community groups, or other landowners to your land
- Provide guided walks or tours of your land
- Offer to speak to local K-12 classrooms and share how you manage your land
- Provide an open house to the public to share the economic and ecological importance of your land
- Have informational booths on your CE program (if existing) at local Farmer's Markets, Science Fairs, School Events, or Career Fairs

- Use social media to market your program or showcase your land or management via short online videos

- Consider providing access and/or funds to local researchers from universities to conduct research on your land—this gathers more information about your property but also provides information to the public and scientific community and educational opportunities to the researchers

One of the key components of conservation education is to reach out to the future generation of conservationists. Becoming involved in a K-12 classroom or outreach program provides the setting needed to reach out to this important group. One of the best ways to accomplish this is through hands-on, in-field activities that get the students excited and out of their normal classroom environment. A few activities you can offer aimed towards grassland ecology include: grassland bird identification, "Grow Grass Grow" activity, and citizen science programs for monitoring. "Basics of Birding" is a free activity available at ckwri.tamuk.edu that introduces students to common birds that they learn to identify via field marks (Ortiz 2015). Once students become familiar with bird identification, they can go to the field site and conduct a bird count. This gives the landowner an idea of what species are present on his or her land but also gives students the chance to practice scientific methods in the field. "Grow Grass Grow," is an activity from the Welder Wildlife Foundation's Rangeland Curriculum that gets students to act as different plant parts, giving them an introduction to plant biology and allows them to recognize how each plant part is crucial to the success of an individual plant (Johnson and Winans 2012). Schools and adult community groups are often interested in citizen science programs as well. Citizen science is defined as the public's involvement in scientific research ranging from involvement through data collection to analysis. Citizen science programs such as iNaturalist, eBird, Project BudBurst, and I See Change allow the landowner and education participants to begin a monitoring program on the land relating to plants, animals, and environmental changes.

Conservation education programs on public and private lands can provide positive experiences in nature for all participants and citizen scientist opportunities for students and the public. You as a landowner or natural resource professional can take pride in your land and community involvement by offering these opportunities to the public and making your own mark on the world in terms of grassland conservation. If you are interested in contributing to grassland conservation via conservation education programs, please refer to Figure 1 on how to get started. When we all come together in community partnerships, we can help develop awareness, understanding, and sensitivity to environmental problems of grasslands and their associated ecosystems.

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## TEACHING ENVIRONMENTAL STEWARDSHIP THROUGH USE OF OUTDOOR CLASSROOMS: A MULTI-CAMPUS RESTORATION INITIATIVE

**Greta Bowling, Ping-Sha Sheffield, Tarrant County College**

In a time where natural areas are fewer and farther between due to urban sprawl, educating youth and the community about the benefits of essential ecosystems is of utmost importance. Colleges and universities across the nation have heard the call to action and have seen the benefits outdoor classrooms have on promoting land stewardship as well as student success and retention.

Tarrant County College District (TCCD) is one of the 20 largest higher education institutions in the United States, serving over 50,000 students across six campuses annually. As a two-year college, it provides affordable, open access to the community, a wide variety of associates degrees and certifications as well as partnerships with local school districts offering Early College High Schools.

Tarrant County College has over 800 acres of land spread across five major campuses. Each campus has designated a fraction of its land to house sustainability initiatives with the aim to connect students to nature through outdoor classrooms. Recently, a group of faculty, staff and administrators across the district came together to form the TCC Conservation Coalition (TC4). The aim of this committee was to combine the efforts of all campuses to support a vision of experiential learning as well as to foster a culture of land stewardship among students, faculty and the community.

Prior to the formation of this new committee, faculty and staff from across the district struggled to establish footholds for support and community involvement. It is the continued hope of this committee that by joining forces, TCCD will become a leader among colleges hoping to develop outdoor classrooms and restore natural habitats as well as increase the likelihood that curriculum and programs created under this committee will be more sustainable across the five campuses.

With the multitude of restoration strategies employed across the campuses, TCC is able to demonstrate to students and the community that there is more than one way to restore habitat and approach environmental problems. The current initiatives across TCC promote land stewardship and include service learning opportunities through a diverse offering of courses and campus organizations. More specifically, there have been areas designated as Wildlife Demonstration Sites by Texas Parks and Wildlife Department, and projects designed to support the creation and maintenance of Monarch Waystations as well as seed bank initiatives. The college has also seen the benefit of developing partnerships with local groups like the Native Prairies Association of Texas, to establish preserved areas as well as develop education campaigns for the community and others like Fort Worth Nature Center & Refuge and Tarrant Regional Water District. Among other initiatives falling under TCC Conservation Coalition are working with local farmers' markets and recycling programs to educate the public and forming academic pathways from TCCD to careers in sustainable land management. Future goals across the campuses include development of curriculum for outdoor classrooms, expanding upon established partnerships between the college and local school districts, forming new alliances between local colleges and universities as well as improving community involvement through outdoor programming.

Tarrant County College prairies serve as a window of opportunity to provide learning beyond the classroom, also known as experiential or hand-on learning. Tarrant County College wants to use its natural areas to combine classroom and field experience to help students apply their learning to living in the community. This type of service learning will deepen their knowledge and understanding of classroom theories and thus, establish a culture of environmentally-conscious students. With the establishment of this type of learning into our curriculum, we can focus on building collaborative learning communities and directing our students to understanding the value of constructing relevant connections between theory and practice.

## RESEARCH AND EDUCATIONAL EFFORTS TO COMMUNICATE THE BIODIVERSITY OF WET MEADOWS AND PRAIRIES ALONG RIVERS OF CENTRAL NEBRASKA, USA


### Mary Harner, University of Nebraska at Kearney

*Other Authors: Emma Brinley Buckley, Keith Geluso, University of Nebraska at Kearney; Ben Gottesman, Purdue University; Michael Farrell, Michael Forsberg, and Jamie Loizzo, University of Nebraska-Lincoln*


Central Nebraska lies in a region where the Great Plains, Ogallala Aquifer, and Central Flyway overlap a number of easterly flowing rivers, creating a biologically rich intersection of terrestrial and aquatic habitats, including mesic grasslands, that support a diverse assemblage of resident and migratory species. The objectives of this work were to 1) document seasonal dynamics and biodiversity of grasslands that are associated with riverine systems of central Nebraska and 2) explore creative ways to communicate about these ecological dynamics with broad audiences. Our focal sites were along the Platte River and in the Sandhills of central Nebraska. These sites were part of a network of time-lapse cameras placed on the landscape associated with the Platte Basin Timelapse (PBT) project. For over seven years, PBT digital cameras have been recording images of the landscape every daylight hour, capturing change over time. Information contained within this imagery offers opportunities to increase our understanding of ecosystems, monitor change, and share outcomes. In partnership with the Center for Global Soundscapes at Purdue University, we have been combining time-lapse photography and sound recordings to capture visual and acoustic diversity on the central Platte River. Finally, through a new initiative called Streaming Science, we have been leading electronic field trips to camera locations, connecting middle and high school students with scientists working in grassland ecosystems. In this presentation we shared photography, videography, and acoustic recordings from grasslands of the Platte River and Sandhills of Nebraska; described some of the methodologies and outcomes of batch image classification and time-series analysis to describe environmental change and wildlife activity; and communicated our approach and results of a pilot electronic field trip titled *Ranches, Rivers, and Rats* shared with Nebraska students in spring 2017.
We invite you to learn more at **plattebasintimelapse.com, centerforglobalsoundscapes.org,** and **streamingscience.com.**

# ROUNDTABLE DISCUSSIONS

## CONTINENTAL-SCALE GRASSLAND CONSERVATION

**Moderator: Carolyn Callaghan, Canadian Wildlife Federation**

### Why Should We Establish a Continental-scale Network and Initiative?

• Migratory species of bats, birds, mammals, monarchs need cross-border contiguous habitat.

• Climate Change will cause range shifts and areas beyond the United States will become important refuges for some species.

• Working together may reduce the likelihood that any one country will act in isolation and allow degradation and loss of prairie grasslands.

### What are the Barriers to Overcome in Establishing a Network?

• Cultural and language barriers between Mexican and US/Canadian participants

• Institutional barriers – i.e. rapid turnover of officials in Mexico is common and consequently new relationships need to be built regularly.

• The general public in all three countries has little awareness of grasslands and therefore the issue is likely off the radar screen of most senior bureaucrats and politicians.

• Funding capacity, especially for the participants of Mexican partners.

### What are the Opportunities?

• Create a North American Grassland Conservation Network. We can capitalize on the networks that currently exist: Joint Ventures (Habitat and Monarch) committees, AFWA, trilateral Wildlife Committee to identify a coordinating body for the initiative.

• An official tri-national Grassland Conservation Act or Agreement may be an effective tool to stem the loss of grasslands in the three partnering countries. Use the Migratory Bird Convention Act/Treaty and that North American Wetland Conservation Act as models to develop a North American Grasslands Conservation Act.

### What Can We Do Over the Next Two Years to Move this Initiative Forward?

• Identify and engage a coordinating body and develop a mission and vision.

• Establish a working group comprised of participants from all three countries to move the concept forward and begin developing key relationships in the respective countries well before the next conference.

• Engage senior bureaucrats from all countries in the vision and identify champions in each country.

• Strongly suggest that the theme of the next Grasslands Conference is: *Moving Toward a tri-National Partnership for Grassland Conservation in North America* (the wording is not set in stone, but very important that *North* preface *America* to be inclusive).

• Suggest holding the next conference somewhere close to the Mexican border to ease travel of Mexican partners.

• Suggest incorporating Live Streaming for participants who are not able to attend and integrate their talks into the regular program.

• Seek funding from the Commission for Environmental Cooperation (CEC) for the development of a white paper with rationale for the establishment of a tri-national group, provision of travel support (especially for Mexican partners) and a report collating the state of the grasslands in each country and catalogue the initiatives that are already underway.

• Convene a special meeting with senior government officials during the next conference.

• Ensure that invitations are made to senior bureaucrats in each country.

# MANAGING OUR NATIONAL GRASSLANDS FOR MULTIPLE USE

## Moderator: Chamois Andersen, Defenders of Wildlife

### Case Study: Thunder Basin National Grassland

The Code of the West and "doing the right thing" in Wyoming are more than abstract expressions at the Thunder Basin National Grassland. They are the basis of a long-standing argument about how to manage prairie dogs. Only "doing the right thing" has a different meaning between two disparate stakeholder groups who have long been ensnared in a debate about how prairie dogs should be managed on these grasslands.

**Background**

• Thunder Basin National Grassland is comprised of 550,000 acres in northeastern Wyoming

• managed by the US Forest Service

• abounds with wildlife, provides forage for livestock, and is underlain with vast mineral resources

• land patterns are complex because federal, state and private lands are intermingled, with livestock permittees who also live on these lands

For the ranchers, "doing the right thing" means putting their interest first because these lands were set aside for agriculture in the first half of the 20th century, and they need ample forage for their cattle.

For the conservationists, "doing the right thing" means restoring the grassland's natural balance, in part by allowing this keystone species – the prairie dog – to thrive on a large enough area to sustain healthy populations of the many grassland species that benefit from their presence.

**What's at Stake**

***Wildlife interests***
Thunder Basin National Grassland is one of the best locations for maintaining an intact complex of prairie dog colonies, an important part of a fully-functioning ecosystem on the Great Plains. Prairie dogs provide habitat for burrowing owl, mountain plover, and serve as prey for endangered black-footed ferret, swift fox, ferruginous hawks as well as a host of other wildlife.

***Agriculture interests***
The ranchers' way of way of life and their economic viability is at stake. Many take issue with what they see as a landscape over run with prairie dogs, impacting their livelihood by the prairie dogs competing with their cattle for grass.

**What About the Multiple Use Mandate?**

Multiple use of National Grasslands includes outdoor recreation, range, timber, watershed, and fish and wildlife purposes.

The GOALS of the **Land and Resource Management Plan** for the Thunder Basin are 1) ensure sustainable ecosystems; 2) provide multiple benefits to people (including recreation, livestock grazing, mineral and energy resources, cultural resources and education; 3) scientific and technical, and 4) effective public service (ADA, etc.).

Under the Forest Service Manual, the U.S. Forest Service is mandated to: (FSM 2670.21.1) "Manage National Forest System habitats and activities for threatened and endangered species to achieve recovery objectives so that special protection measures provided under the Endangered Species Act are no longer necessary."

### Questions and Answers

*What can the Forest Service do to resolve the social issue on the Thunder Basin when it comes to prairie dogs?*

*You need to entice ranchers and the conservationists to consider the other's perspective.*

*You should consider a program for hunting prairie dogs to keep numbers under control; maybe in the areas open to shooting.*

*Another comment indicated the science may not support shooting as a method to control numbers or density. Prairie dogs breed once a year and on average have 2.5 young. There is also the issue of lead bullets impacting associated species.*

*With six or seven landowners who are impacted by the 18,000 acres of designated prairie dog habitat, it seems reasonable to find an economic incentive or solution for those impacted landowners.*

*The Forest Service needs to do a better job of management and dedicate resources to see the buffer zones are clear of prairie dogs so they don't go over to the private lands.*

*The 2012 Planning Rule includes a sustainability tool. It might be a good idea to use that document to develop a sustainability plan with this issue in mind, and therefore the social dilemma may be better defined. It seems important to really consider the ecosystem benefits and the planning rule does this.*

*Ranchers are operating on 1 to 2 percent profit margin. It is important to find a way to compensate those landowners impacted by prairie dogs.*

*The collaborative process working group needs to better hold the Forest Service accountable to the triggers and tools in the management plan and prairie dog strategy.*

*What does the Thunder Basin look like when this issue is solved?*

*It looks like two healthy systems, increased load for livestock with increased profits to ranchers and in the areas where prairie dog habitat is designed for associated species, healthy prairie dogs and black-footed ferrets on the ground.*

*It's important for cattle as grassland grazers to play a role where prairie dog towns are located, they or at least with a similar grazer, bison have coexisted.*

*What resources do we need to implement the solution?*

*You need better relations, to get along and to really work together toward a solution.*

*NFWF funding is available. It is going to take additional funds to help support the Forest Service with management.*

*You have a plan with many legs or parts and as new people come in to this area and issue, more legs appear; the idea is to have a long-range plan that pulls all these pieces together and is adaptable.*

## SETTING A SCIENCE AND POLICY AGENDA FOR GRASSLAND CONSERVATION

### Moderator: Tyler J. Lark, University of Wisconsin-Madison

**Overview:** The goal of this roundtable discussion was to generate a collective science and policy agenda to help guide grassland conservation. One possible outcome from the roundtable is to develop the identified action items into an article to submit for publication in order to help communicate the aims and gain broader support for grasslands research and policy advancement. If you are interested in contributing to this continued effort, please email the roundtable moderator at lark@wisc.edu for more information.

**Background:** Unplowed native grasslands are among the most endangered ecosystems in world. These highly diverse areas provide critical habitat for wildlife, support an abundance of plant, animal, and microbial species, and store rich carbon reserves beneath their undisturbed soils. Despite this, only a fraction of the original extent of grasslands in the U.S. now remains, and the rate of prairie conversion and loss has recently accelerated. In this roundtable discussion session, we discussed steps and actions that could help curb native prairie loss in the U.S. and reduce grassland conversion. In general, these suggested needs and solutions fell into the realm of either science-focused, policy-focused, or public-focused and other recommendations. A summary of suggestions organized by areas follows.

**Suggestions identified during discussion:**

***Science***

- Create a national grasslands inventory; differentiate native vs tame grasses

- Synthesize the available research on grasslands and their ecosystem services

- Quantify both the direct and indirect value of grasslands

- Analyze of the role of different drivers of grassland conversion

***Policy***

- Modify tax policies to make land managed as prairie equivalent to agricultural land

- Prioritize cultivation of CRP over native grasslands

- Expand Sodsaver to full U.S.

- Revise ethanol policy

- Create a national "no net conversion" policy

- Analyze and enforce policies outside of the traditional "silos" in which they are created

- Increase the financial reward structure for maintaining grasslands

- Allow stacking of carbon and ecosystem service credits

- Allow ranchers to own or have access to their carbon credits

- Encourage urban infill policies to reduce conversion pressure from development

***Public Support & Other***

- Leverage the power of markets

- Change the name of the U.S. Forest Service to the U.S. Forest and Grasslands Service

- Support grassland storytelling advocates

- Develop educational tools about the benefits of grasslands

- Increase education of the economics of grassland management

- Instill a culture of "see something, say something" regarding conversion and conservation compliance

- Create public service announcements about grasslands to increase public support

- Develop a unified message on grasslands across the conservation community

**Next Steps:** The goal of this discussion was to generate an initial list of actions to help prioritize conservation efforts and identify tangible steps that can be pursued across the science, policy, and public support arenas. To follow up on this effort, we are organizing the suggestions into a refined framework to help facilitate collective support and guide next steps. The intent is to then submit a commentary-type article to a journal based on this work in order to reach a broader audience of researchers and conservationists. **If you would like to help develop this article or the priority actions list, please email lark@wisc.edu.** Anyone who is interested in the topic is highly welcome—whether you attended this roundtable or not—and individuals and stakeholders from all backgrounds, including producers, policymakers, academics, and advocates, are all encouraged to contribute.

## GRASS BASED LIVELIHOODS

### Moderator: Ryan Stockwell, National Wildlife Federation

#### Barriers

- Access to land for next generation
- Absentee landowners creating wildlife ranches
- Cooperation among neighbors
- Cost of land, restoration
- Access to capital
- ROI

- Access to knowledge for specific audiences: young ranchers, old ranchers, partners

- Competing with conventional ways: cultural inertia, lack of ability to communicate to reach them, commonly held assumptions of "new ways," lack of basic knowledge of key concepts, learning the ability to read the land, desire for simple "recipe" solutions, fear of failing at new ways, assumption we can control everything.

#### Opportunities

- A program to "phase in" ranchers to "unlearn" old ways.

- Family-based workshops to make learning a social and cultural value

- Older generation available to teach younger generation:
    - Intern program
    - Grass bank
    - Mentor program: see example of WI Dairy Grazing Apprenticeship that provides training and access to capital. See also the King Ranch Institute
    - Connecting young and old through a match program
    - Webinars and small trainings targeting specific audiences:
        - Old ranchers
        - New ranchers
        - Grades 9-12

- Teaching young to value ecology of ranching and getting them access to enjoy it (to create memorable experiences to shape future decisions):
    - Grades 4-5 ranch visits

- Local "Conservation Menu" that provides resources (experts, funding, local leaders) on various components of good ranching.

*Photo: Melissa Bookhout*

# RANCHER PLENARY PANEL

### Moderated by Jon Hayes, U.S. Fish and Wildlife Service

Ranchers presented their experiences and insights on the challenges and opportunities of ranching based livelihoods. The discussion ranged from questions about specific USDA programs, approaches to decision making, regional variation, and what keeps them going.


*Panelists from left to right: Brain Alexander (Kansas), Tracy Rosenberg (South Dakota), David Sanchez (New Mexico), Cody Sand (North Dakota), Karl Ebel (Texas). Photo: Julie Sibbing*

# CLOSING KEYNOTE - DEBORAH CLARK

**Deborah Clark** of the Birdwell and Clark Ranch, closed out our conference by providing a moving account of their conservation ranching journey. Deborah also shared wonderful drone taken videos of their grazing operations and outlined the ways they follow a holistic management approach on their ranch. By outlining five key principles of sharing a big tent, keeping sight of our mission, telling our stories, being fearless, and continuing to add to the body of proof on what works on the ground, she certainly left our conference attendees with a renewed sense of purpose for grassland conservation!

*Photo: Deborah Clark*

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