

Managing Grassland Vegetation with Winter-Patch Grazing: Potential Benefits to Livestock and Wildlife

Final report for LNC15-371

Project Type: Research and Education

Funds awarded in 2015: \$199,294.00

Projected End Date: 09/30/2019

Grant Recipient: South Dakota State University

Region: North Central

State: South Dakota

Project Coordinator:

[Dr. Patricia Johnson](#)

South Dakota State University

Project Information

Summary:

This study was implemented in winter 2015-16 with heavy winter patch grazing (WPG) of research station and cooperator ranch pastures followed by summer grazing of all research and cooperator pastures. Data on livestock, vegetation, and wildlife attributes were collected according to protocol during Year 1 and are being analyzed.

Two events have altered the trajectory of this project. The first was a severe hailstorm in July 2016 that destroyed all standing vegetation in a large area, including the pastures of one of our cooperators. Lack of sufficient vegetation growth and recovery precludes us from including that cooperator ranch in Year 2 of the study. The second event was a large wildfire in October 2016 that burned substantial portions of 4 of the 8 pastures at the Cottonwood Research Station that were included in this study. We have modified the study to include both WPG and the burn in Year 2.

Year 2 Update:

Cottonwood Research Station: As a result of the fire that burned substantial portions of several pastures at the Cottonwood Station, 6 of our 8 pastures were recombined into 3 pastures; the remaining 2 pastures were maintained in their original configuration (1 WPG and 1 control). Each of the recombined pastures includes a WPG patch, a burned (PBG) patch, and a control (no burn, no winter grazing). A new patch in the remaining WPG pasture and the WPG areas of the recombined pastures were heavily grazed in winter 2016/2017. Yearling steers grazed each of the study pastures in summer 2017. Due to extreme drought conditions in the area, grazing animals were removed from pastures in mid-July rather than the planned mid-August removal date. Data on livestock, vegetation, and wildlife attributes were collected according to protocol during Year 2 and are being analyzed.

Cooperator Pastures: A new patch was grazed during winter 2016/2017 in the WPG pasture of the remaining cooperator ranch. Cow/calf pairs grazed the WPG and

control pastures according to protocol for the entire summer (drought conditions were much less severe compared to Cottonwood). Data on livestock, vegetation, and wildlife attributes were collected according to protocol during Year 2 and are being analyzed.

Year 3 Update:

Data collected during Years 1 and 2 have been summarized and analyzed; reports and manuscripts are being developed and submitted.

Year 4 Update - Final Report Summary:

1) Problem addressed: Traditional range management techniques are commonly used to improve livestock production; these techniques, however, promote development of homogenous vegetation structure/composition and are contributing to reduction of grassland bird habitat. Interspersion of diverse habitat types throughout a heterogeneous landscape is necessary to preserve habitat for grassland birds and other wildlife species, improve livestock production, and increase resiliency of rangelands to disturbances. The use of fire to create burned patches in the landscape has been shown to be an effective land and grazing management tool in improving heterogeneity in vegetation structure/composition and habitat for livestock and wildlife in the south and southwest. However, ranchers in the western region of NCR are very reluctant to burn due to costs, concerns about weed invasion, and potential for changes in carrying capacity. Using cattle to heavily graze patches in the winter may provide an alternative to patch-burn grazing. This study was designed to determine if winter-patch grazing would be an effective alternative to burning for 1) improving heterogeneity in vegetation structure/composition, 2) improving/maintaining cattle performance, and 3) improving habitat and use of pastures by grassland birds. If successful, this study could provide an alternative to burning for ranchers and land managers interested in developing wildlife habitat while still maintaining good livestock production.

2) Research approach: This study was designed to determine the extent to which winter-patch grazing (WPG) could be used to create heterogeneity in vegetation structure/composition, maintain/improve livestock performance, and improve habitat for grassland birds. The approach used in this study was to create patches within pastures that were grazed heavily in winter and then allow cattle to graze in those pastures and select the WPG patch or non-patch areas; pastures without WPG pastures served as controls. Resulting impacts on vegetation structure, livestock weight gains, bird habitat, and bird use were measured.

Year 1: This study was implemented in winter 2015-16 with heavy winter patch grazing (WPG) of research station and cooperator ranch pastures followed by grazing of all research and cooperator pastures in summer 2016.

Two events altered the trajectory of this project. The first was a severe hailstorm in July 2016 that destroyed all standing vegetation in a large area, including the pastures of one of our cooperators. Lack of sufficient vegetation growth and recovery precluded us from including that cooperator ranch in Year 2 of the study. The second event was a large wildfire in October 2016 that burned substantial portions of 4 of the 8 pastures at the Cottonwood Research Station that were included in this study.

Year 2 Cottonwood Research Station: As a result of the fire that burned substantial portions of several pastures at the Cottonwood Station, 6 of our 8 pastures were recombined into 3 pastures in Year 2; the remaining 2 pastures were maintained in their original configuration (1 WPG and 1 control). Each of the recombined pastures includes a WPG patch, a burned (PBG) patch, and a control (no burn, no winter grazing). A new patch in the remaining WPG pasture and the WPG areas of the

recombined pastures were heavily grazed in winter 2016/2017. Yearling steers grazed each of the study pastures in summer 2017. Due to extreme drought conditions in the area, grazing animals were removed from pastures in mid-July rather than the planned mid-August removal date. Data on livestock, vegetation, and wildlife attributes were collected according to protocol.

Year 2 Cooperator Pastures: One of our 2 cooperator ranches was removed from the study due to the impacts of the 2016 hailstorm. A new patch was grazed during winter 2016/2017 in the WPG pasture of the remaining cooperator ranch. Cow/calf pairs grazed the WPG and control pastures according to protocol for the entire summer (drought conditions were much less severe compared to Cottonwood). Data on livestock, vegetation, and wildlife attributes were collected according to protocol.

3) Research Conclusions: This project has resulted in several research conclusions:

1. Cattle demonstrated a significant preference for the WPG patch compared to control areas of pastures. When given the choice of grazing a WPG patch or a burned patch (as occurred in 2017), cattle preferred the burned patch. It is unlikely, however, that cattle will have opportunity to select between burned and WPG patches on producer pastures.
2. Heavy winter grazing significantly changed the structure in the WPG patches to a much shorter height; structure in burned patches was also short. Cattle grazing in summer maintained that shorter structure throughout the summer in both years for both the burned and WPG patches.
3. Cattle average daily gain (ADG) did not differ between WPG and control pastures, demonstrating that WPG does not limit livestock production.
4. Bird habitat was affected by WPG and burning, with both producing the shorter habitat preferred by a number of grassland bird species. The non-patch areas of the pastures maintained the taller structure preferred by other bird species.
5. In general, while habitat for both short-structure and tall-structure birds was available, birds did not respond to the available habitat. It is likely that scale was an issue, especially on the Cottonwood Research Station pastures. Greater bird densities and diversity was noticed on the larger producer pastures.

4) Farmer adoption actions: Adoption of new grazing strategies is typically very slow in the Northern Great Plains, however there has been continued interest in WPG as an alternative to burning, especially on public lands. For example, ranchers have contacted the US Forest Service National Grasslands staff in the region to ask them to consider WPG rather than burning to generate wildlife habitat.

Year 2 research plans:

1. A new WPG patch was created in winter 2016-17 on the remaining cooperator pastures and on the unburned WPG research station pasture. Grazing and data collection will be conducted as in Year 1.
2. The 6 remaining research station pastures were recombined to form 3 separate pastures, each having a burned patch, a 2016-17 WPG patch, and a control (not burned, not winter-grazed) area. Each of these 3 pastures will be grazed in summer 2017 by steers having access to all patches in their assigned pasture. Data collection will be conducted as in Year 1.

Year 3 research plans:

1. Field data collection for the project is complete.
2. Data collected in Years 1 and 2 will be summarized and analyzed, and reports and manuscripts will be developed and submitted.

Year 4 research plans:

1. Field data collection for the project is complete.
2. Data collected in Years 1 and 2 have been summarized and analyzed; reports and manuscripts will be developed and submitted.

Year 5 research plans: None. Project is finished.

Project Objectives:

Attachment

Original objectives of this research are to evaluate winter-patch grazing (WPG) on 1) heterogeneity in vegetation structure/composition, 2) cattle performance, and 3) habitat and use of pastures by grassland birds. The research is occurring at 2 scales/intensities: 1) intensive, statistically rigorous data collection on small-scale research station pastures and 2) extensive data collection on production-scale pastures on 2 ranches.

A new objective of this research was added in year 2 as a result of the wildfire that burned several of the research pastures at Cottonwood. That objective is to compare WPG, patch burn grazing (PBG), and control (no burning, no winter grazing) on 1) heterogeneity in vegetation structure/composition, 2) cattle vegetation/site selection, and 3) habitat and use of pastures by grassland birds. The original objectives were maintained for the non-burned pasture pair at Cottonwood and the remaining cooperator ranch pastures.

Objectives and Performance Targets for Year 1 (2015-16) that were met include:

1. Winter-patch grazing was accomplished on a 20% patch of the 4 study pastures at the Cottonwood Research Station and the 2 producer pastures.
2. Summer grazing occurred on all study pastures.
3. All data collection was accomplished on the Cottonwood Station and one cooperator's ranch, but was suspended on the 2nd cooperator ranch (see below for explanation).

Objectives and Performance Targets for Year 2 (2016-17) that were met include:

1. Winter-patch grazing was accomplished on a 20% patch of the remaining original WPG pasture at Cottonwood and on the cooperator WPG pasture.
2. Six of the study pastures at Cottonwood were recombined into 3 pastures, each having a burned and non-burned area. Half of each non-burned area of each pasture was grazed heavily in winter 2016/2017 to form a WPG patch.
3. Summer grazing occurred on all study pastures. Grazing was suspended in mid-July at Cottonwood due to extreme drought conditions; grazing continued as planned at the cooperator ranch due to much milder drought conditions there.
4. All data collection was accomplished on the Cottonwood Station and the remaining cooperator ranch.

Objectives and Performance Targets for Year 3 (2017-18) that were met include:

1. Data collected on this project were summarized and analyzed.
2. An MS Thesis (Ms. Jennifer Lutze) based on the research from this project (focused on bird habitat and use) is being written.
3. Publications on vegetation structural change, livestock production, and livestock use patterns are currently in development.

Objectives and Performance Targets for Year 4 (2018-19) that were met include:

1. An MS Thesis (Ms. Jennifer Lutze) based on the research from this project (focused on bird habitat and use) is nearing completion, with an estimated publication date of January 2020.
2. Publications on vegetation structural change, livestock production, and livestock use patterns have been developed; papers have been presented at scientific meetings and manuscripts are nearing finalization for submission for publication.

Cooperators

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Research

Hypothesis:

Hypotheses for this study include:

1. We expect that winter-patch grazing (WPG), as compared to control, will:
 - a. Increase plant structural heterogeneity
 - b. Alter livestock use patterns, with concentrations of cattle use on patches; attraction to winter grazed patches should decline over the summer
 - c. Maintain or increase livestock weight gains
 - d. Increase bird species richness and numbers
2. (Added after fire burned several study pastures at Cottonwood Station) WPG and patch burn grazing (PBG) will
 - a. Increase plant structural heterogeneity similarly
 - b. Alter livestock use patterns, with cattle attracted to WPG and PBG patches similarly for grazing; attraction to WPG and PBG patches will decline similarly over summer.
 - c. Bird species richness and density will be similar on WPG and PBG patches

Materials and methods:

Data collection at Cottonwood and on cooperator pastures included:

1. Vegetation height, height density (Robel Pole), species composition (% based on weight), and utilization were measured in winter-grazed patches and control areas of all pastures in the study, and on the burned patches in each of the burned study pastures.
2. Cattle were weighed onto and off of patches during winter grazing. Cattle were weighed onto and off of study pastures during summer grazing. A subset of cattle in each study pasture was fitted with GPS collars that recorded location and grazing activity of cattle throughout the summer grazing season. GPS data are being evaluated using ArcGIS to determine cattle preferences for winter-grazed patches, burned patches, and control areas.
3. Habitat suitability for bird nesting was evaluated using height-density measures (Robel Pole) in winter-patch and control areas of all pastures in the study, and on the burned patches in each of the burned study pastures. Bird surveys to identify bird use of pastures were conducted. Bird nest dragging was performed to find nests; success/failure of each nest was followed throughout each summer.
4. Species richness and biodiversity were measured for vegetation on permanent plots and for birds from nest and bird surveys.

Research results and discussion:

Data analysis for both years of the study are currently being conducted. Some preliminary results from our analyses include:

1. Vegetation production was highest in control areas, lowest in burned patches, and intermediate in winter-grazed patches. The low production in burned areas is likely due, in part, to lower soil moisture resulting from lack of snow capture on burned areas.
2. Average daily gains (ADG; kg/hd/d) of steers were similar ($P > 0.05$) across all treatments.
3. Cattle preferred (in terms of time spent) burned and winter-grazed patches over control patches in 2 of the 3 study pastures. Data are being further analyzed to determine which areas they prefer specifically for grazing.
4. Bird abundance (total # birds) and density (birds/ha) are generally higher on pastures with burned and/or winter-grazed patches than on pastures with no patches.

Update (2018-19): Results from our study that will be included in publications (thesis, journal manuscripts, etc.) include:

1. Winter patch grazing (WPG) and patch burning (PBG) were successful in creating significantly ($P < 0.05$) shorter structure compared to control.
 1. WPG reduced height of standing dead and current season growth in spring of both years compared to control at the Cottonwood Station. Similar results were observed on the cooperator pasture in both years.

2. PBG patches had shorter standing dead (height was 0.0 due to complete burn previous fall) and current season growth heights compared to both the control and WPG in 2017 at the Cottonwood Station.
2. Cattle preferences for grazing areas were significantly ($P < 0.05$) affected by WPG and PBG patches.
 1. In 2016, yearling steers at Cottonwood strongly preferred WPG patches over control areas in spring and late summer, with no differences in mid-summer. Cows on the cooperator ranch also strongly preferred grazing in the WPG patch.
 2. In 2017, yearling steers at Cottonwood strongly preferred WPG and PBG over control areas throughout the grazing season; preference for PBG was greatest. Cows on the cooperator ranch again strongly preferred grazing in the WPG patch (no PBG on cooperator pasture). It should be noted that it is highly unlikely that both WPG and PBG would be included in the same pastures. Thus, the continued preference of cattle for WPG over control suggests it is a reasonable substitute for burning for attracting cattle for concentrated grazing.
3. Both WPG and PBG treatments were successful in creating and maintaining habitat heterogeneity in both years of the study.
 1. At the end of the grazing season at Cottonwood in 2016, visual obstruction rating (VOR) was shorter, percent bareground was greater, and percent litter cover lower on WPG patches compared to control. This indicates that the combined WPG patch and control areas of these pastures provided habitat for both the low-structure requiring and high-structure requiring bird species.
 2. At the end of the grazing season at Cottonwood in 2017, VOR was shorter in WPG and PBG compared to control. Percent bareground was greatest in PBG as a result of the burn.
 3. For both years on the cooperator pastures, VOR was shorter on the WPG patch than on controls at the end of the grazing season.
4. Although bird habitat was more diverse with WPG and/or PBG compared to control, bird densities and diversity was not affected. This is likely due to several issues. The first is scale: pastures at the Cottonwood Station may not have been large enough to attract enough birds to evaluate. There was evidence on the larger cooperator pastures that WPG may attract more birds favoring short structure, however the loss of the second cooperator in the study limited our ability to perform appropriate analyses.

Research conclusions:

Impacts

Interest in this study is high and has increased since the Cottonwood Fire in October 2016. Prior to that fire, several ranchers in the area surrounding the research station had expressed concerns regarding plans for controlled burns on US Forest Service allotments; they were very interested in the results of this study as it may provide an alternative strategy for managing rangelands on the National Grasslands. Their interest has increased since the wildfire. The project director was invited to present information about this study and to provide some preliminary results at the annual

meeting of the Association of National Grasslands in October 2017.

This study was featured in an episode in a weekly, half hour television series, "*Out On The Land*". Reed Cammack, one of our cooperators, was interviewed by the host of the series, Dr. Larry Butler, in summer 2016, prior to the hailstorm that decimated the Cammack Ranch pastures. This NCR-SARE study was one component of the Cammack Ranch operation that was featured in the episode, and included video of the pastures, cattle, and heifers wearing the GPS collars collecting data for this study. The episode (Season 8, Episode 96) can be accessed at <http://www.outontheland.com/#!season-8-episodes/ja3rk>.

Update (2018-19): This study continues to generate great interest in the region. Project PIs have continued to present information from this study at a variety of venues to ranchers, agency personnel, and researchers.

Accomplishments

Year 1 Accomplishments:

All pastures were grazed according to the study protocol in Year 1. This included 1) heavy winter grazing of 20% patches on the 4 study WPG pastures at the Cottonwood Research Station and the 2 producer WPG pastures, and 2) summer grazing on all research and producer pastures (see below for exception). Data collected on research station and producer pastures included: livestock production (weights); livestock spatial use patterns (GPS collars); vegetation structure, composition, and utilization (plant height, biomass, forage removal); quality of bird habitat (height-density); and use by bird species (bird species identification, bird counts, nesting, and nest success). In addition, satellite imagery was collected and converted into an NDVI image for all study pastures to aid in evaluation of structural differences and vegetation greenness between winter-grazed patches and control areas of pastures. Data from all of these aspects of the study are currently being analyzed.

Two events have affected this study:

1. The first was a very large, severe hailstorm that occurred in the area of one of our producer ranches in July 2016. All of that cooperator's pastures (several thousand ac.) were affected; vegetation both inside and outside of grazing exclosures was reduced to a 2 inch stubble by hailstones up to 3" in diameter. Cattle were seriously injured and wildlife were killed in the storm. Sampling of vegetation, livestock, and birds was immediately suspended on that ranch. The rancher was forced to rent pasture elsewhere for the remainder of the summer, fall, and winter grazing seasons, thus no further data collection on his pastures was possible. Vegetation recovery did not occur as expected; this storm occurred at the end of the growing season for this region, and subsequent drought conditions were not favorable for plant growth. As a result, we were unable to implement the winter patch grazing protocol on that rancher's pastures in winter 2016-17. Because we could not include this rancher's pastures in Year 2 of the study, we considered including another ranch as a substitute. Two major issues ultimately precluded us from adding a new ranch to the study: 1) limited time for initiation of the study on a new ranch and 2) lack of a 2016 WPG patch on a new ranch pasture which limited its comparability with our remaining collaborator's pastures. Thus we have only one producer cooperator ranch involved in the project in Year 2 (2017).
2. The second was a 41,000 ac wildfire, the "Cottonwood Fire", that occurred in

the area of the Cottonwood Research Station on October 16, 2016. The Cottonwood Station was on the north edge of the fire, however over 1100 ac of pasture were burned on the station, including substantial portions of 4 of the 8 pastures involved in this study (Pastures 3b, 5a, 5b, and 6b; see Attachment). The fire burned 3 of the 4 patch pastures (Pastures 3b, 5b, and 6b; see Attachment) completely to nearly so, including the 2016 WPG patches in each. One control pasture (Pasture 5a) also lost substantial acreage to the fire. The burn occurred so late in the year that vegetation recovery did not occur prior to onset of winter. Vegetation growth on the burned areas is not expected to appear until spring 2017. As a result, no winter-patch grazing was possible on those 3 patch pastures.

After considerable thought and discussion, we have determined that our best option going forward is to implement the following modifications of the study in Year 2:

1. We will repeat the study in the remaining cooperator pastures. Winter-patch grazing of a new patch has been completed there as of this report. Grazing and data collection will be conducted as in Year 1.
2. One pasture pair remains at the Cottonwood Research Station for which both the control (pasture 2a) and patch (pasture 2b) pastures were not affected by the fire. We plan to repeat the study as previously planned in those pastures. Winter-patch grazing of a new patch has been completed as of this report (see Attachment). Grazing and data collection will be conducted as in Year 1.
3. The study for the remaining pasture pairs for which one or both subpastures were substantially burned will be modified to incorporate the burn into the study design. The pastures will be recombined to form 3 pastures (Pasture 3=3a+3b, Pasture 5=5a+5b, and Pasture 6=6a+6b); each pasture will have a control patch (not burned or heavily grazed in winter), a burned patch, and a heavy winter-grazed patch (Control, PBG, and WPG, respectively; see Attachment). These 3 pastures will be grazed by separate herds of cattle in summer 2017. Data will be collected on all 3 pastures on all components of the study (livestock production; livestock spatial use patterns; vegetation structure, composition, and utilization; quality of bird habitat; and use by bird species) as was done in Year 1 (2016).
4. Satellite imagery will be collected and converted into an NDVI image for the research station study pastures in May 2017 to aid in evaluation of structural differences between WPG, PBG and control patches of the pastures.

Year 2 Accomplishments

All pastures were grazed according to the modified study protocol in Year 2 (see above). This included 1) heavy winter grazing of a 20% patch on the one remaining WPG pasture at the Cottonwood Research Station and the 1 remaining producer WPG pasture, 2) heavy winter grazing of the WPG patch in each of the three recombined pastures at the Cottonwood Station, and 3) summer grazing on all research pastures at the Cottonwood Station and on the pastures of the remaining cooperator ranch. Data collected on research station and producer pastures included: livestock production (weights); livestock spatial use patterns (GPS collars); vegetation structure, composition, and utilization (plant height, biomass, forage removal); quality of bird habitat (height-density); and use by bird species (bird species identification, bird counts, nesting, and nest success). In addition, satellite imagery was collected and converted into an NDVI image for all study pastures to aid in evaluation of structural differences and vegetation greenness between winter-

grazed patches, burned patches, and control areas of pastures. Data from all of these aspects of the study are currently being analyzed.

Year 3 Accomplishments

Data from all aspects of this study have been analyzed and summarized. A thesis and several manuscripts are in preparation.

Year 4 Accomplishments

In 2019, 4 abstracts and presentations (both oral and poster) of this project have been presented at scientific meetings; an invited paper presented at Black Hills Area Botany & Ecology Workshop; 2 papers have been published in refereed scientific publications; and a thesis is nearing completion.

Participation Summary

2 Farmers participating in research

Project Activities

[Some New Ideas on Grazing Systems](#)

[Managing Grassland Vegetation to Benefit Livestock and Wildlife](#)

[Winter Patch Grazing](#)

[Research on Winter-Patch Grazing and Patch-Burn Grazing at the Cottonwood Station](#)

[Managing Grassland Vegetation to Benefit Livestock and Wildlife](#)

[Winter Patch Grazing as a Surrogate for Fire](#)

[Plant Community Response Following Wildfire and Heavy Winter Grazing Disturbance Regimes](#)

[Impacts of strategic grazing and fire on soil seed bank heterogeneity in mixed-grass prairie](#)

[Impact of fire and heavy winter grazing on livestock use patterns](#)

[Comparing bird communities in winter patch and patch burn grazing systems in western South Dakota](#)

[Promoting vegetation heterogeneity with alternative grazing strategies to improve ecosystem services](#)

[Impacts of strategic grazing and fire on soil seed bank heterogeneity in mixed-grass prairie](#)

[Classifying livestock grazing behavior with the use of a low cost GPS and accelerometer](#)

[Heavy winter patch grazing as an alternative to fire on the Northern Great Plains](#)

[Impacts of different disturbances on the performance of clonal plant buffalograss](#)

[Examination of fire and grazing-induced vegetation heterogeneity on trophic level relationships - small mammal diversity](#)

[Impacts of patch-burn grazing and winter-patch grazing on arthropod community heterogeneity](#)

[Promoting vegetation heterogeneity with alternative grazing strategies to improve ecosystem services](#)

[Monitoring daily livestock foraging activity with accelerometers: calibration, formula discovery, and final data processing](#)

[Heterogeneity on grasslands: Why do we need it and how can we get it?](#)

Educational & Outreach Activities

- 2 Journal articles
- 2 On-farm demonstrations
- 3 Published press articles, newsletters
- 1 Tours
- 20 Webinars / talks / presentations
- 2 Workshop field days

PARTICIPATION SUMMARY:

200 Farmers

500 Ag professionals participated

Education/outreach description:

Activities:

1. Journal articles: Two articles have been published from this study. Additional journal articles are in preparation. Published articles are:
 1. Brennan, J., P.S. Johnson, and K. Olson. 2019. Method to streamline processing of livestock global positioning system collar data. *Rangel. Ecol. Manage.* 72(4): 615-618. DOI: 10.1016/j.rama.2019.03.003.
 2. Weathers, K., L. Xu, and P.S. Johnson. 2018. Impacts of strategic grazing and fire on soil seed bank heterogeneity in mixed-grass prairie. *Proc. SD Acad. Sci.* 97-174.
2. On-farm demonstrations: This project was implemented on 2 ranches in western South Dakota. Both ranchers have talked extensively with other ranchers in their areas, and both have involved neighboring ranchers in gathering, sorting, weighing, etc. of livestock on the project.
3. Published press articles: This project was the subject of 1 newspaper article (in the TriState Neighbor), a discussion on South Dakota Public TV, and a TV (KOTA-ABC) news story.
4. Tours: This study was the featured tour for the annual meeting of the South Dakota Section of the Society for Range Management
5. Webinars, talks, and presentations: Information from this study has been presented widely to rancher groups (e.g. National Association of Grasslands), grazing/rangeland management conferences (in NE and ND), and at scientific meetings (Society for Range Management annual meetings, Academy of Sciences annual meetings, and the Northern Plains Climate Hub meeting)

6. Workshops, field days: The impacts of winter patch grazing and fire on soil moisture were examined during a field day at the Cottonwood Station in spring 2017 with about 20 area ranchers in attendance. Strategies developed under this project for dealing with GPS and accelerometer data from GPS collars on cattle were presented at a workshop during the 2019 Society for Range Management meeting.

Learning Outcomes

15 Farmers reported changes in knowledge, attitudes, skills and/or awareness as a result of their participation

40 Agricultural service providers reported changes in knowledge, skills, and/or attitudes as a result of their participation

Key areas taught:

- Importance of heterogeneity for sustainable livestock production
- Efficacy of using heavy winter grazing in patches to promote heterogeneity and manage for wildlife habitat
- Value of winter-patch grazing as an alternative to patch-burn grazing to manage for heterogeneity on Northern Great Plains grasslands

Project Outcomes

Key practices changed:

2 Grants applied for that built upon this project

1 Grant received that built upon this project

4 New working collaborations

Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture or SARE.



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