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Cool-season invasive grasses of the Northern Great Plains workshop abstracts and recordings

Edward (Shawn) DeKeyser, North Dakota State University

INTRODUCTION

The workshop held on March 18-19, 2014 was developed to share current knowledge, technical information, practical management information, and provide training opportunities for private local, federal and state participants that either manage land or work with land managers. The focus of the workshop was on the cool-season invasive grasses of North Dakota, South Dakota, Minnesota, Montana, Iowa, and Canada.

Presentations that relate to the use of fire for managing the cool season invasive grasses were recorded. In this document, abstracts of all the presentations are available. Recorded presentations are preceded by the symbol R and are hyperlinked to the recording.

Acknowledgements: The event was hosted by the Society for Range Management and North Dakota Chapter of the Wildlife Society. Thanks to Shawn DeKeyser for providing the presentation recordings.

ABSTRACTS

Current distribution and diversity trends of cool season invasive grasses in the Northern Great Plains.

Kenneth E. Spaeth Jr.

Rangeland Hydrologist, USDA-NRCS, Central National Technology Support Center, 501 West Felix St., Bldg. 23, Fort Worth, Texas 76115

The geographic spread and the number of invasive plant species has increased significantly over the past 200 years as a result of human activities. On rangelands, exotic grass invasion has been especially dramatic and has transformed many native plant community types throughout the United States. Kentucky bluegrass (*Poa pratensis*) and/or smooth bromegrass (*Bromus inermis*) invasion in the mixed grass prairie has been rapid and ubiquitous and many questions remain about current and potential changes in ecosystem dynamics. The U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) in cooperation with Iowa State University's Center for Survey Statistics and Methodology has conducted national resource inventories (NRI) for over 65 years to assess the Nation's natural resources on non-Federal lands. The current rangeland onsite study (2004-2011) included over 265 random observations. Extent of these two cool season grass species and their effect on species diversity trends will be reported.

R[Ecological site and state and transition model dynamics in the Northern Plains Grasslands]

Jeffrey L. Printz

State Rangeland Management Specialist, USDA-Natural Resources Conservation Service, Bismarck, ND

Plant community development in the Northern Great Plains was influenced by a disturbance regime which included fires of varying intensity and frequency, intense defoliation by grazers ranging from large herds of migrating herbivores, to prairie dogs, to swarms of grasshoppers, drought of varying intensity and duration, and varying periods of above, and below normal precipitation and temperature. The native plant communities responded to these various disturbances with subtle to sometimes dramatic species shifts depending upon the severity and duration of the disturbance.

Invasion by Kentucky bluegrass (*Poa pratensis*) and smooth bromegrass (*Bromus inermis*) shifts the ecological processes, alters how the plant community responds to disturbances and may change the ecological services provided by the plant community. These changes, along with the positive and negative drivers responsible for the shift and, the resulting plant community phase(s) are documented within the state and transition model for the individual ecological site. These state and transition models along with the accompanying plant community narratives document the ecological dynamics of the site both before, and after, invasion.

[R]Potential impacts of Kentucky bluegrass invasion in the Northern Great Plains

John Hendrickson[1], Mark Liebig[1], Allison Haider[1], Scott Kronberg[1] and Jeff Printz[2]*

[1]USDA-Agricultural Research Service and [2]USDA- Natural Resources Conservation Service

Over the past 30 years, Kentucky bluegrass (*Poa pratensis* L.) has been increasing on rangelands in the Northern Great Plains. While the ecological implications of other cool-season grass invasions have been documented, this is not true for Kentucky bluegrass. A project was initiated at the Northern Great Plains Research Laboratory (NGPRL) near Mandan, ND to evaluate the impacts of Kentucky bluegrass on above- and below-ground parameters. Four different sites (4.9 x 4.9m) were exclosed within a moderately grazed pasture at NGPRL. On approximately ½ of each site, Kentucky bluegrass was visually estimated to be abundant (POPR), while on the other ½, Kentucky bluegrass was less abundant (CONTROL). Within each ½ of the site, 3 sub-plots (1 x 2 m) were permanently marked. Each sub-plot was used for collecting either vegetative, soils or probe data. This abstract will only focus on the vegetation data. During the first week of July 2013, two 1/8 m^2 were clipped to ground level and sorted by species. Standing dead and litter biomass was also collected. There were no significant differences for species richness between the POPR and CONTROL areas in the sites (9.25 and 11.00 average species richness for POPR and CONTROL respectively). However, there were significant differences (P=0.0005) in the Simpson's diversity index between the POPR and CONTROL plots (D = 0.379 and 0.666 for POPR and CONTROL respectively). Results from the soil data are still being analyzed but the vegetation results indicate while Kentucky bluegrass invasion has not reduced species richness, it is having an ecological impact by reducing species diversity.

[R]An adaptive approach to managing smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*) on U.S. Fish and Wildlife Service-owned native prairies in the Northern Great Plains

Cami Dixon[1], Bridgette Flanders-Wanner[2], Terry Shaffer[3], Todd Grant[4]*

[1]U.S. Fish and Wildlife Service/Woodworth, ND, 2U.S. Fish and Wildlife Service/Vancouver, WA, 3U.S. Geological Survey/ Jamestown, ND, 4U.S. Fish & Wildlife Service/Upham, ND

The extensive loss and degradation of North America's grasslands presents a formidable challenge to resource managers. Much of the native mixed-grass and tallgrass prairies managed by the U.S. Fish and Wildlife Service (Service) in the Northern Great Plains are extensively invaded by introduced cool-season grasses, principally smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Management to suppress these invasive plants has had poor to inconsistent success, mainly for lack of understanding of prairie restoration ecology and absence of systematic evaluation of management effects. The central challenge to managers is selecting appropriate management actions in the face of biological and environmental uncertainties.

In partnership with U.S. Geological Survey, Service staff are implementing an adaptive decision support system known as the Native Prairie Adaptive Management project (NPAM) that assists managers in selecting management actions under uncertainty and maximizing learning from management outcomes. More than 20 Wetland Management Districts/National Wildlife Refuges are involved across Montana, North Dakota, South Dakota, and Minnesota with a shared goal of increasing native prairie composition. The NPAM has been operational for five years, with Service staff implementing annual management (burning, grazing, haying, and resting) and monitoring activities. Data are used to assess the predictive performance of the decision support system and to generate the next management decisions. Decision making under this framework is adaptive, as monitoring feedback increases understanding of the system and in turn determines the path of future decision making. Targeted research efforts also enhance the learning under this adaptive decision support system. There are several uncertainties that research partners including North Dakota State University, South Dakota State University and U.S. Geological Survey are helping the Service to address. Eventually information gaps that are filled from these efforts can be included in the decision support system, reducing overall uncertainty to generate better management decisions.

[R]The population genetics and competitive ability of an important invasive species in the prairies of the Great Plains; Kentucky bluegrass (*Poa pratensis*)

Lauren Dennhardt[1] *and Steven Travers*[1]*

[1]North Dakota State University, Department of Biological Sciences, Stevens Hall, Fargo, ND 58108

Kentucky bluegrass (*Poa pratensis*) is an invasive species from Eurasia introduced during early European settlement of North America. Kentucky bluegrass (KBG) has been studied extensively as an economic crop, but has had little attention from the ecological community despite its destructive potential as an invasive species. Recent studies indicate that KBG is aggressively invading and altering the character of prairie communities in North and South Dakota. We studied the genetic diversity of these populations using 10 microsatellite markers from wild populations in the Dakotas and selected cultivar KBG. Additionally, we measured genome size and estimated chromosome copy number using flow cytometry. We discovered a pattern indicating that KBG relatedness followed wind patterns in the Dakotas and wild KBG populations were not like domesticated KBG genetically. Interestingly, only two genome sizes were observed in the wild unlike the cultivars reported in the literature displaying a wide range of genome sizes. Our results have implications for management and policy decisions regarding native prairie and may provide a tool for understanding and controlling this species along with furthering the narrative of why KBG is becoming so prolific.

[R]Using prescribed fire and glyphosate to manage the invasion of native prairie by trees and shrubs, and the exotic invasive grass, smooth brome (*Bromus inermis*), in Saskatchewan

R. A. Wright[1]**, G. Longpre*[1]*, J. R. Smith*[1]*, K. Kelly*[1]*, and J. Karst*[1]

[1]Landscape Management Unit, Saskatchewan Parks Service (Canada), 3211 Albert Street, Regina, SK, Canada, S4S 5W6, rob.wright@gov.sk.ca

A long-term study was initiated in the 1990s to develop a best management practice (BMP), utilizing a combination of spring prescribed fire and early summer herbicide application, for controlling the invasion of indigenous trees and shrubs, and the exotic invasive smooth brome (SB) in three Saskatchewan Provincial Park grasslands. Several prescribed fires were undertaken between 1994 and 2012. Wicked applications of glyphosate to SB were incorporated into the experiment in 2008. Prescribed fires are successfully controlling native tree invasion and the combination of burning and glyphosate wicking is more effective for smooth brome control than either fire or glyphosate alone, but control of shrubs remains problematic. Height differentials between the SB and native plants is essential for effective, low-risk wicking but sufficient differentials may only occur early in the first summer following spring prescribed burning. Specific results include: 1) Combined burning and wicking treatments diminished the cover and reproductive potential of SB, 2) SB affected the resource partitioning among species but did not diminish native species richness, 3) the native grass Big Bluestem (*Andropogon gerardii*) appears to be dominant over SB and has promise as a biocontrol agent for SB, 4) three prescribed burns, over 15 years, were required to nearly eliminate invasive tree growth and restore the dominance of grasses and forbs.

[R]Managing crested wheatgrass within native rangelands

Paul Drayton[1]*

[1]USDA Forest Service, Grand River Ranger District, Lemmon, SD

Crested wheatgrass *{Agropyron cristatum}* was planted following the Dust Bowl of the 1930's to stabilize abandoned and blowing homestead fields. It not only stopped soils from blowing, but provided large amounts of early, high quality forage for livestock. Crested wheatgrass begins growing early in the spring, even faster than most native grasses. It also matures faster and becomes a management issue, especially when intermingled within native prairie. Crested wheatgrass becomes unpalatable and livestock consume most of their dietary needs from the surrounding native forage. This is creating range health issues on the native portion of the pastures and enabling crested wheatgrass to spread. We will take a look at how crested wheatgrass may be managed through targeted grazing, mowing/haying, prescribed burning and compressed grazing seasons. Utilizing one or a combination of these methods may prove successful in managing crested wheatgrass within native rangelands.

[R] Spring clipping, fire, and simulated increased atmospheric nitrogen deposition effects on tallgrass prairie vegetation

Alexander J. Smart[1], Tabithia K. Scott[2], Sharon A. Clay[3], David E. Clay[3], Michelle Ohrtman[4], and Eric M. Mousel[5]*

[1]Professor, Department of Natural Resource Management, SDSU, Brookings, SD 57007. [2]Soil Conservationist, USDA NRCS, Brookings, SD 57006. [3]Professor and [4]Post Doctoral Researcher, Department of Plant Sciences, SDSU, Brookings, SD 57007. [5]Extension Cow-Calf Specialist, North Central Research and Outreach Center, University of Minnesota, Grand Rapids, MN 55744

Defoliation aimed at introduced cool-season grasses, which uses similar resources of native grasses, could substantially reduce their competitiveness and improve the quality of the northern tallgrass prairie. The objective was to evaluate the use of early season clipping and fire in conjunction with simulated increased levels of atmospheric nitrogen deposition on foliar canopy cover of tallgrass prairie vegetation. This study was conducted from 2009-2012 at two locations in eastern South Dakota. Small plots arranged in a split-plot treatment design were randomized in four complete blocks on a warm-season grass interseeded and a native prairie site in east- central South Dakota. The whole plot consisted of seven treatments: annual clip, biennial clip, triennial clip, annual fire, biennial fire, triennial fire, and undefoliated control. The clip plots consisted of weekly clipping in May to simulate heavy grazing. Fire was applied in late April or early May. The subplot consisted of nitrogen applied at 0 or 15 kg • N ha-1 in early-June. All treatments were initially applied in 2009. Biennial and triennial treatments were reapplied in 2011 and 2012, respectively. Canopy cover of species/major plant functional groups was estimated in late August/early-September. Annual clipping was just as effective as annual fire in increasing native warm-season grass and decreasing introduced cool-season grass cover. Annual defoliation resulted in greater native warm-season grass cover, less introduced cool-season grass cover, and less native cool-season grass cover than biennial or triennial defoliation applications. Low levels of nitrogen did not affect native warm-season grass or introduced cool-season cover for any of the defoliation treatments, but it increased introduced cool-season grass cover in the undefoliated control at the native prairie site. This study supports the hypothesis that appropriately applied management results in consistent desired outcomes regardless of increased simulated atmospheric nitrogen depositions.

[R] Kentucky Bluegrass: A History of an invasion (A last minute addition to the program.)

Edward "Shawn" DeKeyser

Plant-soil feedback and invasive grasses

Recording not available

*Lora B. Perkins[1]**

[1]Assistant Professor, Department of Natural Resource Management, South Dakota State University, Brookings, SD

Plant-soil feedbacks occur when plants alter their soil environment in a manner that influences subsequent plant performance. Meta-analyses suggest that most plants create plant-soil feedbacks (psf) that decrease subsequent plant performance (i.e. create negative feedbacks). However some plants create positive psfs wherein subsequent plant performance is enhanced. The ability to create plant-soil feedbacks that increase conspecific performance can contribute to a plant's invasive potential and impact restoration of invaded sites.

Plant-soil feedback dynamics were investigated for *Bromus inermis*, *Poa pratensis*, *Pascopyrum smithii*, and *Elymus canadensis* in a greenhouse study. Grasses were allowed to grow in field- collected topsoil for a 'growing season' of 6 months. After the growing season, grasses were removed and the soil microbial community was quantified using phospholipid fatty acid analysis (PLFA). The soil conditioned by each species within each replicate was then homogenized and repotted.

To examine the influence of psfs on restoration, four treatments designed to remediate microbial plant-soil feedbacks were applied and bioassay species were sown. The remediation treatments include fungal or bacterial inoculum, a fungicide, and a bacteria/fungicide combination. Bioassay species were the species that initially conditioned the soil (*B. inermis*, *P. pratensis*, *P. smithii*, and *E. canadensis*), two native grasses (*Andropogon gerardii* and *Schizachyrium scoparium*), and two native forbs (*Aster ericoides* and *Echinacea angustifolia).*

The soil microbial community was significantly different and the performance of the bioassay generation was significantly different among soils conditioned by each species. However, no one remediation treatment consistently improved bioassay performance. These results suggest that plant-soil feedback may contribute to the success of *B. inermis* and *P. pratensis* and

may present a challenge during restoration. Remediation treatments may be effective, but the optimal treatment may depend on both conditioning and restoration species. Further field investigations are planned.

[R] Can leaf-level photosynthesis help explain the success of cool-season invasive grasses?

*Xuejun Dong[1], Janet Patton[2], Lianhong Gu[3], Jinzhi Wang[4] and Bob Patton[2]**

[1]Texas A&M AgriLife Research and Extension Center, Uvalde, Texas 78801 USA, [2]North Dakota State University, Central Grasslands Research Extension Center, Streeter, ND 58483 USA, [3]Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831 USA, [4]Chinese Research Academy of Environmental Sciences, No. 8 Dayangfang, Beiyuan, Chaoyang District, Beijing, 100012 China

The widespread invasion of exotic cool-season grasses, such as Kentucky bluegrass and smooth brome, in the mixed-grass rangelands is diminishing the hope of bringing back the natural native plant-dominated communities. A best management strategy for these rangelands, according to several plant community studies, is perhaps to live with these cool-season exotics to some extent while reducing their cover in favor of a diverse plant community. However, there are uncertainties for the future of these invaded rangelands as the ecophysiological mechanisms generally are lacking to explain the relative competitiveness between the native and exotic species. Our research provides a broad comparison of leaf-level photosynthesis among 26 plant species co-occurring in the mixed-grass prairie near Streeter, ND USA. The highlight is on the correlations between photosynthetic potential and plant success, with special reference to Kentucky bluegrass and smooth brome. Photosynthetic potential is defined as a composite variable summarizing the intrinsic limiting factors for photosynthesis as obtained from the net assimilation (A) vs. internal CO_2 (Ci) response curves from plants grown under well-watered greenhouse conditions. Plant success was defined as the average frequency measured over 25 years (1988-2012) in the over-flow ecological sites across five levels (no-grazing, moderate, light, heavy and extremely heavy) of grazing intensity. The correlation between photosynthetic potential and plant frequency was negative ($n=26$ species, $p<0.05$), suggesting that the two cool- season grasses, Kentucky bluegrass and smooth brome, do not rely on their superior leaf-level photosynthesis for competitive success. Instead, some other traits, such as early and prolonged growth, may be more important for them to gain dominance in the mixed-grass prairie. This is compatible with the management suggestions provided by plant community-based studies for controlling exotic grass dominance and encouraging plant diversity through proper use of early-season grazing and fire.

Evaluation of annual grass control in range, pasture, and roadsides with herbicides in Colorado, Wyoming, and South Dakota from 2006 through 2012

Recording not available

*Jim Daniel[1]**

[1]Agricultural R& D Consultant, Keenesburg, CO

Thirty-three trials were conducted across Colorado, Wyoming, and South Dakota to evaluate and demonstrate control of annual grasses with herbicides in range, pastures, and roadsides. Trials were conducted from 2006 through 2012. Fourteen of the trials were replicated, small plot experiments with three replications. Plots were 10 feet wide by 25 to 30 feet long. Applications were made with CO_2 powered backpack sprayer delivering 15 gallons per acre. The remaining trials were non-replicated demonstrations ranging in size from 20 X 50 feet to 5 acres. Application timings ranged from early fall to late spring. The primary grass target was downy brome, *Bromus tectorum* L. In addition, Japanese brome, *Bromus japonicus* Thunb., bulbous bluegrass, *Poa bulbosa* L., jointed goatgrass, *Aegilops cylindrica* Host, and annual wheatgrass, *Eremopyrum triticeum* (Garertn.) Neuski. was also evaluated.

Primarily, three herbicides, LANDMARK XP, sulfometuron methyl 50% + chlorosulfuron 25%, MATRIX SG, rimsulfuron 25%, and PLATEAU Herbicide, imazapic 25% were evaluated. Across all locations and seasons, both LANDMARK XP and MATRIX SG provided excellent annual grasses control. It was determined that in most cases, the optimum rate of LANDMARK XP was 1.0 to 1.25 oz product per acre and of MATRIX SG was 3 oz product per acre.

[R] Effects of burn frequency and grazing on the abundance and distribution of invasive and native cool-season grasses.

*Greg Hoch[1]**

[1]MN Department of Natural Resources, 35365 800th Av, Madelia MN 56062, Greg.hoch@state.mn.us

Konza Prairie Biological Station is located in the north of the Flint Hills region of Kansas and is one of the original eight sites of the National Science Foundation's Long-Term Ecological Research (LTER) program. Although further to the south, there is a high degree of overlap in both native and invasive grassland species with the Northern Great Plains. I selected ten years of data from 1998 to 2007 from the database and extracted three invasive and six native cool-season grasses that are also found in North Dakota and that have high, medium, and low Coefficent of Conservatism in North Dakota. Transects are located in upland and lowland soils, grazed and ungrazed watersheds, and watersheds are burned annually, biennially, quadrennially, and unburned. Plant species are annually surveyed in five 10 square meter plots along eight transects within each watershed and assigned Daubenmire cover classes. *Dicanthelium oligosanthes*, *Koeleria macrocantha*, and *Poa pratensis* were the most common species across all management treatments. *Bromus inermis* and *B. japonicus* as well as the annual native species were most common in the grazed watersheds. Annual spring burning had the lowest cover of all cool- season species, summer burns the highest occurrences of cool-season species, with fall burns intermediate between them. Species had varying levels of inter-annual variability in their abundance.

[R]Evaluating the effects of different timings of prescribed fire on rangeland invaded with mKentucky bluegrass in east-central North Dakota

Amy Ganguli[1], Kevin Sedivec[2], Dennis Whitted[2], Jim Bennington[3], and Kent Belland[3]*

[1]New Mexico State University, Las Cruces, NM, [2]North Dakota State University, Fargo, ND, [3]North Dakota National Guard, Devils Lake, ND.

The objectives of the study were to determine the effects of different seasons of prescribed fire on 1) Kentucky bluegrass (Poa pratensis) abundance within a diverse rangeland plant community and 2) abundance of native plants associated within a mixed grass prairie community. The study site was located on rangeland within the Gilbert C. Camp Grafton – South Unit near McHenry, ND on a mixed-grass prairie plant community. The area is dominated with sandy soils and classified as thin sands, sandy and sandy overflow ecological sites; depending on topographic position within the landscape. The area is a military training base used for training soldiers, with most common disturbances foot traffic, bivouacking, and some off-road vehicle driving. The area was grazed with cattle for over 100 years and sheep the past 10 years at a moderate stocking rate (35 to 55 % degree of disappearance). The study area was located on a fairly level to gently rolling sandy site and fenced to eliminate grazing and enhance the build-up of litter in August 2010, and pre-data collected prior to the burns in 2011. Prescribed burning treatments were conducted in 2011 and included spring (early June), summer (mid-July) and fall (mid- September) burns. The study design was a randomized block design with four replicate using a one-time burn and no grazing prior to or after the burn. Data was analyzed using PC-ORD to determine Pearson and Kendall correlations. A permutation-based nonparametric MANOVA was performed to test for differences ($P<0.05$).

There was a significant difference between burn treatments ($P=0.0008$) and dates ($P=0.0002$); however, no treatment by date interaction ($P=0.114$) occurred. The treatment effect was driven by the control, with no difference ($P>0.05$) among the three seasons of prescribed fire; however, all three seasons were different ($P<0.05$) than the control. Fire, irrelevant of season, had the greatest negative impact on Kentucky bluegrass ($r = -0.767$) and dandelion (Taraxacum officinale, $r = -0.264$). Fire had a positive impact on blue grama (Bouteloua gracilis, $r = 0.763$), needlegrass (Heterostipa) species (needle-and-thread and porcupinegrass, $r = 0.603$), and prairie sandreed (Calamovilfa longifolia, $r = 0.204$). Kentucky bluegrass cover declined 91.0, 80.1, and 79.7 percent 12 months after treatment (MAT) on the spring, summer and fall burns; respectively. However, 24 MAT Kentucky bluegrass returned to pre-treatment levels on the spring burn while maintaining a reduction of 27.1 and 35.7 percent cover on the summer and fall burn; respectively.

In contrast, prairie sandreed increased from no cover to 5.8, 5.3 and 3.8 percent cover on the spring, summer and fall burn treatments 12 MAT; respectively. Even more impressive, prairie sandreed cover increased to 22.0, 13.4 and 6.8 percent on the spring, summer and fall burns 24 MAT; respectively. Blue grama also responded positively to the fire treatments, but only 12 MAT. Blue grama cover was less than 0.5 percent on the control during all years and on all burn treatments pre-burn. Canopy cover increased to 3.3, 11.6, and 14.4 percent on the spring, summer and fall burn treatments 12 MAT; respectively. Blue grama returned to pre-treatment levels 24 MAT. Lastly, the canopy cover of needlegrass species were similar for all years of the study on the control; however, increased by 36.9 and 106.1 on the summer and fall burns 12 MAT; respectively. The spring burn decreased cover of the needlegrass species 29.8 percent 12 MAT. Canopy cover of the needlegrass species increased 80.5, 139.2, 113.2 percent on the spring, summer and fall burns 24 MAT; respectively.

In summary, prescribed burn in the spring, summer and fall negatively impacted Kentucky bluegrass in a native plant community that was left idle for 12 months (one growing season). This impact is likely due to the increased litter build-up that created very high temperatures within the burn, impacting the new green growth. Native species such as prairie sandreed and needlegrass species were positively impacted by the fire, irrelevant of burn season, 24 MAT. Blue grama also had a positive response to the three fire seasons, but only for 12 MAT.

[R]**Early intensive grazing research in the Missouri Coteau Region**

Bob Patton1, Bryan Neville1 and Anne Nyren1*

1Central Grasslands Research Extension Center, NDSU, Streeter, ND

Early season intensive grazing is being tested as a means to control Kentucky bluegrass (*Poa pratensis* L.), an invasive grass species. Removing cattle before native grasses and forbs have received much grazing pressure should allow these species to increase in the community. After three years, initial results indicate that early grazing can reduce Kentucky bluegrass aerial cover and frequency.

Each of six pastures is assigned to one of two grazing treatments: early intensive and season - long. On the early intensive treatment, cattle are stocked as early as possible after Kentucky bluegrass greens up (as early as mid-April), ideally prior to the three-leaf stage, and removed when 30 percent of the native species have received some grazing. On the season-long treatment, cattle are placed on pasture in mid-May and removed in mid-September. The objective is to achieve a similar over-all grazing pressure on the early intensive treatment as on the season-long but in a shorter period of time.

Changes in the plant community are monitored by sampling frequency, density and aerial cover of the approximately 97 plant species using nested frames along a transect, with 50 readings per pasture. Forage production and utilization are determined using the cage comparison method, clipping three times per season. While clipping plots at peak production, an estimate is made of species percentage by weight. All samples are oven-dried and weighed.

Forage production was not significantly different between the early intensive and the season-long grazing treatments in 2011, 2012 or 2013 (P>0.05). During this period, aerial cover (P=0.001) and frequency of occurrence (P=0.003) of Kentucky bluegrass declined on the early intensive treatment, while aerial cover increased on the season-long treatment.

Bud bank reduction: a new ecological approach for controlling smooth brome (*Bromus inermis*)

Recording not available

Lan Xu[1], Haiming Kan[1], and John Hendrickson[2]*

[1]Department of Natural Resources Management, South Dakota State University, Brookings, SD. [2]USDA-ARS Northern Great Plains Research Laboratory, Mandan, ND

Intended as a foraging grass for North America, smooth brome has invaded the Northern Great Plains and is threatening native prairie species and wildlife habitats. Traditional control methods have proven minimal or short-term effects, because they focused on killing the invasive species rather than to the underlying mechanisms driving invasion and persistence in response to control managements. Since bud bank serves as a reservoir for recruitment of future aboveground tillers, bud bank reduction represents the most appropriate criterion to measure the level of control. Our objective was to investigate the effects of simulated grazing (mowing) on smooth brome bud bank dynamics in southeast of South Dakota. The experiment was a complete random block design with 3 mowing treatments including mowing once, twice and three times after the last elongated node reached mowing height plus a control. Each treatment had 4 replications. Tiller density of smooth brome within two 0.1m2 subplots was recorded before treatment and every 3- week after each treatment. Three tillers were randomly selected from each treatment plot and excavated to determine the number of crown positions and buds, and bud viability. At the end of the growing season, compared to control, all mowing treatments reduced the number of crown positions per tiller from 17% to 28%, total number of buds from 43% to 66%, bud density (# buds/m2) by 65% to 88%, and tiller density (# tillers/m2) by 40% to 65% as the mowing frequency increased. All mowing treatments increased percent of active buds and outgrowth tiller to bud ratio, and decreased percent of dormant buds. However, these differences were not observed in the following year without treatment. These results suggest that mowing at the optimal growth stage can effectively hinder bud formation, tiller recruitment, and reduce existing bud banks, but the treatments need to be repeated the following year or beyond for the long-term effectiveness.

[R]**Potential management of Kentucky bluegrass (*Poa pratensis*) on native prairies in the Northern Great Plains**

Jonathan Quast[1], Shawn DeKeyser[1], Cami Dixon[2]*

[1]North Dakota State University/Fargo, ND, [2]U.S. Fish and Wildlife Service/Woodworth,

ND Kentucky bluegrass (*Poa pratensis*) and other invasive perennial grasses such as smooth brome (*Bromus inermis*) have invaded thousands of rangeland hectares in the Northern Great Plains. Historic management such as prolonged idleness and intermittent grazing and fire has proved ineffective at reducing Kentucky bluegrass invasion, thus changing the prairie from a heterogeneous to a homogeneous landscape resulting in losses of diversity and richness on native prairie. The influence of Kentucky bluegrass management efforts towards maintaining diversity are addressed by studying the traditional as well as novel techniques used by federal, state, private, and non-profit land managers. Techniques used include grazing, fire and rest with variation to the timing and intensity regimes. Thirty-seven study sites were located across North and South Dakota covering four different major land resource areas. Plant community sampling was conducted in 2012 and 2013 using modified Whittaker plots to detect species richness and diversity within loamy ecological sites. Statistical analysis revealed species diversity responses to management techniques, and landscape level patterns in species and community characteristics. 11 sites saw a significant decrease (p value < 0.05) in Kentucky bluegrass cover, 14 sites saw a significant increase while 12 sites saw no significant change. Species diversity responded positively to multiple disturbances and started showing sign of regression with no disturbance. Precipitation, a large contributing factor to plant communities was significantly different between sampling seasons and may have affected the results of our study. Early spring grazing may be the most effective management action especially when combined with burning to allow effective use of emerging invasive grasses, as well as implementing continued disturbance may possibly reduce Kentucky bluegrass cover to an acceptable level.

[R] **Kentucky bluegrass invasion: mismatches between socio-economic and biological thresholds**

David Toledo[1], Matt Sanderson[1], John Hendrickson[1]*

[1]USDA-ARS Northern Great Plains Research Laboratory, Mandan ND

Observations of plant diversity and Kentucky bluegrass invasion patterns show an alarming increase in cover of invasive species with a related decline in plant diversity. These changing vegetation patterns are altering key ecosystem processes important to their productivity, structure, and function, driving change and potentially threatening human well-being. Many landowners and land managers at the local scale are experiencing dramatic changes due to Kentucky bluegrass invasion and there are lags and mismatches between how ecosystem degradation is perceived and how it is actually occurring. There are also mismatches in the scale at which we measure and manage ecosystems and the scale at which ecosystems function. A critical constraint in addressing these mismatches is the lack of information describing the complex interactions between the increase in Kentucky bluegrass, Kentucky bluegrass biology and control methods, and the social and economic factors affecting decision-making in the Great Plains Region of the USA. We used data available from the literature and from ongoing studies at the USDA-ARS NGPRL to develop a dynamic simulation model to test different socio- economic and biological scenarios. This model will help provide some better insight into how to address existing mismatches. Our goal is for this to be an interactive presentation where we present the current model and gather participant input on model function and the parameters used to create the model.

GETTING HELP

The Great Plains Fire Science Exchange is dedicated to working with partners to share fire science research focused on grasslands of the region. You can find more resources on our website, The Great Plains Fire Science Exchange has resources on fire, fire effects, monitoring, and more at http://GPFireScience.org. We can also locate experts to address your fuels questions.