Reassessing Impacts of Kentucky Bluegrass on Prairie Plant Communities

Chris Helzer, The Nature Conservancy

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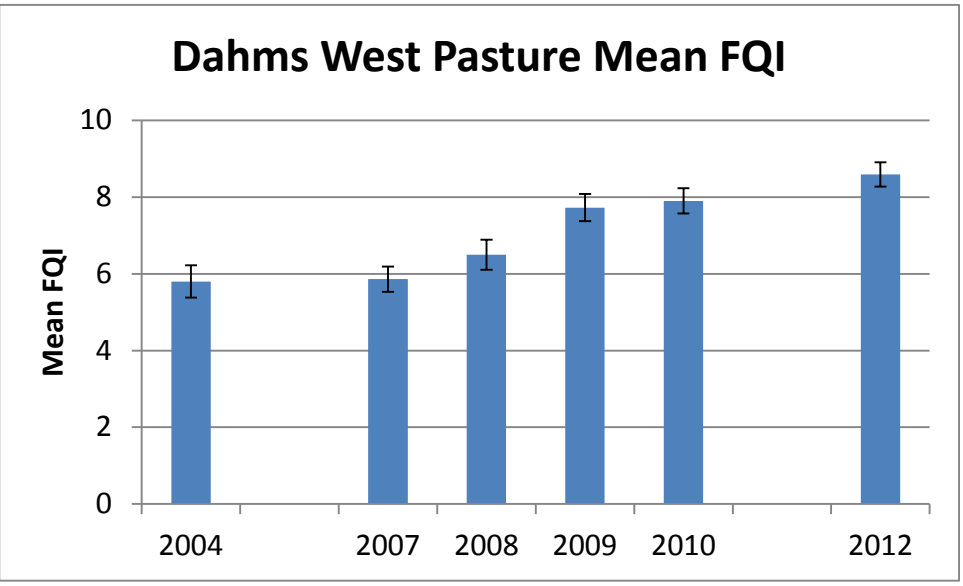
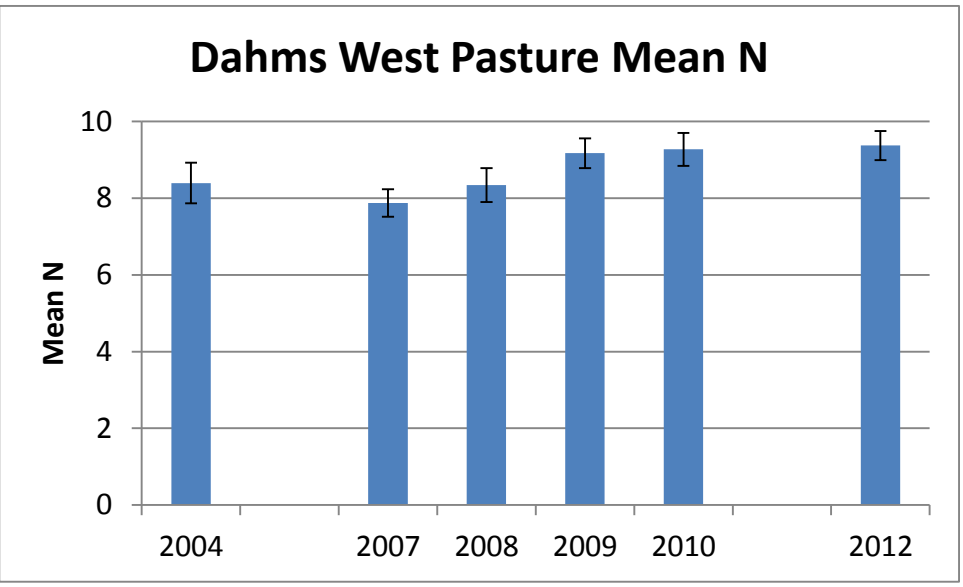
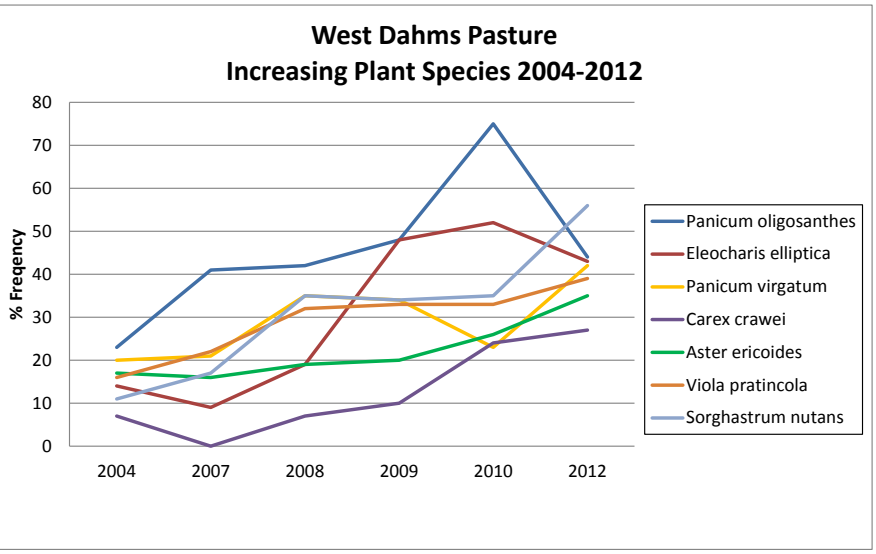
Degraded prairies are often characterized by low plant diversity and a few dominant plant species. In northern tallgrass and mixed-grass prairies, those dominant species are usually invasive cool-season grasses such as Kentucky bluegrass and smooth brome. Increasing the plant diversity within those degraded prairies is a priority for many land managers. When controlling many invasive species, it's relatively easy to measure changes in the number of invasive plants or the size of patches occupied by those plants. However, with pervasive species like Kentucky bluegrass, that kind of measurement is much more difficult. In that case, it's more important to focus on the larger goal of plant diversity, rather than trying to quantify changes in bluegrass cover or frequency. Recently, I analyzed some long-term plant community data I've collected from our Platte River Prairies in Nebraska. The results show that our fire and grazing management appears to be increasing and/or maintaining plant diversity. This comes in spite of the fact that Kentucky bluegrass is just as abundant and widespread as ever.



To the left are two graphs of data collected from a native degraded prairie along the Platte River. Mean floristic quality has been increasing between 2004 and 2012. This is calculated from the average floristic quality of about 100 1m^2 plots per year - see the Methods Section at the end of this document for details.



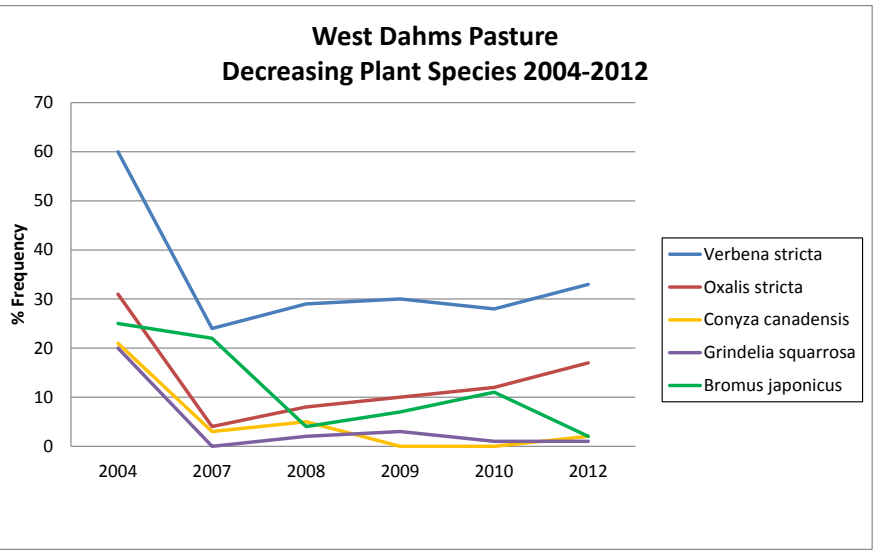
Interestingly, the mean number of plant species per plot actually decreased between 2004 and 2007, before rising again and leveling off during 2009-2012. Species richness is one of two factors that influences floristic quality (the other is the mean Coefficient of Conservatism value – or c-value). The graphs on the next page show some of the individual plant species responsible for the increase in small-scale plant species richness.



This graph (left) shows plant species that have been steadily increasing in frequency within 1m^2 plots. Most have fairly high c-values.

The species and their c-values are as follows:

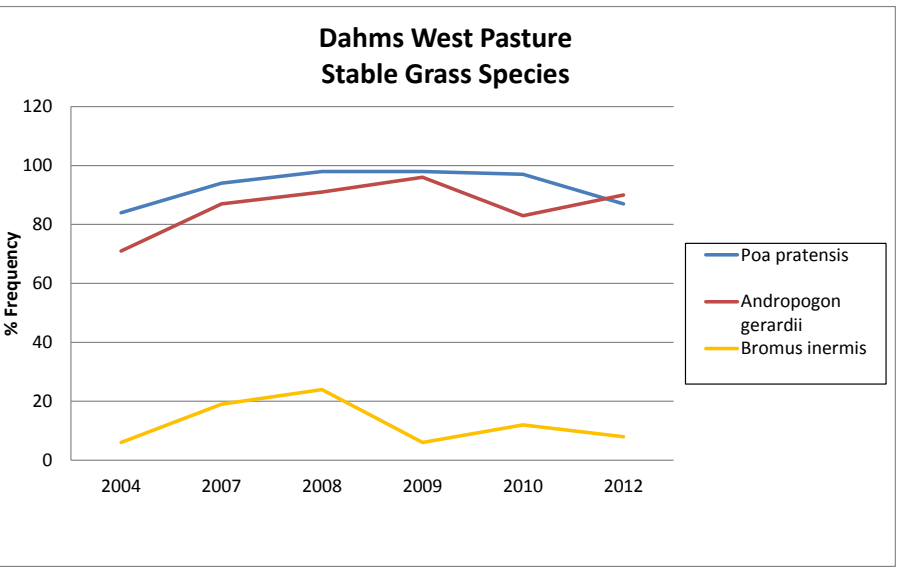
P. oligosanthes (Scribner's Panicum) = 4
E. elliptica (northern spikerush) = 7
P. virgatum (switchgrass) = 4
C. craweii (Crawe's sedge) = 6
A. ericoides (heath aster) = 3
V. pratincola (blue violet) = 1
S. nutans (indiangrass) = 5



2004 was in the midst of a multiyear drought, but 2007-2010 had fairly normal precipitation. This graph shows a few "colonizing" plant species that were abundant in 2004 but declined quickly after the drought. Those species were largely responsible for the overall decrease in mean species richness between 2004 and 2007. However, as these low c-value plants decreased in abundance after the drought, higher c-value species were increasing with higher rainfall.

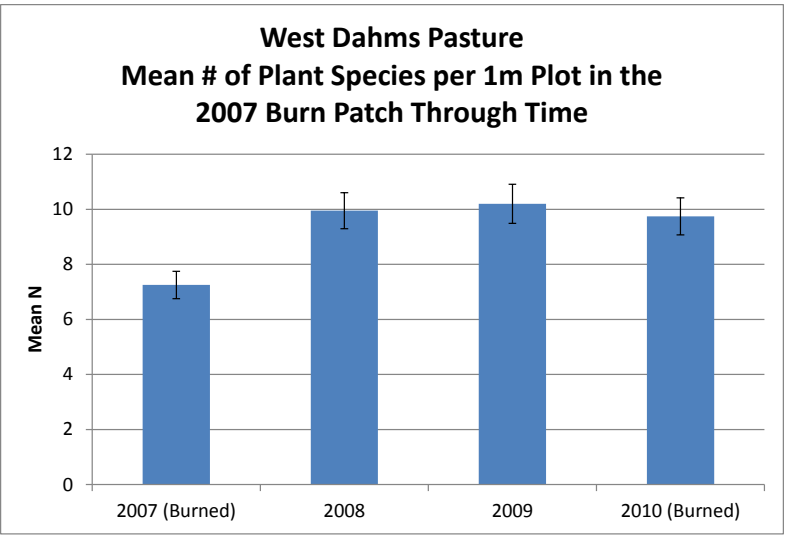
Species (and c-values) are:

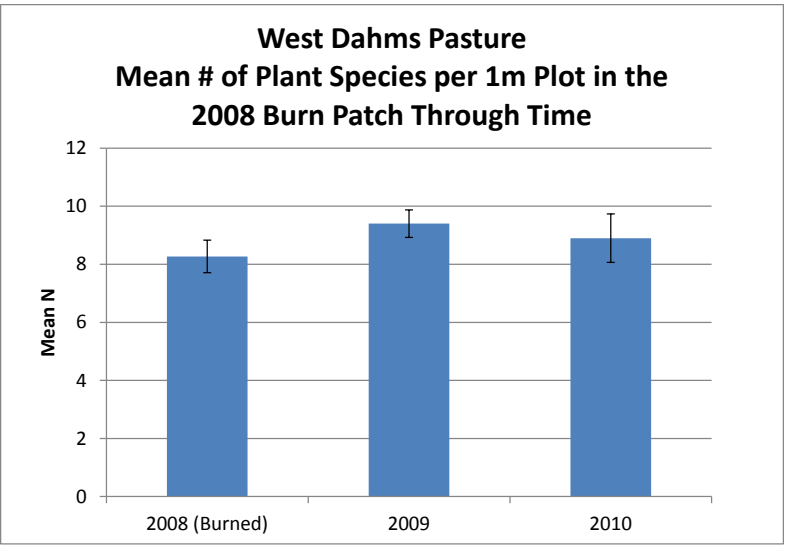
V. stricta (hoary vervain) = 1
O. stricta (yellow woodsorrel) = 1
C. canadensis (marestail) = 0
G. squarrosa (gumweed) = 0
B. japonicus (annual brome) = 0



Despite the above examples, many other plant species have remained relatively stable in abundance over time. Those include three dominant perennial grass species, which were slightly depressed in frequency during the drought, but have otherwise maintained a steady level since – at least at the 1m^2 plot scale. These species are:

P. pratensis (Kentucky bluegrass)
A. gerardii (big bluestem)
B. inermis (smooth brome)

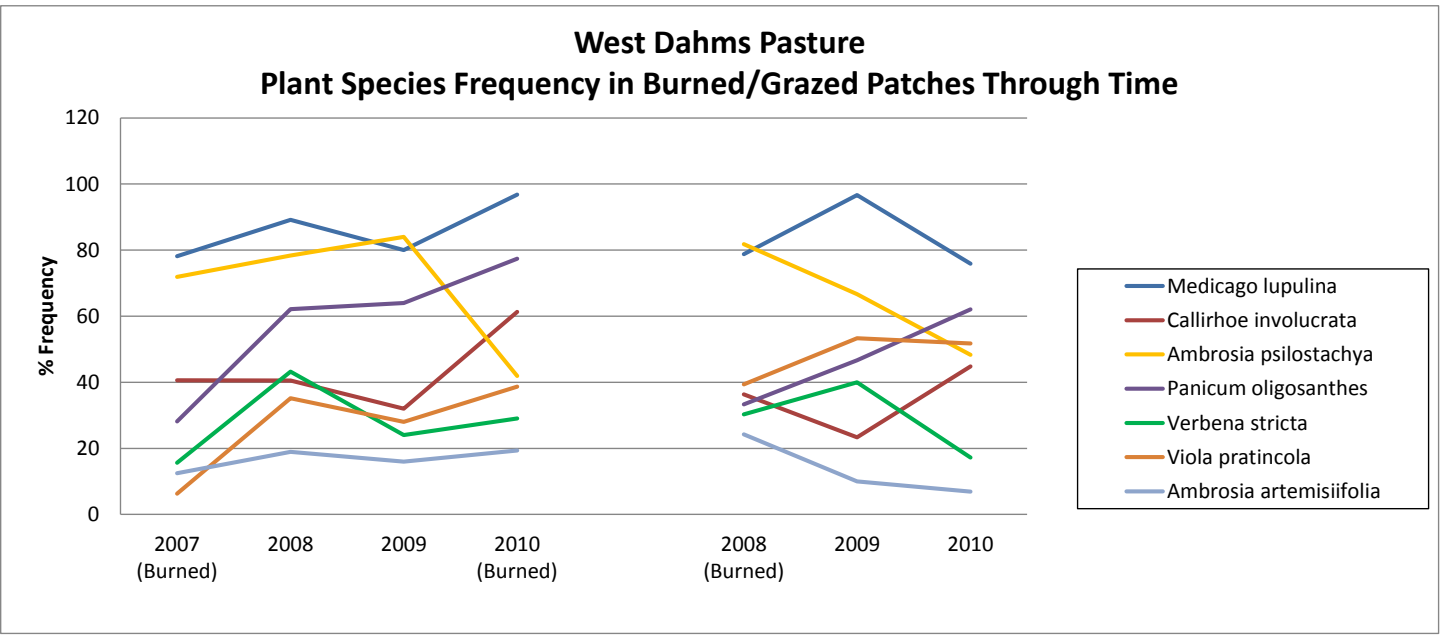




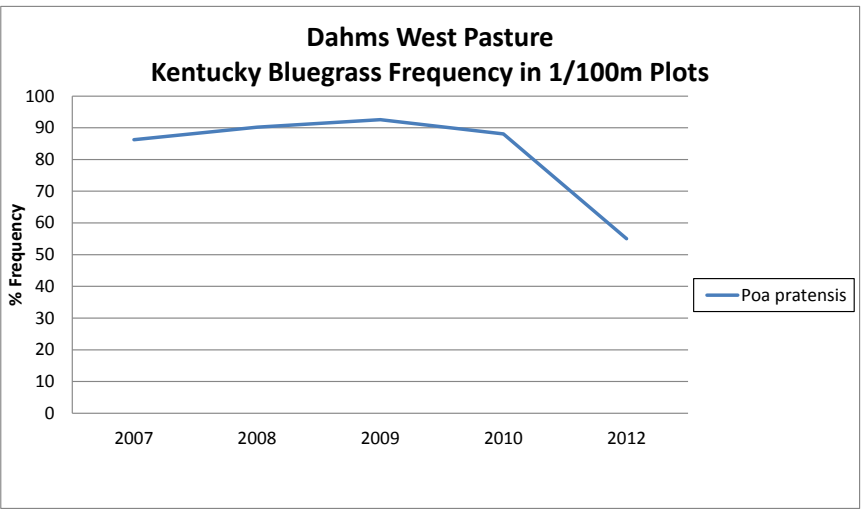
Our patch-burn grazing management entails burning a portion of the pasture each year (roughly 1/3). The burned patch is grazed intensively in the first season after the fire and then progressively less intensively over the next couple of years until the vigor of the vegetation recovers sufficiently to allow another prescribed fire.

In two particular burn patches from 2007 and 2008 (left) we observed substantial increases in plant species richness in the year following the burn – a pattern that is consistent with observations from other pastures. We have hypothesized that the increased plant species richness is a result of grass vigor being suppressed enough to allow plant species to encroach upon territory held by those grasses.

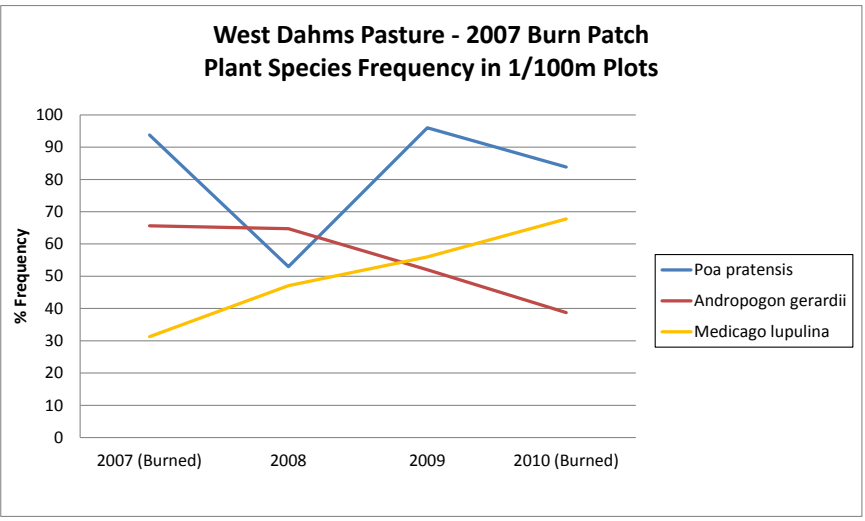
The graph below shows the response in frequency of various plant species to the fire/grazing/rest regime. The response pattern (of these and other species) shows that most individual species don't respond predictably to our management treatments. However, there is an overall increase in plant species richness following a season of fire and grazing.



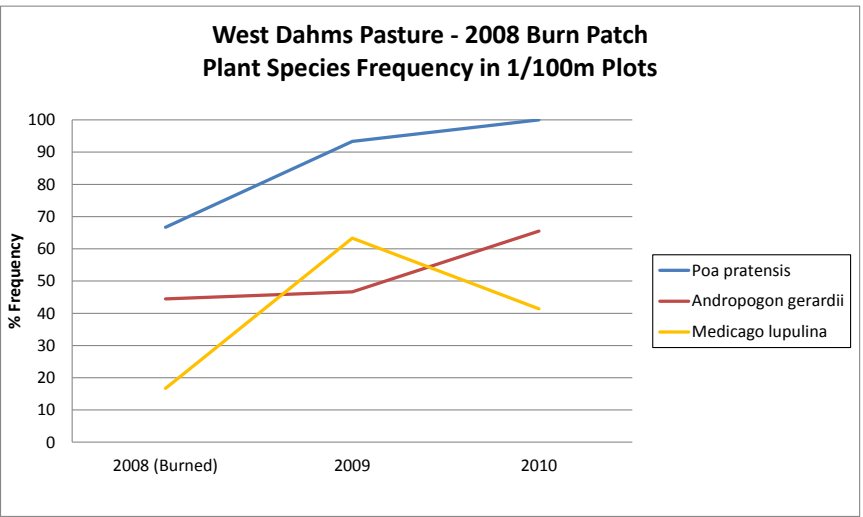
One might assume that increased plant diversity would be correlated with a decrease in the footprint of Kentucky bluegrass. However, at the 1m^2 scale, we've not seen any decrease in its frequency over time. Between 2007 through 2012, I collected data on plant species frequency at the 1/100m^2 scale as well, allowing me to more easily see changes in the frequency of very abundant plant species such as Kentucky bluegrass. The top graph below shows the frequency of bluegrass over time within those tiny plots.



Interestingly, the frequency of bluegrass did not go down while mean species richness and floristic quality were increasing. There was a big drop between 2010 and 2012, but that was likely due to the extremely warm and dry winter and spring this year, rather than any response to management. During the rest of the time period, Kentucky bluegrass seemed to maintain its same footprint even while mean species richness and floristic quality increased.

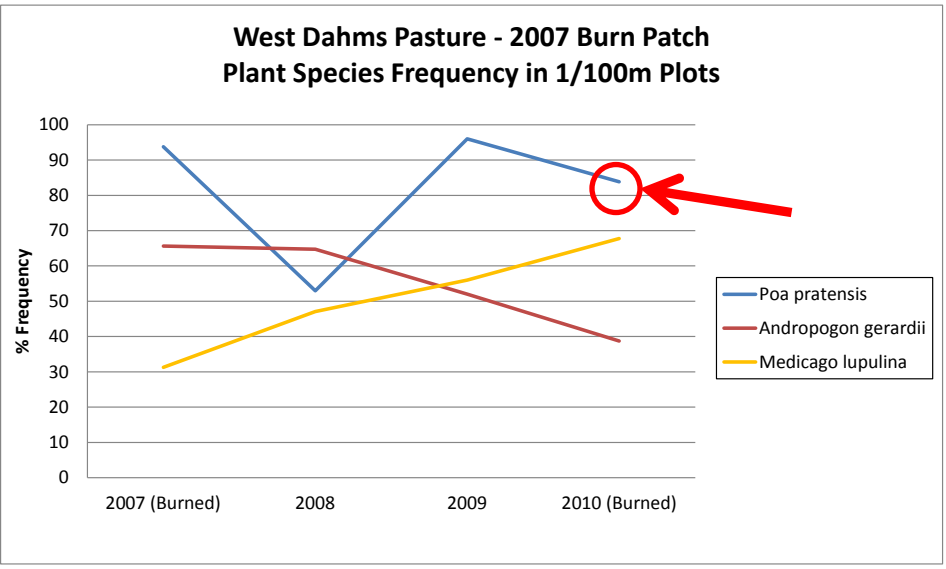


The two graphs on the left show the frequency of bluegrass (*Poa pratensis*), along with big bluestem and black medic, in 1/100 m^2 plots over time within the same individual burn patches shown earlier. The 2007 burn was in the late spring, and the 2008 and 2010 burns were both in mid-March. All three were followed by intensive grazing.



The changes in bluegrass frequency (measured in June) don't seem to track consistently with those management , and any impacts from management were apparently temporary at best. These data make it appear that measuring bluegrass density/frequency is not a good way to measure success, assuming increased plant diversity is the real goal.

While floristic quality and species richness of the West Dahms Pasture has increased since 2004, most of the increasing plant diversity appears to be the result of higher frequencies of native grasses and a few forb species. If we're only going to be successful at increasing the species diversity of grasses across this degraded prairie, we're going to hit a ceiling in floristic quality pretty soon, and we'll not get many of the advantages of higher plant diversity that more forb richness would bring – e.g., benefits to pollinators. However, it's likely that we're only seeing increasing in species that are already present and poised to spread when given an opportunity. Many forb species are so rare (or absent) in this and other prairies that population increases will be very slow.



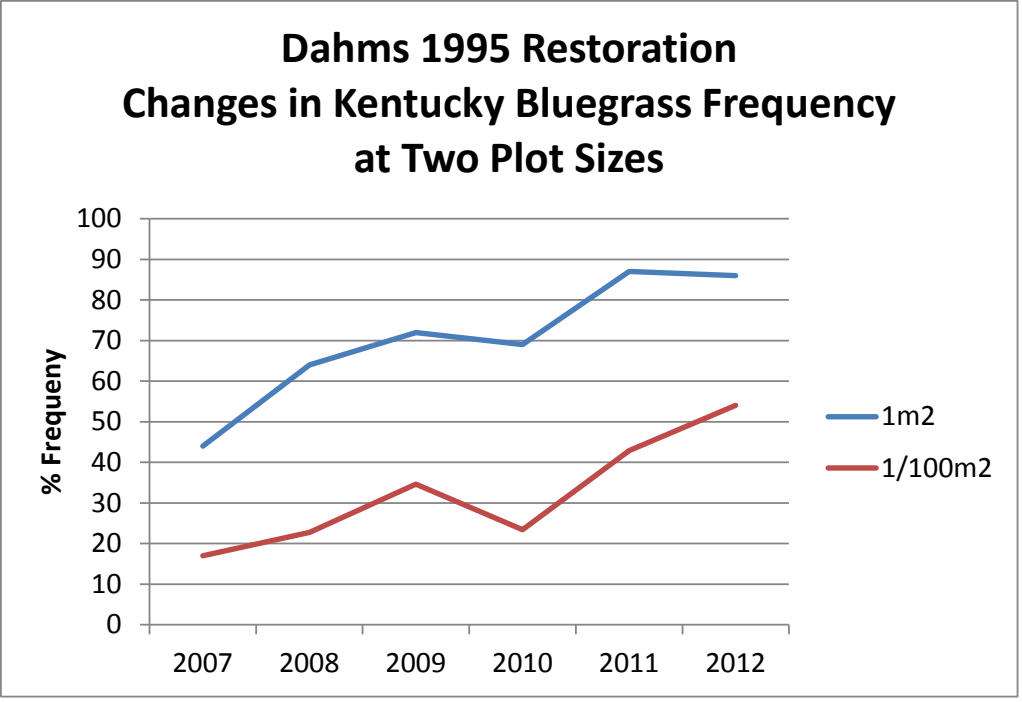
In order to speed up recovery of plant diversity, we've been overseeding portions of this prairie with rare or missing forb species. We broadcast seeds of these species immediately after spring fires, right before cattle start grazing those same areas. One overseeding effort took place in the spring of 2010. In the graph to the left, you can see that in June of 2010, Kentucky bluegrass was found in about 85% of 1/100 m^2 plots in that burned area. (It was actually found in 100% of 1/10 m^2 plots.) That's a lot of bluegrass.

West Dahms Pasture - 2010 Overseed Plot Results

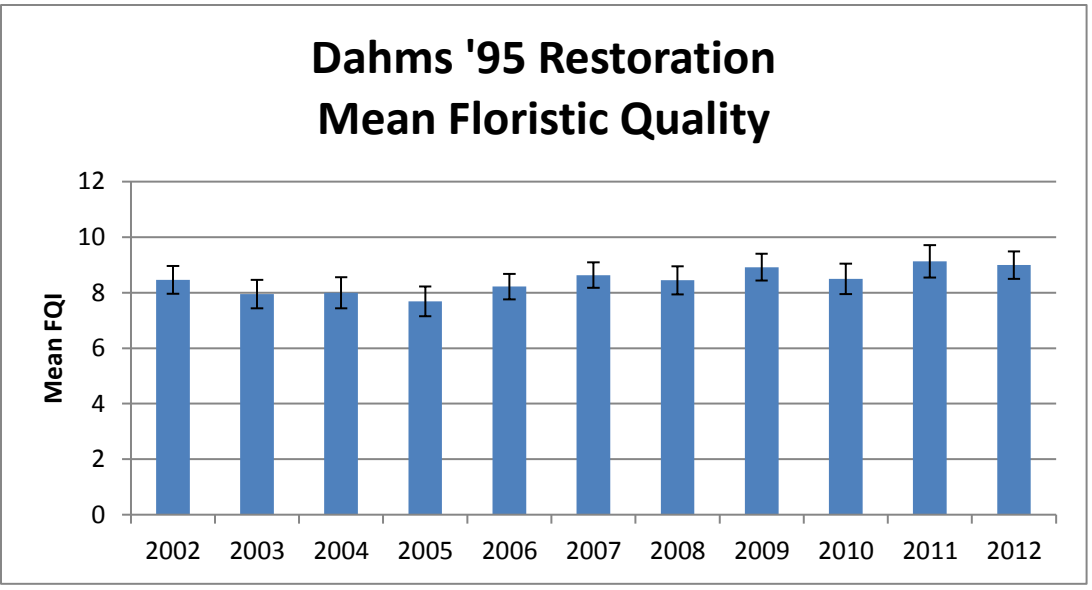
	2011 Data			2012 Data		
	0 gals	**4 gals**	**8 gals**	**0 gals**	**4 gals**	**8 gals**
Illinois Bundleflower	7	14	48		21	37
Black-eyed Susan	3	36	18		21	34
Bergamot		8	14		27	61
Maximilian Sunflower	1	11	24		21	27
Purple Prairie Clover	1	3	6	1	7	15
White Prairie Clover	7	13	3		1	7
Foxtail Dalea			2			
Rosinweed		1	5		8	28
Stiff Sunflower		3	2		3	1
Canada Milkvetch		1	1			5
Illinois Tickclover			1			1
Stiff Goldenrod			6	6		10
False Sunflower						2
New England Aster		1				

However, even with that high abundance of Kentucky bluegrass, we saw reasonably good establishment of seeded forbs. The table at left shows results of plant counts from 2011 and 2012 from areas seeded in 2010. The numbers represent the total number of plants in three 100m x 2m transects. We were testing the importance of seeding rate, so the three columns of data for each year represent seeding rates of 0, 4, and 8 gallons of rough-cleaned seed per acre.

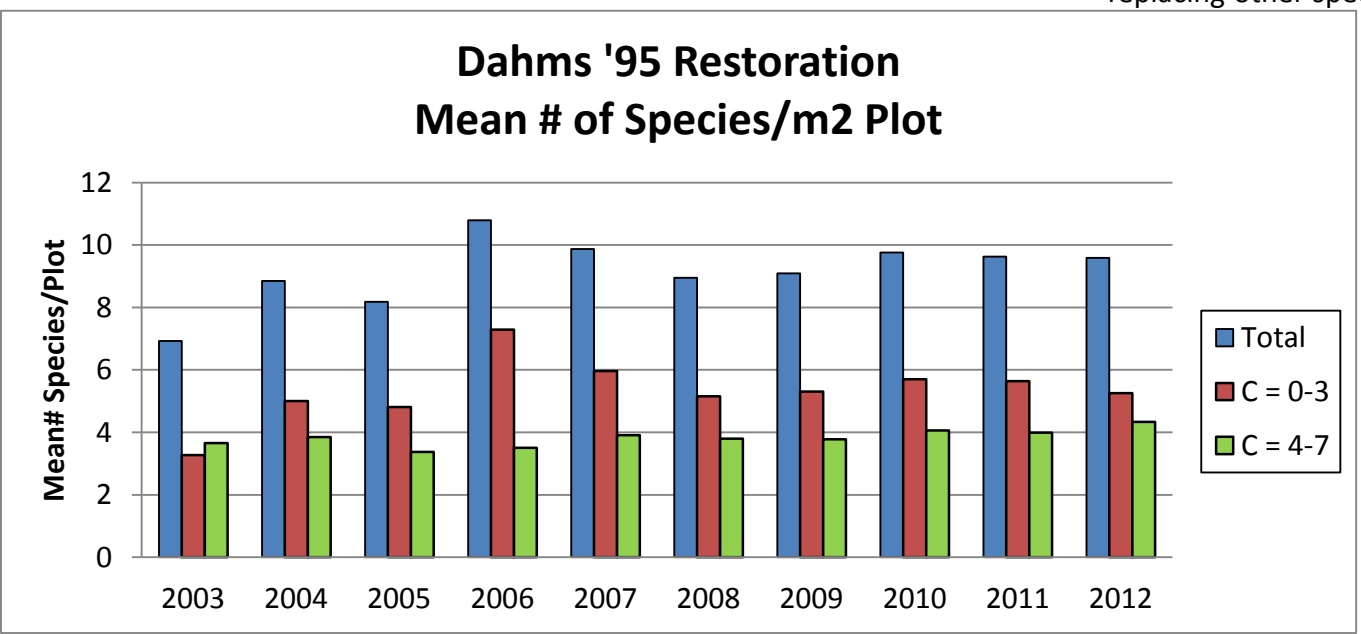
It appears that new plants are able to establish and survive in the midst of a pervasive, but weakened, population of Kentucky bluegrass. Previous studies (not shown here) we've done have shown very low establishment rates without fire and/or grazing to suppress bluegrass competition.



Data from a high-diversity prairie restoration seeded in 1995 provide even more into the interaction between Kentucky bluegrass and prairie plant communities: Between 2002 and 2011, the prairie was managed with patch-burn grazing, and Kentucky bluegrass increased in frequency from almost nothing to 87% of $1m^2$ plots and 54% of $1/100m^2$ plots. The graph to the left shows the last 6 years of that increase.

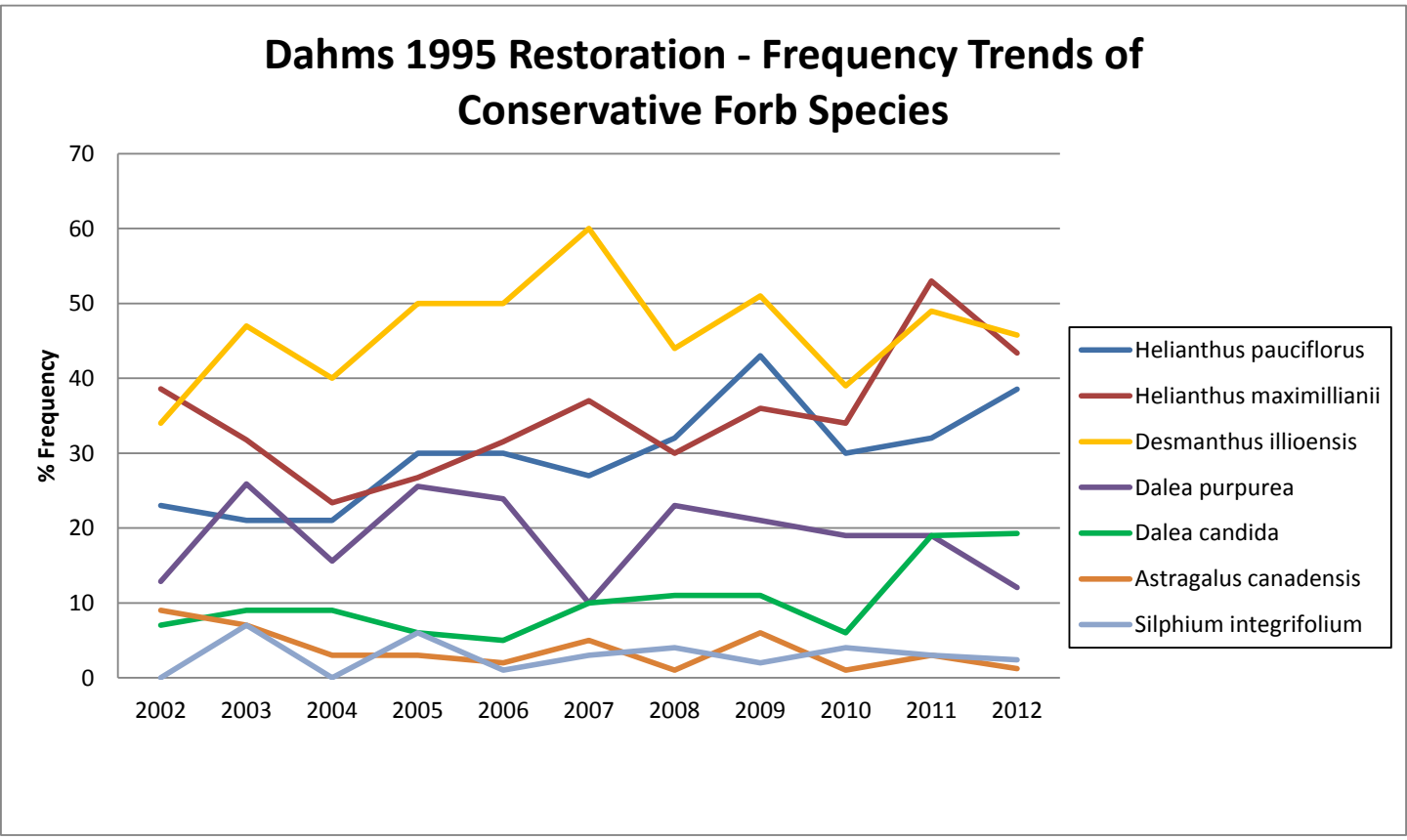


However, over the same period, mean floristic quality has not changed, and the mean number of plant species per square meter has also been fairly consistent, especially among higher c-value species. Is this because frequency isn't yet high enough to impact the community? Or is the bluegrass just adding itself to the plant community without replacing other species?



Not only has the overall mean species richness stayed the same within the Dahms 1995 prairie restoration, the frequency of individual conservative forbs has also been stable over time. Below is a graph showing the frequency of seven forb species within $1m^2$ plots between 2002 and 2012.

The species and their c-values are as follows:
H. pauciflorus (stiff sunflower) = 5
H. maximilianii (Maximilian sunflower) = 4
D. illioensis (Illinois bundleflower) = 4
D. purpurea (purple prairie clover) = 6
D. candida (white prairie clover) = 6
A. canadensis (Canada milkvetch) = 5
S. integrifolium (rosinweed) = 4



Summary and Implications

Kentucky bluegrass is a pervasive invader in many prairies that have been degraded by years of overgrazing and/or broadcast herbicide application. Increasing plant diversity in these prairies can seem like a daunting task, but appears to be possible. The key is to measure success of restoration and management efforts by focusing on plant diversity rather than worrying about how much area bluegrass occupies. It may be difficult to see changes in the abundance/dominance/cover of Kentucky bluegrass, but higher species richness and floristic quality – especially at small scales – is the more important measure anyway.

Methods

These data were collected from The Nature Conservancy's Platte River Prairies, a collection of remnant and restored prairies along the Central Platte River in Nebraska. The sites included here are all located about 6 miles south of Wood River, Nebraska. Prairie communities sampled were lowland tallgrass prairie (wet-mesic to mesic grasslands) on alluvial soils - mostly sandy loam over sand.

*The data in this report were collected with nested frequency plots, randomly stratified across sites. Data collection occurred between late May and late June each year, and consisted of listing the plant species found within nested plots of 1/100*m^2*, 1/10*m^2 *and 1*m^2 *in size. Typically, 100 nested plots were used for each prairie being sampled. Data from individual burn patches were collected from approximately 30 plots (1/3 of the total site) each year.*

*Once the data are collected, floristic quality is calculated for each 1*m^2 *plot, following Swink and Wilhelm (1994). This produces a floristic quality value for each plot, which can be averaged across the site to create mean values, with standard deviations, for each prairie. The mean N (number of species) per plot is also averaged across the site with standard deviations.*

Literature Cited

Swink, F. and G. Wilhelm (1994). Plants of the Chicago Region, 4th ed., Indiana Academy of Science, Indianapolis, 921 pp.