Patch-Burn Grazing for Biological Diversity

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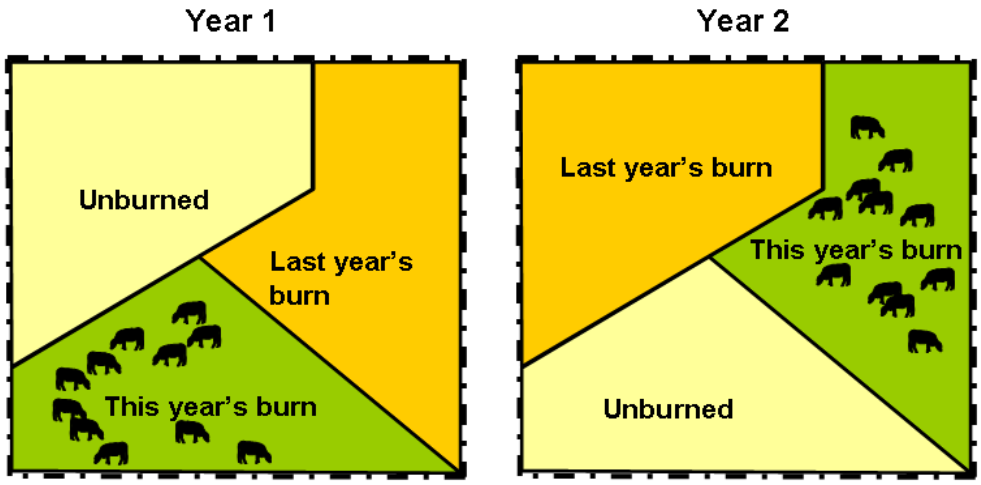
By Chris Helzer
The Nature Conservancy – Nebraska

INTRODUCTION

Patch-burn grazing is a grassland management strategy in which a portion of prairie is burned to attract grazing animals. Those animals concentrate their grazing in that burned "patch" even though they have access to the entire prairie. As new patches are burned, grazers shift their grazing to the most recent burned patch, allowing previously-burned patches to recover (Figure 1). Today's methods evolved from early efforts by The Nature Conservancy and others to manage large grasslands with a combination of prescribed fire and bison grazing. The bison in those grasslands showed strong grazing preference for grasses (as opposed to forbs, aka wildflowers), and that selective grazing led to increases in plant diversity in recently grazed portions of those grasslands.

Figure 1. The Basic Patch-Burn Grazing Model. Cattle concentrate their grazing within the most recently-burned patch, even though they have access to the entire prairie. When a new patch is burned, cattle shift their grazing to that patch, allowing older burned areas to recover.



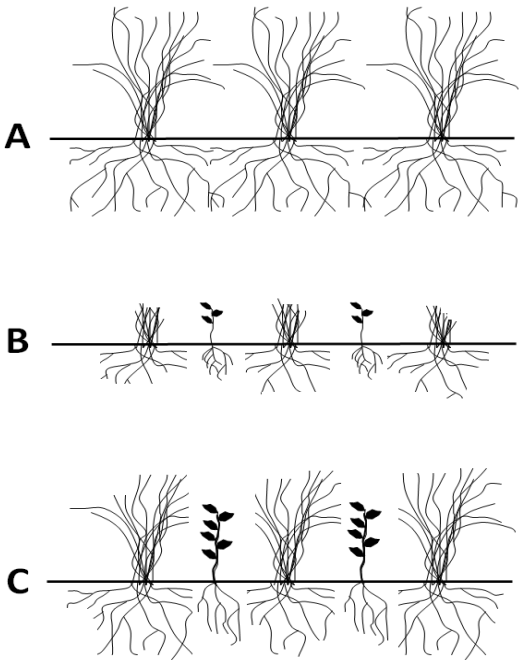
Most of today's applications of patch-burn grazing are designed to improve wildlife habitat quality of rangeland by increasing the heterogeneity of habitat structure – as compared to many traditional cattle grazing systems that try to avoid grazing extremely low or high intensities. Researchers from Oklahoma State University have led the effort to test patch-burn grazing's applicability to rangelands, and have documented many benefits to wildlife species and plant/insect diversity. More importantly, ranchers can typically obtain these results without compromising either stocking rate or weight gains. Because of OSU's positive findings, a variety of agencies, universities, and landowners are now testing patch-burn grazing in their local landscapes to see whether or not they can obtain the same kind of results. Currently, patch-burn grazing shows great potential for improving habitat quality in privately-owned agricultural grasslands, something that could have profound impacts on many at-risk grassland wildlife species.

In contrast to the vast majority of patch-burn grazing studies, however, our work along the central Platte River in Nebraska is not focused on altering management in production-oriented grasslands, but rather was specifically designed to increase and maintain floristic quality in prairies. During the last two decades, we invested significant resources into creating diverse prairie restorations (reconstructions), using seed mixes of between 150 and 230 plant species, as a way to enlarge and reconnect fragmented native prairies. As those restored prairie plant communities became established, we needed a way to maintain that plant diversity. In restored prairies (and many native prairies as well) dominant grasses tend to monopolize many of the resources, decreasing plant diversity. The Nature Conservancy's experience with bison/fire management had shown us that selective grazing by bison temporarily suppressed grass vigor and allowed other plants to become more abundant – increasing plant diversity. We hoped we could get similar results in our restored prairies by substituting cattle for bison and applying patch-burn grazing at much smaller scales (e.g. 80-400 acre prairies). While we are targeting plant diversity, we are also using that as one indicator of our larger goal of overall biological diversity,

much of which depends heavily on plant diversity as a foundation. Other studies have documented impacts of patch-burn grazing on other taxa (birds, small mammals, insects, etc.) so we are focusing mainly on plant species and community responses.

OUR APPROACH

Because we were not constrained by the need to design a management system that would be acceptable to ranchers or farmers, we were able to think about stocking rate, grazing season, and the timing and frequency of fire purely from the standpoint of what we thought would best achieve our primary objective – to prevent dominant grass species from reducing overall plant diversity. We started with the knowledge the intense defoliation of grasses reduces their vigor substantially. Those grasses lose aboveground stems and leaves, allowing more light to hit the ground around them. More importantly, the aboveground defoliation reduces the ability of grasses to support their massive root system, and they have to abandon many roots – leaving soil moisture and nutrients for other plants. Opening up space around dominant grasses allows other plant species to spread by seed and/or rhizome into territory formerly held by grass plants, increasing overall plant diversity. We hoped to get cattle to graze grasses hard and long enough to significantly weaken them, but then allow those grasses to rest and recover their vigor before the next grazing bout. At the same time, we wanted grazing pressure on forbs to be as light as possible to allow them to take advantage of the temporarily weakened grasses and increase (or at least maintain) their abundance.



An illustration of how grazing can influence dominant grasses in a prairie. In A, dominant grasses are monopolizing above and belowground resources. Other plant species have little opportunity to obtain light, moisture, or soil nutrients. In B, intensive defoliation has removed the leaves and stems, which has led to the abandonment of much of the root system. This opens up resources for other new plants to start. In C, those new plants are growing stronger as the grasses recover their vigor.

Over the last 10 years or so, we have experimented with various modifications of the basic patch-burn grazing system on about a half dozen prairies. Those prairies include lowland and upland sites, and restored and remnant (unplowed) prairies. We have been employing cow/calf pairs as our grazers because that is what our neighbors have, and we lease our pastures to those neighbors, who bring in cattle based on our plans for timing, duration, and stocking rate each season.

GENERAL RESULTS

Our early experiments confirmed that cattle followed the grazing pattern we hoped they would – spending the vast majority of their time in the most recent burned patches, and grazing very little in unburned areas. More importantly, we have found that under light stocking rates the cattle in our prairies graze very selectively – eating almost exclusively grasses. (The patch-burn grazing system seems to help facilitate that selectivity, but we've also seen it occur under light stocking rates in other grazing systems.) Increasing the stocking rate increases the amount of grazing on forbs within the burned patch and also increases the amount of grazing that occurs outside the most recent burned patch.

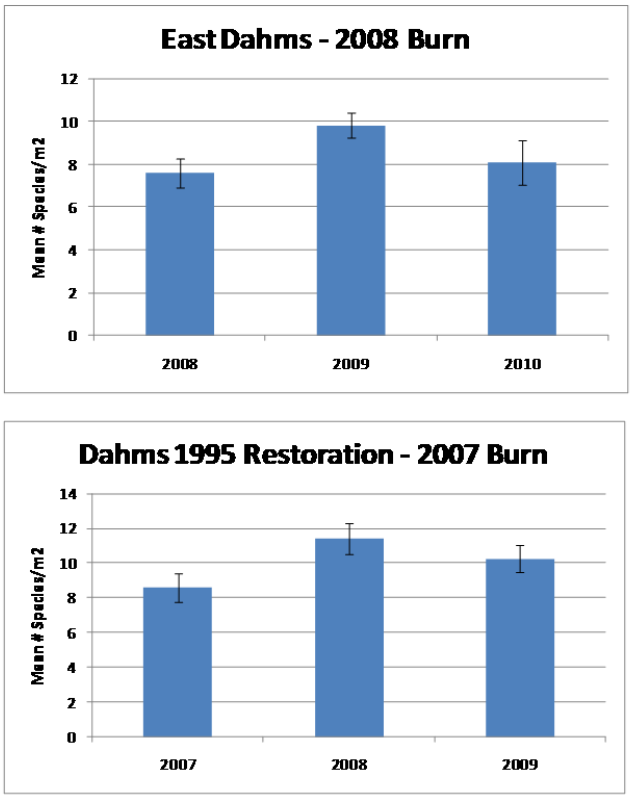
Selective grazing in a restored prairie under a light stocking rate. Most grasses have been grazed but few forbs have, including Maximilian sunflower, purple prairie clover (blooming) and rosinweed (blooming).

Stocking rates are difficult to translate from site to site because of differences in annual rainfall, soil types, vegetation composition, etc. In general, our patch-burn grazing stocking rates are about half to three-quarters of what the Natural Resources Conservation Service (NRCS) would recommend to a livestock producer on the same site. In addition, we alter stocking rates annually based on the previous year's rainfall and the results we see on the ground.

It's been fascinating to watch cattle select which plants to graze on, and to see how that changes through the season. During the early spring, their favorite plant in our prairies is smooth brome, an invasive species that we target for suppression. We try to get cattle into our pastures as early in April as we can so that the cattle can start grazing it (and stressing it) while it is still relatively short. At that time of year, cattle can generally "get ahead" of the grass in the burned patch, meaning that they can graze it all down faster than it can regrow, so they also spread out and selectively graze patches of smooth brome elsewhere across the prairie. As soon as the burned patch starts growing faster, however, they refocus their grazing there. As the season progresses into warmer weather, cattle tend to focus primarily on big bluestem and indiangrass – our most dominant native grasses during the summer. Other grass species, such as switchgrass, tall dropseed, Canada wildrye, and others are also grazed, but the grazing intensity on those species increases with stocking rate. At lower stocking rates, cattle tend to stick with their favorite species most of the time. When we do see grazing on forbs, cattle have favorites among them as well. Their absolute favorite forb is sweet clover – another species we're happy to let them suppress for us – but they also like native legumes such as Illinois bundleflower and Canada milkvetch. As a result of knowing the grazing preferences of our cattle, we can easily gauge our stocking rate by whether or not species like switchgrass and Illinois bundleflower are being grazed. Again, the "appropriate" stocking rate changes from year to year based on our objectives for each prairie.

To date, we've primarily evaluated two different aspects of plant community changes under patch-burn grazing. First, we've examined short-term changes in the plant composition as a direct result of the fire/grazing/rest cycle in the patch-burn grazing system. Second, we've tracked long-term changes in the plant community (up to 9 years so far) as prairies have gone through repeated cycles of fire/grazing and rest. In both cases, we measure changes by identifying and counting plant species within numerous $1m^2$ plots spread across each site. We can then look at changes in the species diversity at both small (1m) and large (prairie) scales. In addition, we can calculate the floristic quality (*see* Swink, F. and G. Wilhelm, 1994, Plants of the Chicago Region, 4^{th} ed.) at the 1m scale and average it across the entire prairie to look for change over time.

In both restored and remnant prairies, we generally see about a 20-30% increase in plant species density at small scales ($1m^2$) after a season of fire/grazing. In other words, within a burned patch, the number of plant species per square meter is about 20-30% higher in the year after intensive grazing than the previous year. Many of those "new" plants are opportunistic species such as ragweeds, annual sunflowers, marestail, and others that are quick to take advantage of the grazing-weakened grasses. However, we also see seedlings of plants like purple prairie clover, Illinois bundleflower, perennial sunflowers, and many other perennial native wildflowers that are taking advantage of the same open space. Many of those same plants are also spreading through rhizomes. That bump in species density drops off again the following year as the grasses recover most of their vigor. Sometimes the density drops back to pre-burn levels, but in other cases it retains some of the "new" species. We've not yet been able to predict why species densities sometimes remain higher, but it does seem to be at least somewhat related to weather patterns.



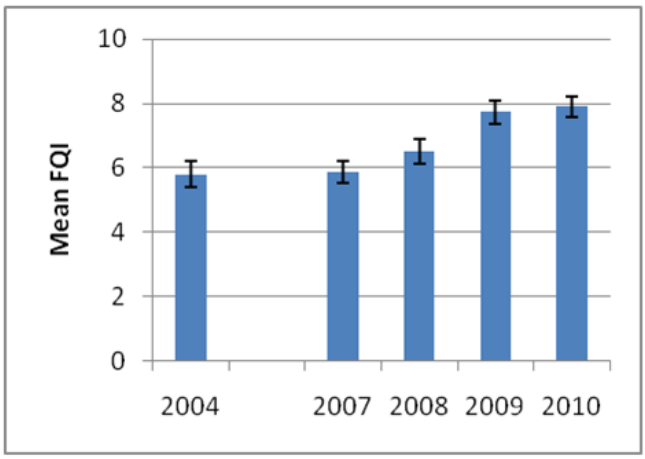
Two graphs showing changes in the average number of plant species per meter in burned patches. The top graph shows a burned patch within a degraded remnant prairie over three years, starting with 2008 when the patch was burned. The bottom graph shows the same pattern in a 2007 burned patch within a restored prairie. In both cases, the species density increases in the year after the fire but drops again the subsequent year. Error bars indicate 95% Confidence.

In terms of long-term (9 year) data on changes in plant species composition in prairies, we've certainly seen changes, but most seem more strongly linked to weather patterns than our fire/grazing work. Most of our remnant prairies have relatively degraded plant communities, dominated by grasses (native and non-native) and with fairly low numbers of forb species. Those prairies have tended to increase in mean floristic quality during our patch-burn grazing experiments, but for the most part we're not seeing increases in the abundance of perennial forb species that are largely missing from those prairies. In addition, those increases in mean floristic quality corresponded with a return to wetter years following a drought that lasted from about 2000 through 2006.

In many of our degraded remnants, plant species such as Maximilian sunflower (left) and purple prairie clover (right) are uncommon. However, even when they have nowhere to hide, they are rarely grazed within our patch-burn grazing system when we employ a light stocking rate, giving us hope that they will increase in abundance over time.

On the one hand, an increase in floristic quality in those degraded remnants is positive, and it doesn't appear that our fire/grazing is having detrimental impacts. On the other hand, we don't yet know how much our management influenced the change relative to the influence of weather. For the most part, we feel that we're not seeing perennial forb species increase in abundance because they're simply not there anymore. A few, especially Maximilian sunflower, are increasing over time, but our next job is to reintroduce other species to the site. We've been experimenting with overseeding those species within the patch-burn grazing system – with some success – but it's too early to know how well that will work.

Changes in Mean Plot-wise Floristic Quality in a Degraded Remnant Prairie

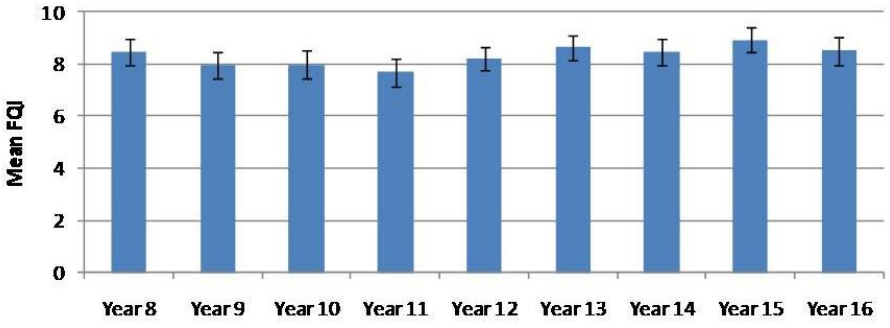


Data were collected from approximately 100 1m plots each year. Within each plot, all plant species were listed and the floristic quality (FQI) was calculated for that plot. Those values were then averaged across the site. Error bars indicate 95% Confidence.

In contrast to our degraded remnant prairies, our restored prairies already have about what we want for plant species composition, and our objective is simply to maintain that. We introduce patch-burn grazing to restored prairies when they establish to the point where most species are present, but before grasses begin to become overly dominant. So far, our data show that we are maintaining mean floristic quality in those restored prairies over time – through both drought years and wet years. Some individual plant species increase and decrease over time, but none show a steady drop (excepting a few non-native annuals). Most species are either relatively stable or bounce around in abundance as a result of the combination of our fire/management and weather. In one site, only two plant species have steadily increased over time – Carex brevior (a native sedge) and Kentucky bluegrass (a non-native invasive grass). We're glad to see the sedge increase in abundance but wary of the bluegrass. Bluegrass is now found in about 75% of our annual data plots, but has not had any visible impacts on species diversity, so we're wondering whether or not we can keep it suppressed enough (like other grasses) that it simply joins the plant community instead of dominating it as it does in nearby degraded prairies.

We don't collect data from every prairie in every year, but in the case of one restored prairie, we have nine years of annual data, dating back to when we first started implementing patch-burn grazing at the site (2002). As with other restored prairies, the site has maintained its mean floristic quality and has not lost any plant species that we're aware of. In this prairie, though, we also have a couple of fairly large (2-4 acre) exclosures that have gotten similar fire management to the rest of the site, but have not had any grazing. The prairie plant communities within those exclosures are significantly lower in mean floristic quality and species diversity – and are dominated by warm-season grasses and a few forb species. We have installed exclosures at other restored prairies during the last couple of years but don't know if we will see similar differences at those sites or not. At this point, it appears that grazing is an important component in our attempt to maintain species diversity in our restored prairies, but we will continue to learn over the coming years.

Changes in Mean Plot-wise Floristic Quality in a 1995 Prairie Restoration Seeding During Nine Years of Annual Patch-Burn Grazing



Data were collected from approximately 100 1m plots annually. Within each plot, all plant species were listed, and the floristic quality (FQI) was calculated for that plot. Those values were then averaged across the site. Error bars indicated 95% Confidence Intervals.

Year 8 – Year 16 on the X axis indicate the age of the seeding.

MODIFICATIONS FOR SPECIAL CIRCUMSTANCES

The standard patch-burn grazing template we use consists of a three year fire frequency, meaning that we burn a third of each site annually. However, in reality, we don't stick with that frequency - and to meet objectives for individual prairies, we constantly manipulate other aspects of the model as well, including length of grazing season, season of fire, stocking rate, and others. In addition, on most sites, we don't use the same burn units each time around, choosing instead to mow firebreaks around the portions of the prairie that contain the most fuel (dry grass) for burning. In this way, we avoid creating permanent edges between patches, but also help regulate the fire frequency based on the recovery needs of the prairies. In other words, portions of the prairie that recover more slowly after fire/grazing will get burned less often than those portions that recover faster. For example, locations with sandy/gravelly soils tend to recover more slowly than those with richer soils because soil nutrients are lower - so they get less frequent fire. On the other hand, we tend to burn Kentucky bluegrass-dominated portions of our remnant more frequently (sometimes every other year) than we burn other portions because cattle often don't graze bluegrass as hard as other species, so it recovers quickly – and the fire may be a better agent of bluegrass suppression than grazing.

The following is a set of examples of the kinds of modifications we make to the basic patch-burn grazing system to meet specific objectives.

Season of Fire

We try to alter the season of fire as much as we can to ensure that we're not falling into a set pattern of consistently burning at the same time of year. This seems important in terms of impacts to both plant and animal species – we don't want to negatively impact the same species over and over. In deciding what time of year to burn, we consider the impact of both the fire and grazing intensity on plants and animals. For example, a dormant season (late fall or early spring) burn – before cattle come into the prairie – means that when cattle are brought in they'll immediately begin grazing that recently-burned patch, and the remainder of the prairie will get very little grazing. By contrast, if we do a late-spring burn (May) but bring cattle into the pasture in April, the cattle will be grazing cool-season grasses throughout the site – but especially in the previous-year's burn – until the May burn greens up. The late-spring burn can be helpful when we are fighting cool-season invasive grasses because both the fire and spring grazing will target those grass species.

We've also begun experimenting with summer fires (July/August) as a way to have a greater impact on dominant warm-season grasses and to release a different set of forbs from competition than we do with spring fires. Ordinarily, a summer fire with no subsequent grazing will favor fall-growing plants (including smooth brome and Kentucky bluegrass), but when cattle are present to graze the fall regrowth following the fire, the vigor of cool-season grasses are suppressed, leaving forbs with less competition. Our limited experience with summer fires so far has shown us that short-lived species that overwinter as rosettes are particularly favored by the treatment, but that many other forb species benefit as well. At this point, we consider summer fires to be a treatment that supplements our larger management with something a little different, so we tend to consider burning perhaps one-fifth or less

of the prairie with a summer fire. That helps to minimize impacts to the many insect and wildlife species that are active in the summer, but still provides a patch of different wildlife habitat and opportunities for plant species that might not otherwise be favored by dormant season or late spring burns. The other impact of a summer burn is that it pulls grazing pressure off of the remainder of the prairie during the fall green-up of that summer-burned patch. One of the advantages of that is that we often see cattle ranging outside the recent burned patch during the fall when warm-season grasses are dormant and the cool-season grasses in the same patch are still weak from the spring grazing (or late spring fire). Since there's not much for cattle to eat in the burned patches, they start looking elsewhere, sometimes causing us problems (discussed below). A summer fire can concentrate that fall grazing into a smaller area, allowing large parts of the prairie to remain ungrazed or lightly grazed.

Stocking Rate and Grazing Season Length

Following up on the last thought, we're still debating the idea of how long to leave cattle in our prairies during the fall. Because they tend to start foraging outside spring-burned patches in the late summer and early fall, we've had years where fall-grazing cattle have significantly knocked down vegetation height and density in the portion of the prairie we were hoping to burn the next spring. Sometimes that's helpful because it reduces the intensity of the fire, but other times it prevents us from being able to burn – or to burn with enough intensity to kill eastern red cedar trees. Removing cattle from the prairie in the early fall can help remedy that. On the other hand, fall grazing on cool-season invasive grasses can be very helpful in suppressing them, and we've noticed that smooth brome that was grazed in the fall often appears very sluggish and weak the next spring.

There is a period starting in mid-late August when warm-season grasses are of low forage quality for cattle and cool-season grasses aren't growing much when we see cattle graze on forbs more than at other times of the season. That usually entails grazing the tops of plants, as opposed to grazing them down to the ground, but many flowers are nipped off during that period. For perennial plants, this probably has a negligible impact if it only happens once in a while, but if those plants are never allowed to flower and produce seed, it can clearly have more serious consequences. As we continue to experiment with fall grazing, we sometimes put up an electric fence in the late summer around the portion of prairie we plan to burn the next year – both to build fuel and to reduce grazing on forbs. In addition, if we do keep cattle in the prairie until late fall one year we don't tend to do the same the next year.

On the other end of the season, we tend to try to put cattle into the prairies as early as we can in the spring because most of our sites either have an abundance of cool-season invasive grasses or are at risk from an invasion. Putting cattle into the prairie in early April often means that our late spring burns occur while cattle are in the prairie – which has never led to any issues. (Cattle tend to retreat to the far side of the prairie to watch the fire.) In sites where not much is greening up in early April, we'll bring cattle in later, but that's a rare situation for us. Ordinarily, the biggest challenge of early spring grazing is convincing the owner of the cattle that there is enough grass to sustain grazing needs. Balancing our desire for early season intense grazing against the livestock owner's worries about running out of grass is an annual event.

As discussed earlier, stocking rate can have a tremendous impact on the selectivity of grazing cattle. As stocking rate increases, both the amount of total grazing outside the burned patch and the amount of forb grazing inside the burned patch increase as well. At extremely light stocking rates, almost no grazing occurs outside the burned patch and very patchy grazing occurs inside the burned patch. Conversely, at very heavy stocking rates, cattle will quickly run out of grass in the burned patch and graze the majority of the prairie.

This July photo shows the burned patch of a restored prairie under patch-burn grazing management with a light stocking rate. Most grasses are grazed – but not uniformly – while the majority of forbs are ungrazed. In the photograph are opportunistic species such as black-eyed Susan and hoary vervain that typically respond well to grazing pressure, but also Canada milkvetch and compass plant that are often seen as plants that do poorly under cattle grazing.

There is no single "perfect" stocking rate for patch-burn grazing because the appropriate rate depends upon objectives – which can change over time. A lighter stocking rate will leave more flowers ungrazed, but will also have much less impact on the vigor of dominant grasses. In fact, light grazing on grasses often leads to increased rhizome development, helping those grasses to spread horizontally. On the other hand, a heavy stocking rate can more strongly suppress dominant grasses but will also lead to more forb grazing. It's important to remember that even if a perennial forb is grazed down to the ground for an entire season (more typically, much of the plant is left ungrazed) it will recover its vigor during the subsequent year if that grazing doesn't continue. In other words, periodic defoliation of forbs does not necessarily have a negative impact on those species or their relative abundance within the prairie.

Stocking rate decisions can be made annually, based on weather and objectives. In our case, we typically lower stocking rates after dry years to compensate for what was heavier-than planned grazing during that year. Conversely, we usually increase stocking rates after wet years to make up for an "excess" of grass coming out of that season. We can't predict the coming season's weather, but we can at least adjust to compensate for the prior year. In addition to weather, though, we also look at the

vigor of invasive and native grasses, our desire to create certain kinds of wildlife habitat structure, and objectives related to forbs and other plants and insects as we determine annual stocking rates.

There is no rule that stocking rates have to stay constant through the season. Historically, bison grazing was likely most concentrated in burned patches of the landscape during the early part of the summer, before herds broke up into smaller wandering groups in the late season. More importantly, our desire for a certain intensity of grazing often varies by season, depending upon our objectives for a prairie. An advantage of using yearling cattle instead of cows/calves is that reducing stocking rates as the season progresses can sometimes fit well into a marketing plan for yearling cattle. It rarely makes sense to sell cow/calf pairs in mid-summer, however, so when we reduce stocking rates of cow/calf pairs in our prairies mid-season, we or the livestock owner have to find another place for those extra cattle to graze. Regardless, we have been experimenting more and more with stocking rate changes during the season.

In many of our prairies, the ideal stocking rate regime might call for a high number of cattle in the early spring, somewhat fewer animals in the early summer, and then no cattle, or just a few, in the fall (maybe just enough to "clean up" any brome that is growing strongly, but not enough to knock down fuel for the next year's fire). An early high stocking rate helps to suppress invasive cool-season grasses, but rarely has much impact on forbs because most forbs at that season are either dormant or so short that they escape notice by cattle. With a dormant season fire, cattle will suppress cool-season grasses most in the burned patch, but with a high enough stocking rate, they will also graze across much of the rest of the prairie – searching out those grasses as well. With a late-spring fire, a high number of cattle in the early spring (before the fire) can knock down cool-season grasses in the previous year's burn, and then the late spring fire can suppress cool-season grasses within the current year's burn patch.

Reducing the number of cattle on the prairie in late May, as warm-season grasses and forbs are starting to hit their growth spurts, can help ensure that cattle will focus more narrowly on dominant warm-season grasses, leaving forbs largely ungrazed and poised to take advantage of weakened grasses. Again, the appropriate summer stocking rate depends on objectives… In any given year, we tend to have some prairies that have a (relatively) high stocking rate in the summer and others with a low rate.

Exclosures/Seasons of Rest

In smaller prairies (a couple hundred acres or less in size) it may be beneficial to provide seasons of complete rest from grazing to ensure that no plant species are being perennially grazed by cattle. Most of our grazed prairies range from between 80 and 400 acres, and we haven't seen any plant species disappear from annual patch-burn grazing. However, in some prairies (why it varies by prairie, I don't know) there are some forb species that can get grazed – at least their flowers – nearly every year. Sometimes that appears to happen because the plants are blooming at a time when grass growth typically slows (e.g. late summer). In other situations, the relative forage value of the most dominant prairie plants may be low enough (especially in prairies dominated by Kentucky bluegrass and switchgrass) that cattle are looking for other plants to supplement their diet. Regardless of the reason, smaller prairies are easy for cattle to search fairly thoroughly for the plants they need to meet their dietary needs, and if some plant species are repeatedly grazed year after year, they are unlikely to

persist. Sometimes, the repeated grazing of forb species – even outside burned patches – can be greatly reduced by simply lowering stocking rates. Other times, periodic total exclusion of grazing may be important.

We have experimented with a couple different ways of periodically excluding prairies from grazing. In some cases, we simply give the prairie complete rest from grazing every few years. In other cases, we'll put cattle in during the spring to hit cool season grasses and then pull them all out in late May or early June. We have one restored prairie where we've increased our stocking rate and burned close to half of the prairie each year, but then only graze that prairie every other year. We're also experimenting with "moving window" exclosures by putting up electric fence around a different portion of the prairie each year so that all portions of the prairie will get some complete rest from grazing while still grazing other portions. In the case of the moving window exclosures, we don't adjust stocking rates because we tend to exclude the area least likely to be grazed anyway, and all we're really doing is preventing "drive by" grazing of favored forbs that don't add much quantity to the forage being taken by the cattle anyway.

We still have a lot to learn about the grazing/rest needs of many plant species, but as discussed earlier, we've not seen any plant species disappear, or even decline precipitously from any of our prairies – even without rest periods or exclosures. The resilience of prairie plants seems to be high, but the lifespan of many plants is also very long, so it may take many years before repeated grazing shows serious impacts. It seems prudent to play it safe by providing complete rest periods now and then when there is a question about what impacts might become important in the long-term.

CONCLUSION

Patch-burn grazing (or any kind of grazing) is not appropriate for all prairies – especially those under 20 acres or so. In our case, we feel that the kind of fire and grazing combinations we're employing are providing benefits, especially in terms of grass suppression, that benefit both plant diversity and habitat quality. At this point, rather than attempting to find a grazing system on our land that would also work for our agricultural neighbors, our approach is to try to optimize biological diversity first. If we can figure out how best to do that, we and others can then focus on how to modify and translate those strategies to fit the needs of private landowners, public land managers, and others working toward a variety of other objectives. In the meantime, we continue to experiment and evaluate the potential impacts of patch-burn grazing – including a multitude of variations on the basic system – on the wide range of species and ecological processes that drive diverse prairie ecosystems. We hope others will conduct similar experiments with fire and grazing combinations that might fit their individual prairie management objectives, and that they will share their results with us and others. There are too many challenges facing prairies not to test all of the tools that could help us ensure that diverse prairies exist far into the future.

Chris Helzer is the author of *The Ecology and Management of Prairies in the Central United States* and blogs at http://prairieecologist.com.