Patch Burn Grazing and Missouri Tallgrass Prairies – The Nature Conservancy's Perspective

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There has been considerable recent discussion regarding the role and desirability of using grazing in managing high quality tallgrass prairie in Missouri, including prairies that are designated State Natural Areas. Much of the debate revolves around the use of some variation of patch-burn grazing (PBG) to create suitable structure for a suite of declining grassland bird species. The role of properly managed grazing in achieving grassland structure favorable to wildlife targets is well supported; less is known about long term impacts to high quality tallgrass prairie natural communities, and potential loss of conservative biodiversity under such regimes. Embedded in the discussion is the erroneous assumption that optimum grassland bird management is by definition optimum prairie management, despite clear data demonstrating that grassland birds can thrive on effectively managed non-prairie habitat.

In Missouri, The Nature Conservancy sees a clear role for application of grazing to support conservation goals, and continues to partner with the Missouri Department of Conservation to use PBG at our Wah'Kon-Tah Prairie site. We will also be reintroducing bison to our Dunn Ranch site late in 2011, adding a key ecological process essential for large scale grassland landscapes. However, we have concerns about the use of PBG in high quality sites, and the protocols and associated impacts of PBG as it has been applied to Natural Areas such as Niawathe Prairie.

Based on extensive experience with sampling and managing Missouri tallgrass prairies over the past 25 years, here are some perspectives and concerns regarding PBG in Missouri, its potential benefits and impacts, and some suggestions for an approach to these types of management activities.

- **Global rarity and irreplaceability** – Any decisions regarding management of intact natural communities or remnants should take into account two critical factors: the global rarity and significance of the resource, and the degree to which it can be restored or replaced. Compelling data compiled by The Nature Conservancy in its global habitat assessment document that temperate grasslands are *the most endangered, least protected major habitat type on earth*, exceeding the degree of imperilment even of highly threatened tropical ecosystems. Missouri's tallgrass prairies are among the most important and rarest subset of temperate grasslands, the last vestiges of the most productive and diverse phase of tallgrass prairie. The vascular diversity and prevalence of conservative taxa obligate to these habitats are among the highest in midcontinental North America. It is also a sad fact that once lost, our society does not currently have the knowledge or technology to restore diverse functional tallgrass prairie. Decades of management and prairie restoration research have clearly demonstrated that, once lost from the system, the full suite of conservative vascular taxa that make a prairie a prairie cannot be

restored, at least within a 60 year time frame. This renders the remaining high quality remnants irreplaceable examples of the most imperiled habitat type on earth, and I submit that as resource managers we have a sacred obligation to pass these down to future generations as functional, diverse habitats. While grassland birds are a critical conservation concern, from the standpoint of both global rarity, and population restoration/reintroduction, they must be a secondary priority to existing high quality prairie habitats, especially since they are not obligately dependent upon them. Accordingly, it is essential that any management undertaken in the few remaining high quality remnants be unequivocally documented as having no deleterious impacts to system diversity or sustainability, since once lost these cannot be regained. To do otherwise is a lapse for which future generations would suffer.

- **Producer considerations** – There seems to be an underlying producer-centric bias among some advocates for increased grazing activities on prairie natural areas. This view is geared to making management activities by public agencies palatable among private producers. I suspect the thinking here is that by doing so, there will be increased credibility for public land managers among the producer community, and greater acceptance and adoption of conservation-appropriate producer practices. While aimed at achieving laudable outcomes, this reasoning is seriously flawed from two standpoints. First and most importantly, any management action on high quality remnants should be devised *completely independently of producer issues* – the priority obligation in these instances is an objective determination of system needs and sustainability, and abating critical threats. Attempting to use irreplaceable fragments of our natural heritage to demonstrate practices applicable to private production lands is inappropriate and counterproductive. Producer practices in Missouri will ultimately determine the fate of our biological resources, and effective communications, demonstration and interaction are essential, but it is short-sighted to use our few high quality habitats for this purpose. Second, extensive experience by the Conservancy and others indicates that the most effective and credible demonstration projects are those that occur on producer lands – it stands to reason that a producer community that often views conservation with suspicion will be less influenced by something happening on conservation lands, which they regard as different from their lands, than what is happening on a neighbor's operation. Conversely, grazing practices, if determined to be ecologically essential for management of high quality habitats, should be configured solely to achieve ecological goals on these irreplaceable assets, and these protocols will almost never align with producer concerns in terms of stocking rates, timing, or forage management practices. We have to become better at communicating the differences between grazing for conservation goals, and conservation-friendly grazing practices; only the latter are likely to be economically viable from a producer standpoint.

- **Compatibility of producer-appropriate grazing levels in Missouri prairies questionable** – A major concern is that, despite oft-repeated assertions that prairies evolved with grazing, and the implied conclusion that therefore prairies have to be grazed, I am aware of no high quality tallgrass prairie in the state (i.e. floristic diversity, conservatism, and floristic quality indices analogous with those of prairie Natural Areas) with a long history of regular grazing at the levels being used for current PBG activities on prairie Natural Areas. Why this has not caused more caution or concern perplexes me – we cannot risk an irreplaceable resource by implementing practices we "think" will help some group of organisms

without concrete assurances that the most endangered and least replaceable facet of our conservation resources will not be irreparably damaged. While there is strong anecdotal evidence that some frequency and intensity of grazing was likely part of the post-glacial Missouri landscape, this does not mean that current practices with Old World animals not native to the system, confined at scales totally incongruent with the original landscape, and potentially used at return intervals far exceeding the original temporal scale of the system, will axiomatically be beneficial. We simply don't know how often and at what intensities bison and elk impacted a given portion of the eastern tallgrass landscape. Despite the range management dictum that grasslands were shaped by mammalian herbivory, this is demonstrably not true for every single modern grassland biome (i.e. Latin American cerrado grasslands), and we should accommodate these uncertainties as we devise our management protocols.

- **Inappropriate scale considerations (1)** – Sadly, we cannot solve our grassland bird conservation issues through management of public lands and Natural Areas, regardless of how well such management provides good habitat for these taxa. Minimum area and spatial issues related to population viability are pretty well known for birds, which because of their highly motile lifestyles dictate that conservation be implemented at a broad landscape scale. The extent and geography of public land in Missouri's grassland regions, including the extreme paucity of high quality prairies, means that managing prairie remnants, likely at the expense of synecological integrity and system sustainability, will not ensure viability of grassland bird conservation targets. In our misguided efforts to do so we risk permanent damage to the even rarer remaining high quality prairies. Moreover, the fact that grassland bird viability is more keyed to structure than dependence on intact prairie habitats creates tremendous opportunities for appropriate conservation activities at scale through a combination of improved private producer practices and incentives, and more appropriate management of large areas of non-Natural Area public habitat.

- **Inappropriate scale considerations (2)** – No surviving high quality prairies exist on a scale approximating presettlement grazing patterns and process regimes of their presettlement antecedents, nor do they even exist at the scale at which much of the extra-Missouri PBG research was implemented. This reduced scale and increased fragmentation by definition constrains the resiliency and amplitudes of the dynamism which these remnants can sustain without inexorable biotic depauperization. Therefore, research on larger scale environments cannot be assumed to provide assurance of similar response, and there is a possibility that irreparable ecological impacts will be sustained by implementing PBG on small remnants.

- **Floristic diversity, and it biological importance, remain underappreciated in a conservation context** – Too many managers with responsibility for sustaining Missouri tallgrass prairies seem to view them through a simplistic wildlife and producer-focused prism of structure and productivity. In reality, these criteria can be attained with appropriate management of virtually any old field or pasture in the tallgrass region. Our few remnant high quality tallgrass prairies, on the other hand, are not only irreplaceable, but are also wondrous and indescribably complex systems that result from countless thousands of organisms interacting with each other, shaping and in turn being shaped by this and the physical

environment. Loss of this perspective can lead to false assurances, since it is admittedly more comforting to (falsely) believe that conservation goals are being met through simplistic, easily measured criteria such as structure. If we disenfranchise the complexity of organismal diversity that makes a prairie a prairie, we risk society's loss of an irreplaceable natural asset.

- **Existing vegetation and floristic data of questionable quality and utility** – Most of the research on PBG has been driven by wildlife concerns, and conducted by otherwise highly qualified people who, unfortunately, have limited experience with or focus on the complexities of vegetational and organismal biodiversity in these systems. In my opinion this has resulted in an undue focus on structure, wildlife effects, and dominant physiognomies at the expense of accurate organismal data. This has also compromised Missouri PBG research: for instance, I spent part of a summer afternoon accompanying the field crew during their sampling of PBG units at Wah'Kon-Tah Prairie, and was disappointed in the lack of botanical expertise or attention to quality control for sample identification. Granted, accurate and consistent determination of vegetative material to species is an extremely difficult task, but it is requisite for any study that purports to make inferences about impacts to overall prairie health and diversity. With the best of intentions, the crew I observed was, for instance, regularly considering vegetative specimens of *Aster pilosus, A. dumosus, A. hemispericus* and *A. ericoides* to be a single entity – one can only speculate at the lack of discrimination among more diverse and cryptic floristic components such as sedges and grasses. The result of this example could be a scenario under which the three conservative prairie asters cited above would be decimated or extinguished through the management treatments, while the weedy *A. pilosus* proliferated, and yet the resulting analysis of effects would reflect no net diversity loss, and perhaps an increase in per-plot frequency and diversity data. These issues are not trivial, and render assessments using species conservatism and Floristic Quality Indices invalid – yet FQI is perhaps the most important overall indicator of the extent to which irreplaceable components of the system are being maintained, thus providing inferences about system sustainability from a diversity perspective. Any contemplated grazing in high biodiversity prairies should require detailed ongoing ecological assessments enfranchising the full array of vegetation components, which in turn will require greater levels of expertise and institutional commitment than have been previously committed.

- **Ecological monitoring** – Given the immense gaps in knowledge and data regarding the composition, structure, process regimes and dynamism of our natural communities and their component organisms, it should be mandatory that any management protocols, especially those that are unproven or potentially deleterious, should be rigorously monitored across multiple organismal groups in all high quality sites subject to the treatment. Failure to do so is inexcusable, in that irreplaceable resources are being risked in a climate of ignorance, with no mechanisms for adaptive management or learning. All too often the argument is advanced that insufficient expertise or resources exist to accomplish this, but such reasoning is circular in that the same organizations and agencies trivialize the priority of the necessary investments in terms of resources and personnel to accomplish this.

- **Resiliency fallacies** – It has become almost a platitude to hear supposedly learned ecologists repeat the tired mantra that prairies evolved as systems in harsh, dynamic environments, and thus prairies are especially resilient to disturbance or are "early successional" systems. Neither of these statements is supported by ecological data. These assertions are glibly pronounced despite explicit documentation that tallgrass prairies are part of the rarest, most obliterated habitat complex on earth – so much for resiliency arguments. The resiliency fallacy seems to emanate from uncritical thinking regarding the tallgrass biome with its harsh and widely fluctuating climate patterns, recurrent fires, and episodic grazing events, but such should not axiomatically be construed to mean that prairies are thus exceptionally resilient to all disturbances, or even more resilient than other midcontinental habitats – indeed a strong case can be made for the opposite. Like any other natural system, tallgrass prairies evolved and were perpetuated as functional assemblages of organisms under a specific range of physical conditions, biotic interrelationships, and process regimes. It is this *constrained dynamism* that must be maintained or emulated to sustain functional prairie systems. If the amplitude of dynamism imposed on the system, intentionally or otherwise, exceeds the dynamism to which the system is attuned through thousands of generations of adaptation and natural selection, there is strong likelihood of species loss, ultimately resulting in system simplification, loss of true system resilience, and possible system collapse if the magnitude of the dynamism is sufficiently excessive. Since we know almost nothing about grazing in the context of sustaining the full array of prairie biodiversity in the tallgrass region, other than all too many examples of negative impacts, prudence dictates that we proceed cautiously as we proceed along the learning curve – i.e. light stocking rates and/or short grazing intervals, sufficient ungrazed reserves, etc. These safeguards become even more critical when considering prairie Natural Areas.

- **Missouri is not the Great Plains** – Much of the data and examples upon which the rationale to support PBG as currently being implemented are based on studies conducted in the Great Plains region west of Missouri, in the western portion of the tallgrass biome. I submit that differences in a variety of factors render these studies at best only tangentially and imperfectly applicable to Missouri. Many of these studies have been implemented in low diversity prairies with a long history of fairly intensive grazing, so damaging impacts may have occurred long before baseline data was collected. Virtually all of Missouri's high quality prairie Natural Areas have had little or no grazing and a century or more of maintenance through haying (this is not a carte blanche endorsement of annual haying as a management activity, only pointing out that it has sustained high quality prairies in the state, whereas similar duration and intensity of grazing history has not). Additionally, the Missouri grassland landscape is much more highly fragmented than those areas of the Plains where the studies were conducted, and local rainfall patterns and often more fertile and loamy soils are more conducive to invasive competition from a suite of factors including opportunistically encroaching native woody species and invasive alien species such as Tall Fescue. Hence, while the pioneering work done in the Great Plains is a valuable information point, extreme caution should be exercised when attempting to apply it to more fertile, fragmented, and diverse prairies in a different biome.

- **Pollinators** – Lost in the discussion regarding potential vegetation impacts and their permanence or evanescence is the degree to which pollinator resources appear to be impacted by PBG as it is presently

applied in Missouri. Although not formally monitored, before and after images from high quality prairies clearly indicate that the diversity of vascular taxa regularly achieving full anthesis is severely impacted in grazed areas. It also appears that the total abundance of nectar and pollen resources is likely impacted. Given that many high quality prairie remnants in the state support a diversity of conservative or habitat-restricted invertebrates dependent upon these pollen/nectar sources, and given the synecological dependence of the prairie system on these pollinators, I find it puzzling that their conservation and habitat quality is not regarded as at least as important as a suite of area-dependent bird species whose fate ultimately depends on landscape factors beyond the scale of existing prairie remnants. This lack of emphasis on sustaining pollinator resources in natural systems is even more questionable given the renewed emphasis on pollinator resources among most public resource management agencies. There has also been no consideration of the effects on invertebrates from cattle that have been treated with anti-parasite agents or insecticides.

- **Opportunistic native woody species** – Many high quality prairies in the contemporary landscape have a multigenerational history of haying and reduced fire frequency, resulting in a significant presence of those native woody species with sufficient autecological plasticity to invade fire-suppressed grassland environments. As long as annual haying occurs, the shading effects of this invasion is mitigated, and the woody taxa (*Rhus copallina, R. glabra, Cornus drummondii, Diospyros virginiana* and the like) are kept low and suppressed. Based on empirical observations on the PBG initiated at Wah'Kon-Tah Prairie, there is at least a possibility that PBG may result in an inadvertent increase of this brush, despite the claims that PBG can concentrate cattle activity on brushy areas. This is a result of the lack of fine fuels among woody stems after PBG activity, creating de facto fire shadows. More attention should be given to determining whether PBG in long-hayed grasslands will result in an undesirable proliferation of woody taxa.

- **Potential aquatic impacts have been trivialized** – Largely lost in all the rhetoric regarding PBG in intact prairie is the potential impact to perhaps the most endangered phase of these systems: prairie headwater streams, aquatic resources, and associated hydric terrestrial communities. These systems have suffered the triple assault of erosional degradation, downcutting, and hydrological impacts from off-site land degradation in the watershed, overgrazing and soil disturbance from disproportionate cattle presence intensity (if in grazed pasture), and increased woody encroachment because of increased moisture availability as compared with the surrounding uplands (if in hayed lands). It is also imprudent to accept that, since bison grazing at some level was part of the pre-Eurosettlement prairie process regime, then grazing by cattle automatically can emulate this – especially given the well-documented proclivity of cattle to disproportionately favor areas near water. This differential grazing pattern occurs at the expense of aquatic resources. Additionally, the swales and verges of headwater streams disproportionately impacted by cattle grazing, even in pasture units with sufficient upland forage farther away, are among the most sensitive and critical prairie resources. No conservation-driven grazing protocol should produce measureable erosion or localized degradation of headwater streams. All presettlement accounts I have seen document that, prior to the pervasive habitat conversion associated with grazing and agriculture, our prairie streams were clear and, even in small magnitude headwaters, likely to be permanent and hold fish throughout the year, because of the sponge-like

infiltration and gradual discharge associated with intact prairie systems (as an aside, in a much neglected paper from the 1930's Weaver and Noll [Ecology 16: 1-12] demonstrated that it is nearly impossible to cause runoff from intact prairie sods because of their exceptional infiltration rates). Anything that damages these sensitive areas, or results in significant surface runoff, loss of water clarity, quality and altered flow duration and amplitudes is likely to result in significant ecosystem degradation.

- **Succession models do not apply in contemporary prairie** – The notion of stable, predictable, "natural" patterns of ecological succession has always been a chimera in the post-settlement landscape, but nowhere is it less applicable than in modern prairie systems. All available sampling evidence indicates that high quality prairies are overwhelmingly dominated by long-lived perennials exhibiting an amazing stability from year to year. Thus a significant decline in floristic quality or native diversity should be viewed as alarming, and a major shift in composition with concomitant FQI loss as even more dangerous. Data from multiple examples paint a stark picture that conservatism is a fundamental attribute of intact natural systems, and once lost, is seldom re-attained, even on a scale of decades. Hence, PBG-associated compositional changes, such as what appear at Niawathe to be a proliferation of *Helianthus mollis, Andropogon virginicus, Euthamia gymnospermoides* and *Eupatorium serotinum* at the expense of more conservative organisms, should cause concern. It may be true that significant areas of our presettlement prairie were at various times more impacted and included regions of annuals and less conservative taxa, but with the lack of recolonization mechanisms in the current fragmented environment, we are faced with the priority of conserving those phases of the system that are least replaceable. This has been dismissed as maintaining "prairie gardens", which trivializes the need to maintain the full array of autochthonous diversity comprising our original natural systems. We don't know the original composition, structure, or dynamism of Missouri's tallgrass prairies, but we have an obligation to save all the biotic components in self-replicating, interactive arrays.

  So where does this leave us? I suggest that the concept of grazing and other practices that are characterized by both a high potential for lasting ecological damage if implemented improperly, and for which there is a high level of uncertainty regarding long term effects, should be approached much as a physician approaches patient care – **an Ecological Hippocratic Oath to do no harm to irreplaceable elements of our natural heritage**. Above all, managers and decision makers must acknowledge the sacred responsibility they bear for effective stewardship for both present and future generations. To that end, decision making should be made with the following in mind:

  1. Grazing-induced structural manipulations should be promoted as essential for long-term viability of grassland bird populations and other area-dependent grassland wildlife, and efforts to both work with private producers and to implement this on non-high quality public grasslands should be intensified.
  2. There should be explicit recognition of the fact that grassland birds and similar scale-dependent conservation targets cannot be sustained through the existing suite of high-quality prairies remaining in Missouri, and that grassland bird conservation is largely a scale issue that must incorporate private lands.

3. Grazing or other manipulations with high uncertainty levels implemented in Prairie Natural Areas and analogous high quality prairies should be accompanied by disciplined, repeatable, dispassionate monitoring protocols (not necessarily or in many cases even appropriately configured as research) that document *at an organismal level* the degree to which the most sensitive, least replaceable elements of the system are being sustained. These data should be available to provide adaptive management feedback on an ongoing basis.
4. Decision making should include input from vegetation ecology, aquatic, wildlife, conservation biology, and biodiversity (across multiple organismal groups, but requisitely vascular plant and invertebrate) perspectives.
5. Decision points should be prioritized from the dual standpoints of priority (Heritage G-ranks are a good starting point) and irreplacability (i.e., if lost, potential for reintroduction/restoration).
6. If there are potential negative ecosystem impacts to a planned management protocol, high quality natural communities should be used only if *there is no possibility of similar results being attained on lower quality examples or restored lands*.
7. The only management decision filter for designated Natural Areas or analogous high quality grasslands should be whether a proposed activity will enhance the viability or abate critical threats to the organismal diversity of that natural area. Consideration of goals for area-dependent organisms and systems whose area exceeds that natural area context are relevant but must be secondary (and may be more appropriately addressed off site and/or on a larger scale - see #2 above).
8. Management protocols for high quality habitats should be designed solely from an ecological approach, and never with alterations designed to make them more acceptable to private producers, or increase their demonstration potential for private landowners. Although demonstrations sites are an important tool, there are ample less unique lands available for that role.
9. In habitats with remnant natural quality, activities such as grazing should be initially implemented at the most conservative levels and shortest duration necessary to achieve desired conditions, with ongoing monitoring.

The issue of PBG and its application has unfortunately become highly polarized and emotional. From the Conservancy's perspective, the need for conservation–appropriate grazing as a management tool is indisputable; similarly, the need to ensure above all else no net loss of quality or extent of high-diversity prairie remnants is paramount. Given the uncertainties regarding PBG in high quality prairies, we think there would be benefits to recognizing a three-tiered conceptual approach, consisting of 1) producer-centered, economically viable grazing regimes with conservation benefits on private lands and public demonstration sites; 2) ecologically-centered grazing regimes for optimum habitat structure, without regard to maximizing economic returns, on most public grasslands, and 3) only using grazing on Natural Areas when necessary to enhance viability or abate threats to the system and its component organisms within the Natural Area, using caution, low intensity and/or low duration approaches, accompanied by zealous ecological monitoring.