GRASSLAND MANAGEMENT IN AMERICA AN OVERVIEW OF RESOURCES, ISSUES, AND PRACTICES

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Abstract: Grassland management in the United States is as large and unwieldy a subject as are the grasslands themselves, varied in their location, size, condition, historic use, and indeed mythology. Grassland naturally occurs in many areas of the United States and in most states, from the coastal grasslands of California, the Everglades of Florida, and the montane grasslands of the Colorado Plateau centered around the state of Utah. But generally when we Americans talk of grasslands we think of the Great Plains, the vast midsection of the country once rhapsodized as the home of the buffalo and antelope, homesteaded by prairie farmers over a hundred years ago. (Pieper 2005, 245).Pioneers, as the early settlers were called, found an unpredictable land of unforeseen challenges. Tall-grass prairie was so tall in places that they "hid the stock, making it sometimes difficult to find the cows and horses. Some of the grass grew to a height of ten feet" (MURIE 1940). Weather was unpredictable and often violent. And clouds of grasshoppers occasionally descended and destroyed crops (Rölvaag 1927). The pioneers persevered with the growing of crops and the raising of livestock. The bison of the plains were replaced by cattle. The objective of this paper is to give an introduction to the vast grassland resources of the United States and discuss the issues that face grassland managers today. Grasslands are inherently unstable ecosystems maintained by disturbance—primarily fire, grazing, and climate factors, particularly drought. Bison, elk, pronghorn antelope, deer, numerous species of small rodents and invertebrates inhabited the prairie long before the European-American settlers arrived with cattle (NPS 2000, 72). Grassland management recognizes the disturbance of grazing as an integral part of sustaining desirable prairie characteristics. While moderate disturbance is beneficial to biodiversity, however, high disturbance typically lowers diversity (ARCHER and SMEINS 2003). Not only is the intensity of grazing a factor, but also the differences in grazing habits of traditional grazers and introduced domestic grazers. Research is currently underway regarding the different effects of grazing on tall-grass prairie composition and biodiversity. While both bison and cattle display generalist food habits, a bison's diet consists of up to 90% grasses, while cattle diets consist of about 70% grasses. (NPS 2000, 74) Traditionally, as well, bison movement was unrestricted and variable whereas modern cattle grazing is heavily regulated, which can be used to a manager's advantage if the manager has a good range management strategy—unfortunately not always the case. Thus, while grazing has been used to create necessary disturbance in the prairie ecosystem, humans have substantially changed its frequency, intensity, extent, and magnitude with the introduction of livestock. The result has been rapid and widespread changes in species composition and productivity of plant communities. (ARCHER and SMEINS 2003). The dominant grasses of the tall-grass prairie are big bluestem (Andropogon gerardii) little bluestem (Schizachyrium scoparium), Indian grass (Sorghastrum nutans and switch grass (Panicum virgatum). In the mixed-grass prairie, needle-and-thread grass (Stipa comata) and western wheatgrass (Pascopyrum smithii) are common grasses, but many other species are abundant on specific sites. Plant diversity of the mixed-grass prairie is highest of all grassland types in the United States. Two major grass dominate short-grass: blue grama (Bouteloua gracilis) and buffalo grass (Buchloe dactyloides). It should also be noted that the term "grassland" is a bit misleading since these zones are also rich in forb species (Pieper 2005, 232). The great grasslands of America are largely in private ownership today, but federal agencies, state agencies, and citizen organizations work closely to provide assistance and incentives to manage grasslands for diverse values, including conservation and restoration of pre-European settlement grassland ecosystems. A large part of this analysis will center on the state of Kansas, in the heart of the Great Plains and representative of the issues considered in our review.

Keywords: *grassland, grassland management, planning, private/public partnerships*

INTRODUCTION

The settlement of the Great Plains by European-Americans began in earnest in the 1860s and 70s. Prior to this time the plains, as with much of the American landscape, were populated by large numbers of indigenous peoples with roots archeologically dated to 10,000 years (NPS 2000, 2). It would be wrong to talk about a time in the past when prairie lands existed in a "natural" state. Rather we should infer from the evidence that the native people created a sustainable way of life with the vegetation and wildlife of their environment. Evidence exists that native people did in fact exert influence on the grassland ecosystem, using fire and hunting the large mammals. As many as 40-60 million head of bison and comparable numbers of pronghorn antelope were present before European-American settlement (Pieper 2005, 221).

With settlers seeking farmland, came the railroad making an easy connection to east coast ports and markets. The slaughter and near extinction of bison resulted from the increased settlement, easy access, and a promotion in eastern states of an enchanted idea of the American West, which continues in various forms today. Americans were and still are captivated by the idea of manifest destiny: that we were destined to expand our country as far as physically possible, and that we were entitled to all which our land would offer. While the subject of manifest destiny in America is beyond the scope of this paper, it is a subject worth contemplating in order to understand how and why the great grassland plains of the United States were so dramatically altered in such a short period of time. Within four years of the coming of the railroad, over four million bison were killed on the southern plains. The slaughter peaked in Kansas between 1870-1873, then collapsed (NPS 2000, 6). The last reported sightings of bison in the state were in 1898 (NPS 2000, 69). The native people fared little better than the wildlife, and most were forcibly removed to Oklahoma (NPS 2000, 6).

Today half the beef cattle in the United States are in the Great Plains (Pieper 2005, 221) and the plains states provide the country and the world with vast quantities of food crops.

MATERIAL AND METHODS

The Great Plains zone is a geologic valley between the Rocky Mountains to the west and the Appalachian Mountains to the east. This vast valley is drained by the Missouri and Mississippi River systems, leaving behind assorted sediments (PIEPER 2005, 245). In addition much of this region received deposits from glacial movement in the past. Grassland soils in this region developed from limestone, sandstone, shale, metamorphic and igneous outwash, and loess (PIEPER 2005, 226).

The climate of the Great Plains is defined west to east by moisture and north to south by temperature. The northern prairie which extends into Canada is predictably colder with harsher winters than the southern prairie that runs all the way to the Gulf of Mexico. Rainfall is higher in the eastern zone since the Rocky Mountains in the west create a rain shadow that affects rainfall for hundreds of miles.

Due to this pattern of rainfall, the plains region is divided into three north-south running zones of distinct ecosystems: tall-grass prairie to the east, receiving the most rainfall; mixed-grass prairie in the middle; and to the west extending to the Rocky Mountains a short-grass prairie, adapted to the dryer conditions. Within these three zones, plant species composition and productivity reflect local climate as well as differences in soil and topography (ARCHER and SMEINS 2003).

Today much of the original prairie grassland that dominated central North America has been converted to cropland or otherwise disturbed from its pre-European-settlement

condition. Authorities estimate that of the original 60 million hectares of tall-grass prairie, for example, less than 4% remain (NPS 2000, 62). Up to 50% of short-grass prairie still remains, reflecting its lesser value to agriculture due to the dryer climate (PIEPER 2005, 221).

Multiple issues dominate the discussion of grassland management in the plains zone: crop agriculture, grazing, fire management, invasive species, threatened and endangered species, woody plants, climate, and more. In addition, many stakeholders besides the private landowner, have an interest in how these lands are used.

The state of Kansas is an appropriate representative of the issues facing the Great Plains in that it lies at the geographical heart of the prairie. In addition, multiple land management agencies operate in Kansas as well as conservation organizations and well-organized private landowner groups. The state provides the elements necessary to observe a small sampling of grassland management that represents a greater whole.

RESULTS AND DISCUSSIONS

Issues in Grassland Management

*Crop agriculture.*While land dedicated to food crops no longer fits the conservation definition of grassland, it is worth discussing the increased movement of cropland conversion back to native prairie. Those early pioneers broke the prairie with their simple plows to plant fields of wheat, potatoes, and vegetables. Over time, acres of wheat were grown during times of good precipitation and high wheat prices, then land was abandoned during drought and periods of low wheat prices (PIEPER 2005, 236). Today wheat is the major crop grown on the western edge of the Great Plains. In the tall-grass prairie zone, corn is the important crop in the north and soybeans in the south (PIEPER 2005, 237). In addition to the use of former prairie grassland for cropland, land managers are concerned about the use of pesticides and herbicides in modern farming and their effects on surrounding natural lands.

Conservation-minded citizens and government agencies today recognize that private landowners—farmers and ranchers—are a necessary component to any grassland conservation strategy, and there is a growing movement to incentive conservation on the part of private landowners. In the following section that examines grasslands in Kansas, we will look at examples of private/public partnerships that seek to foster agricultural development while at the same time maximizing opportunities for grassland conservation that benefit everyone.

*Grazing.Fire Management.*Fire played a role historically in the maintenance of the prairie ecosystem. Fire that is highly variable both in frequency and seasonality encourages the greatest expression of biodiversity (NPS 2000, 71). Fire creates at least three desired objectives: to kill or suppress undesired brush plants; to prevent invasion of inferior species in the understory; and to increase forage production and thus increase grazing capacity (PEIPER 2005, 244). When and how a manager chooses to use fire depends on the values he or she is trying to achieve, and is the focus of considerable research. Managing for biodiversity and a sustainable ecosystem would dictate the mimicking of traditional fire—variable in frequency and seasonality.

*Native, Invasive, and Endangered Species.*As a result of restoration plans in the past, a number of non-native species were introduced. Crested wheatgrass (*Agropyron cristatum*) was used in the 1930s to restore abandoned wheat fields, but today is seen as an invasive species leading to near monocultures. Also troublesome is a perennial forb called leafy spurge (*Euphorbia esula*) infesting over 650,000 hectares on the northern plains and Japanese brome (*Bromus japonicas*) an invasive annual grass that often competes with native perennial grasses (PIEPER 2005, 249).

As a result of all of the changes brought about on the prairie in the past 150 years, many animal species have experienced extirpations from large portions of their historic range,

such as the aforementioned bison, and declines in populations. Two species that are currently federally listed as endangered are the black tailed prairie dog (*Cynomys ludovicianus*) and its primary predator, the black-footed ferret (*Mustella nigripes*) (USGS 2003).

Today land managers have developed site-specific strategies to better manage native species, including decreased disturbance of aquatic habitats, increased hunting of over-abundant species such as the white-tailed deer in the absence of natural predators, monitoring and control of exotic species, and creating a better understanding of recreational impacts (NPS 200, 16).

*Climate.*Looking back over the past 150 years of prairie use and change, researchers have difficulty making generalizations about climate because of the dramatic upheaval caused by crop agriculture and grazing. Vegetation structure lags behind climate change and it is unknown to what extent vegetation can ever be in equilibrium with climate. In some cases, effects of climate have been erroneously ascribed to grazing. But in other cases, vegetative communities established under past climatic regimes may persist but not be able to reestablish following disturbance regardless of grazing pressure (ARCHER and SMEINS 2003).

The apparent displacement of grasses by woody plants in desert grasslands of North America over the past 100 years is a good example of the intertwined role of climate and human disturbance. Climate-based simulations predict present day grasslands will become increasingly susceptible to desertification and woody plant encroachment if changes in temperature and precipitation associated with the greenhouse effect occur (Archer and Smeins 2003).

Managers need to consider the potential effects of climate change when making decisions about land use since each of these issues is interrelated and cause for thoughtful study.

Kansas as a Case Study

Kansas is typical in its system of land ownership. A vast majority of land in the state is privately owned, largely a result of pioneer-era homesteading laws that gave away land to those who would settle and work it. Some small bits of land in Kansas were reserved to achieve public goals of conservation and recreation. Today, various entities are more and more valuing the collaborative approach to conservation and realizing that conservation and good business strategies are not mutually exclusive; we are learning that good stewardship of the land is, in fact, good business.

*Natural Resources Conservation Service.*The Natural Resources Conservation Service (NRCS) is the federal agency, as part of the United States Department of Agriculture (USDA), which supervises and advises on the use of grassland in the Plains states. Although the NRCS directly manages very little federally owned land, the agency is able to effect management through education and government incentives. Once landowners identify management goals on their land, NRCS conservationists can help create a plan to meet those goals using the disturbance tools previously mentioned. NRCS also consults with other federal and state agencies as well as citizen organizations interested in implementing conservation measures (NRCS 5.1-2).

Whether we talk about cropland or grazing land, several management alternatives exist. Focusing on grazing land, which is managed to attain a more natural ecosystem, managers must provide alternatives which foster a healthy ecosystem, produce adequate amounts of quality forage for the grazing animals, and meet the needs of the landowner. The plant community that meets these needs is the desired plant community. The role of the NRCS conservationist is to provide the landowner with information and analysis to first identify the desired plant community, and then to identify the appropriate conservation practices and

resource management systems to achieve or maintain the desired plant community (NRCS 5.1-2).

In order to fulfill this important function, NRCS personnel take the following steps in conservation planning:

- Inventory the present plant community and determine annual production for each species.
- Identify from the ecological site description the desired plant community that meets the land manager's goals and the resource needs.
- Determine what changes may be occurring (trend).
- Compute similarity index of present community to the desired plant community.
- Determine how the ecological processes of the site are functioning (rangeland health).
- Determine what conservation practice alternatives and resulting resource management system will achieve or maintain the desired plant community.
- Provide follow-up assistance to land manager in plan implementation.
- Provide assistance to monitor trend.

Once a plan is in place, three categories of actions are undertaken:

- Vegetation management practices—practices that are directly related to the use and growth of vegetation, such as prescribed grazing and prescribed burning.
- Facilitating practices—practices that facilitate the application of the vegetation management practices, such as water development, stock trains, and fencing.
- Accelerating practices—practices that supplement vegetation management and help to achieve desired changes more rapidly than grazing alone, such as brush management and range planting (NRCS 5.1-2).

Some examples of management knowledge that NRCS has found can help better create and maintain desired conditions are:

- The amount of use that native plants can tolerate varies greatly according to the kind of plant, season of use, soil, climate, recent weather conditions, vigor of the plants, and amount of use to which competing species are subject.
- If a plot of land is grazed mainly during the dormant season, greater use may be appropriate than during the growing season.
- A significantly greater percentage of annual growth can be safely removed from many native plants if land is grazed at a high intensity for short periods and completely rested for longer periods. This is particularly true if all plants growing in association are harvested somewhat equally.
- If land contains significant amounts of both warm- and cool-season forage plants, key species and key grazing areas need to be changed when the grazing season and grazing periods are altered within the grazing prescription (USDA 5.1-7).
- And general fire prescriptions: Burn warm-season grasses as needed. Never burn cool-season pasture forages. Bermuda grass pastures can be burned a week or so after the last killing frost in the spring to control winter annual weeds, some leaf diseases, and insects, such as spittlebugs. It also removes low quality dead grass and hastens green-up. Tall warm-season grasses, such as switch grass, big bluestem, and Indian grass, should be burned periodically in late spring to improve forage quality and remove invading cool-season grasses. Burning should take place before any regrowth of the warm-season grasses; otherwise, stand thinning occurs. All burning should be done by qualified people in accordance to local statutes and the NRCS Prescribed Burning conservation practice standard (USDA 5.2-37).

*Public/Private Partnership.*In addition to providing site-specific data and assistance with planning, implementation, and monitoring of rangeland management, the NRCS is also collaborates on conservation easements which are a good example of public/private partnerships. Conservation easements provide financial incentives to private landowners to conserve pieces of land as natural habitat. Conservation easements provide private landowners monetary payments for voluntarily allowing all or part of their land to remain or revert to a natural state conducive to wildlife use and other conservation goals. Money can come from federal or state governments or from non-governmental agencies. The Nature Conservancy (TNC), for example, is a non-governmental agency supported by citizen donations whose primary mission is to purchase conservation easements from interested landowners.

In 2009, as a result of the American Recovery and Reinvestment Act (ARRA) of 2009, money became available for the USDA to carry out long-approved watershed projects in Kansas, including the purchase of floodplain easements. The three conservation easements will permanently protect 853 acres of frequently flooded land and will be administered by the NRCS. The once intensely farmed ground will now be returned to native grassland habitat and will be allowed to flood naturally. Restoration costs will be about $300,000 which will allow for planting native grasses and trees and some dirt work (USDA 2010).

Another growing example of public/private partnerships is the Tallgrass Legacy Alliance (TLA), an organization composed of local ranchers, federal and state agencies, university representatives, TNC, and other citizen groups. Goals of TLA include preventing further loss of the tall-grass prairie, promoting the values of preserving tall-grass prairie, increase tall-grass prairie conservation easements, and—most notably—provide a means for private landowners to manage their land in a way that supports tall-grass prairie habitat while remaining fiscally productive. TLA writes, “If we are to save the Kansas tall-grass prairie, the first step will be to keep the ranchers on the landscape; everything else becomes secondary” (TLA 2010).

*National Park Service.*The National Park Service (NPS) is generally thought of as a federal agency with the highest mandate for preservation, while also providing for educational and recreational opportunities. The NPS manages park sites in many of the plains states, preserving and interpreting prairie grassland resources. In Kansas, the NPS administers the Tallgrass Prairie National Preserve (TPNP), 4,400 hectares of the largest tract of remaining tall-grass prairie landscape in North America, considered to be the most altered ecological community in North America (The Nature Conservancy). The preserve is within the Flint Hills whose relatively thin soil historically discouraged agriculture, thereby preserving a small piece of natural heritage intact.

TPNP is also a public/private partnership; only a small percentage of the land is owned by the federal government. The remainder is managed by the NPS but remains in private ownership with benefits to the owner of prestige and continued, although managed, use (NPS 2000, 9). The preserve contains rolling grassland, springs and creeks, historic buildings, and some elements of a working ranch including livestock grazing (NPS 2000, 1).

As is required for all NPS sites, TPNP created a General Management Plan to evaluate how to best manage the resource not only for grassland conservation but also the second mandate of providing educational opportunities for the public regarding pioneering and ranching life on the tall-grass prairie. The desired condition of the prairie is pre-European settlement, while incorporating elements of the historic ranching era.

The results of the GMP process created a plan which prioritizes this dual mandate over a strict wilderness view of the prairie landscape while limiting the ranching activities to those necessary for educational purposes. A key element of the GMP is the maintenance of the section of prairie as it would have been found by the first settlers 150 years ago. Experts

consulted for the GMP agree that in order to allow for the full expression of the tall-grass prairie ecosystem, elements of randomness should be encouraged. The complex interrelationships found within nature, especially those involving fire and grazing, should be continued, but ensuring that the same disturbance activity does not occur in the same area, in the same way, at the same time, every year (NPS 2000, 10). Now that a GMP has been completed, the park is obliged to create specific plans for fire management and grazing using the best available scientific data to use these methods to sustain the prairie. The preserve intends to introduce bison as grazers, although not pronghorn antelope or elk since these animals need larger territories than the preserve can supply (NPS 2000, 18). In addition to mimicking historical disturbance models on grasslands, the GMP recognizes that healthy aquatic resources are vital to the prairie ecosystem. Seeps, springs, and streams should be assessed and maintained or restored as integral parts of the ecosystem (NPS 2000, 10).

Another important feature of NPS ecosystem management today is the practice of regional inventory and monitoring. TPNP is part of the NPS Heartland Inventory and Monitoring Network which provides regional resources to create scientifically credible inventories of the species and natural features as well as long-term monitoring of trends and issues. Doing this on a regional basis helps managers monitor trends in a larger area than just their park and work collaboratively with other parks and agencies.

Finally, we should not overlook the mandate of education. It is a fundamental belief of the NPS (and others) that through education of school children and adults—through site visits and field trips, lesson plans, community partnerships, and information available through websites—people will come to better understand the significance of prairie ecosystems. When people value this resource, they will understand that it is in their best interest to protect it and to lobby government officials to practice better conservation measures.

Best Practices for Grassland Management

*Planning.*Federal agencies have long been required to undergo extensive planning exercise, including the input of various stakeholders (USEPA 2010). Stuth, Conner, and Heitschmidt (2003) argue that planning is the primary function of management. Planning involves all of the participants and examines all stages of action. Generally, planning includes establishing and prioritizing goals, inventorying and assessing resources, identifying and analyzing alternatives, and selecting the alternative that most effectively achieves the goals.

Specifically, the GMP team at TPNP assembled a team of scientists to respond to specific questions during its planning process:

- The potential biodiversity of the tallgrass prairie ecosystem in the Flint Hills and the preserve.
- The definition of high-quality range in the Flint Hills.
- How fire and grazing could be manipulated to increase biodiversity of the tall-grass prairie ecosystem.
- Specific management scenarios for the preserve that would enhance tall-grass prairie;
- Inventory, monitoring and research needs.
- Restoration of impacted riparian areas within the boundaries of the preserve. (NPS 12)

It is important to note that while a planning document from which land managers can work is an important record to have, the significance of planning lies in the process itself: the transparent involvement of interested parties and the analysis of alternatives that brings the planning team to an informed decision.

*Private/Public Partnerships.*As we have seen in the examples in Kansas, recognizing the interest of private landowners is essential in developing conservation strategies for natural prairie resources. Developing an interest on the part of governmental and non-governmental

agencies to fund conservation easements and share knowledge and strategies is essential to creating incentives for increased conservation management.

The government's original goals for creating a conservation easement program were to take highly erosive cropland out of production and to establish perennial vegetation cover, to decrease farm commodity surpluses, to generate stable incomes for participants, and to enhance natural resource values, including soil, water, air quality and wildlife (PIEPER 2005, 236). These needs still exist and working together agencies and private landowners can achieve a better balance of conservation and production.

*Inventory and Monitoring.*The NPS has found that creating regional networks for inventory and monitoring benefit individual parks with increased data on trends and management solutions. The United States Geologic Survey (USGS) specifically refers to spatial data and mapping as an essential element of managing inventory. When state and federal agencies share data across traditional lines of ownership and states, the data can be compiled and used by a greater number of entities. USGS writes that special data can play a critical role in issues such as Endangered Species listing and in decision making on habitat restoration projects (USGS 2003).

*Continued Research.*Decision making in prairie grassland management requires a strong foundation of technical knowledge and the scientific understanding of how disturbance methods can work together to the benefit of biodiversity and ecological sustainability (STUTH, CONNER, and HEITSCHMIDT 2003). Research is ongoing regarding the relationships between grazing, fire, climate, and the prairie ecosystems. As peer-reviewed results come to light, these results must be shared openly and made use of in management decisions. In addition, people working in the field of grassland management must take advantage of new technological functions for communicating findings, such as the aforementioned GIS-based inventory databases. With information available electronically, land managers and consultants must educate themselves technologically to maintain access to the best available information (STUTH, CONNER, and HEITSCHMIDT 2003).

CONCLUSION

This small sampling of management practices cannot capture all of the issues facing grassland managers today and certainly cannot account for regional-specific practices that may help to enhance conservation in one area but that may foster negative impacts elsewhere. But it does serve to explain the fundamental need of grassland habitat to be managed with disturbance that has been scientifically determined to best meet the needs of a particular ecosystem. In addition, the essential best management practices serve all management zones equally: collaboration among stakeholders and the free exchange of ideas and data through modern technology.

Although United States has not traditionally been the best example of managing grasslands for the benefit of conservation values, this is a work in progress. In the past few decades, a growing movement has been underway to balance agricultural interests with better preservation of remnants of natural prairie habitat and better management and restoration of increased suitable acreage. Working together, we are moving toward a more complete vision of grassland management.

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