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Tallgrass Prairie: Remnants and Relicts

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FEATURE ARTICLE

TALLGRASS PRAIRIE: REMNANTS AND RELICTS

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"The Heart of North America is a Grassland." J. C. Malin, 1947.

ABSTRACT—The tallgrass prairie once was continuous throughout the eastern Great Plains. Now, scattered remnants remain. The distribution of some of the most interesting and socially valuable remnants occur along the base of the Rocky Mountains as relicts from a past era. When the species composition of these Colorado grasslands is compared with that of the eastern tallgrass prairie by an index of similarity, the relationship is clear, even though the climates of the two regions differ greatly. It is likely that this western tallgrass prairie is left over from past geologic times rather than the product of long distance seed dispersal. Today, the persistence of tallgrass prairie is threatened. These threats include urbanization, mismanagement, under-valuation by the people who inhabit the regions, and invasion by exotic plant species. These are serious, but correctable, problems. The conservation and restoration of the remaining tallgrass prairie is justified because these relicts contain valuable ecological and genetic resources for the future.

Introduction

The tallgrass prairie once stretched from southern Manitoba to Oklahoma, and it included parts of Wisconsin (Leach and Givnisch 1996; Howe 1995) , Minnesota (Tilman et al. 1997), Illinois (Anon. 1996), and Indiana as well as the better recognized tallgrass prairie states of Iowa, Kansas, Missouri, Nebraska, and Oklahoma (Risser et al. 1981: Fig. 2.1, p. 11). Tallgrass is listed as a major ecosystem of the Great Plains in the United States (e.g., Shelford 1963; Taktajan 1986; Barbour and Billings 1988). Its boundaries are often designated as those of the wheat belt and the western part of the corn belt (Küchler 1964). Just as wheat and corn cropping extend far beyond these limits, we propose that the extent of what is considered to be tallgrass prairie can be enlarged when its botanical components are examined. Corn

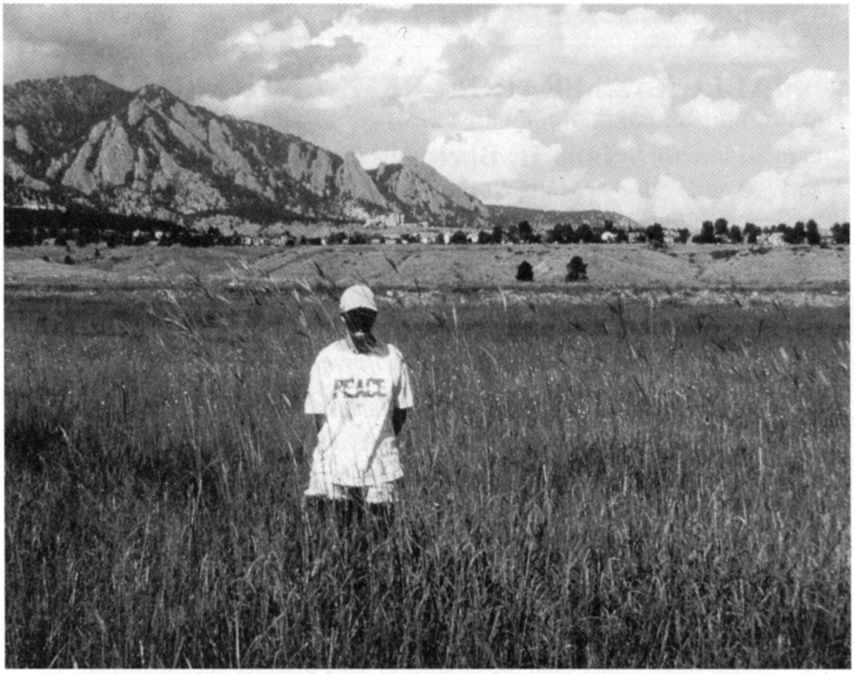

Figure 1. Student, Brenda Koerner, standing in the tallgrass in mid-summer as the grasses are commencing their rapid growth period. In the background rise the Flatirons near Boulder. Photo courtesy of the authors.

and wheat seed producers genetically have developed strains that tolerate differing climatic regimes throughout the heartland of America, and natural selection has done the same for the native tallgrass species over past millennia.

Today, remnant portions of tallgrass prairie remain in the eastern Great Plains. Scattered patches of this vegetation type also occur further west (Knight 1994). One of these is a small piece of tallgrass prairie that occurs at the eastern base of the Rocky Mountains along the foothills of the Front Range in Colorado. Our purposes in this article are twofold. First, we present our view that the prairie relicts in the foothills of the Colorado Rockies are allied closely to tallgrass prairie of the eastern Great Plains. Second, we wish to inform scientists, students, citizen conservationists, and managers of grasslands that there is considerable ecological and genetic value in conserving these disjunct prairie remnants, especially those on the periphery of the Great Plains.

The dominant native grass species of Great Plains tallgrass prairie are big bluestem (*Andropogon gerardi*), Indiangrass (*Sorghastrum nutans*), switch-grass (*Panicum virgatum*), along with associated mid- and shortgrass species such as little bluestem (*Schizachrium scoparius*), and several grama grasses (*Bouteloua* spp.). The westernmost assemblages of these species are found on the piedmont adjacent to the lower montane of the Front Range at the eastern base of the Rocky Mountains. Early in the 20th century, this tallgrass relict extended from south of Colorado Springs to southern Wyoming. As in the eastern tallgrass, agricultural practices and urbanization along this corridor have led to the near disappearance of this tallgrass prairie as well. One on the larger remaining pieces of westernmost tallgrass prairie (100 hectares) belongs to the City Open Space of Boulder, Colorado.

This wider distribution of tallgrass ecosystems might have escaped our notice had it not been for some useful, but little noted, work by our predecessors here at the base of the Rockies (Livingston 1952; Moir 1969; Moir unpublished). The vegetation in the foothills of the Front Range usually is treated as a grassland-coniferous forest ecosystem. Several authors (e.g., Vestal 1917; Ramaley 1931; Livingston 1952; and Moir 1969) have pointed out that tallgrass prairie species could be found in the vicinity of Boulder, Colorado, especially in Rocky Flats Alluvium soils (Branson et al. 1965). Will Moir (unpub.) listed sites where these pieces of tallgrass prairie could be found in Boulder County. We sought out Moir's sites in 1985. This started us on our investigation of the Colorado tallgrass prairie.

At first consideration, the presence of tallgrass prairie in Colorado is surprising. When the climatic regime of tallgrass prairie from the eastern Great Plains is compared with that of the Colorado sites, discrepancies appear. Konza Prairie is owned by The Nature Conservancy and its 3300 hectares have been Long Term Ecological Research site for tallgrass prairie. Their extensive research publications and climatic monitoring, especially by scientists from Kansas State University, make it invaluable as a basis of comparison for other tallgrass parcels in our view (Knapp et al. 1998 and references therein). This makes the parallels in vegetation intriguing because there are such dramatic differences in climate between Konza Prairie, Kansas, and Boulder, Colorado. The 97 year annual precipitation mean for Konza is 82.9 cm, while Boulder's is 46.3 cm (Figure 2). The wettest year over this period in Boulder did not attain Konza's average annual moisture level, and only three times has Konza's precipitation fallen to Boulder's average. Also, the average maximum annual temperature in Boulder is 4.5°C, while it is 8.4°C at Konza, and the average maximum snow depth in Boulder is 38.1 cm, but it is 11.4 cm at Konza.

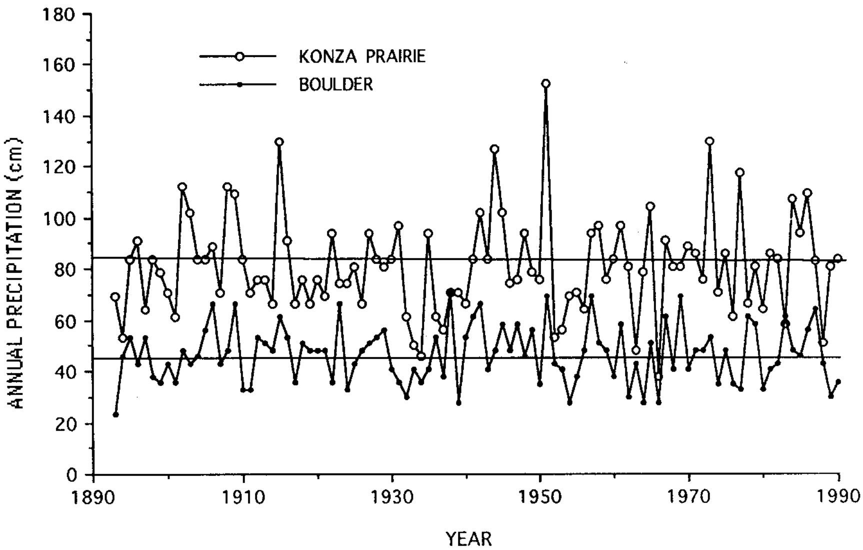

Figure 2. Mean annual precipitation of Konza Prairie, Kansas, and Boulder, Colorado, recorded from 1893-1990. (After Santanachote 1992.)

Methods

We gathered plant species lists from several places in order to compare Boulder tallgrass sites with sites in the main formation in the eastern Great Plains. Copies of these lists are available from the authors. Eastern Great Plains sites included: 1) Konza Prairie and elsewhere in Kansas (Kindscher 1991; Freeman 1998); 2) 10 Tallgrass remnants in eastern Nebraska (Boettcher et al. 1993); 3) Caylor Prairie, Iowa (Aikman and Thorne 1956); 4) Osage Tallgrass Prairie Preserve Species List from Osage County, Oklahoma (Nature Conservancy 1993), and 5) Tucker Prairie Flora, Missouri (Anon. unpub.). The species from tallgrass areas on Boulder Open Space were taken from Santanachote's dissertation (1992), City of Boulder Open Space Management plan (1987), and personal observations. In all, the complete compilation of tallgrass prairie totaled 997 species. To highlight the pattern we used only the two most speciose families of angiosperms: the grass family, Poaceae (144 species) and the composite family, Asteraceae (121 species). These two families contain the most species in the tallgrass prairie in the floras of our survey. When taxonomic discrepancies appeared among local floras, the nomenclature from the *Flora of the Great Plains*

(Great Plains Flora Association 1986) was used. A flora from the high plains grasslands of southeastern Arizona was used as an outgroup comparison. This flora came from the National Audubon Society's Appleton-Whittell Research Ranch, Santa Cruz County, Arizona (Elias 1978. unpub.). This outgroup was put into comparisons here to ascertain that tallgrass prairies were distinctive from grasslands in general.

We used an index of similarity, a statistic called the Coefficient of Jaccard, to compare the composites and grasses among the grassland sites. This index compares the degree to which species compositions from various sites are similar to one another, and it is calculated as:

$$\text{Similarity (J)} = \frac{a}{a + b + c}$$

where a = total number of species shared by the two sites being compared, b = numbers of species at one site alone, and c = numbers of species in the other site alone. Other indices of similarity (including the Sorensen, simple matching, and the B-U/Buser) produced comparable results.

Frequency data document the commonness of species in given places. In this case, we compared the frequency of the tallgrass species from the main tallgrass sites with their frequencies on the Colorado tallgrass sites. Frequency data for the main tallgrass region in the eastern Great Plains were taken from a variety of sources and combined (Weaver 1954; Penfound 1964; Gibson 1988; Collins and Glenn 1991). For the Boulder, Colorado, sites we used data from Moir (1969), City of Boulder Open Space Management (1988), Santanachote (1992) and our personal data.

Comparisons of Western and Eastern Tallgrass Prairie

Our analysis shows that the Colorado site is as similar in species composition to the sites in the eastern Great Plains tallgrass sites as those sites are to each other. All tallgrass sites were clearly distinct in species composition from the outlyer in Arizona grassland (Tables 1 and 2). And, a comparison of the ten most common species in Colorado vs. the other areas also illustrates strong agreement in plant frequencies between relictual and remnant tallgrass prairie (Table 3).

The average similarity of the grasses and composites in Colorado vs. the five "mainland" tallgrass prairie sites in the eastern Great Plains, however, shows problems. For grasses, there is clearly a strong affinity among

TABLE 1

SIMILARITY OF GRASSES (FAMILY: POACEAE) AT VARIOUS TALLGRASS PRAIRIE SITES (PERCENT). THE PERCENT SIMILARITY IS THE NUMBER OF GRASS SPECIES SHARED IN COMPARISON WITH THE TOTAL GRASS SPECIES FOR EACH PAIR OF SITES.

	CO	OK	KS	NE	IA	MO	Arizona
Colorado (CO)	—	34	43	33	43	28	9
Oklahoma (OK)		—	42	27	23	25	8
Kansas (KS)			—	41	43	24	8
Nebraska (NE)				—	44	22	6
Iowa (IA)					—	26	8
Missouri (MO)						—	0

TABLE 2

SIMILARITY OF COMPOSITES (FAMILY: ASTERACEAE) AT VARIOUS TALLGRASS PRAIRIE SITES (PERCENT). THE PERCENT SIMILARITY IS THE NUMBER OF COMPOSITE SPECIES SHARED IN COMPARISON WITH THE TOTAL COMPOSITE SPECIES FOR EACH PAIR OF SITES.

	CO	OK	KS	NE	IA	MO	Arizona
Colorado (CO)	—	25	24	20	24	13	7
Oklahoma (OK)		—	33	23	21	15	5
Kansas (KS		—	46	35	16	6	
Nebraska (NE)				—	39	19	3
Iowa (IA)					—	19	2
Missouri (MO)						—	3

TABLE 3

RANKED FREQUENCIES OF GRASSES IN THE EASTERN GREAT PLAINS TALLGRASS PRAIRIE WITH THE RELICTUAL GRASSLAND SITES IN THE FOOTHILLS OF THE ROCKY MOUNTAINS NEAR BOULDER, COLORADO.*

Colorado	Eastern Great Plains
1. *Andropogon gerardii* (big bluestem)	1. *Andropogon gerardii* (big bluestem)
2. *Schizachrium scoparium* (little bluestem)	2. *Schizachrium scoparium* (little bluestem)
3. *Panicum virgatum* (switchgrass)	3. *Bouteloua curtipendula* (sideoats grama)
4. *Sorghastrum avenaceum* (Indiangrass)	4. *Bouteloua gracilis* (blue grama)
5. *Bouteloua gracilis* (blue grama)	5. *Sorghastrum avenaceum* (Indiangrass)
6. *Bouteloua curtipendula* (sideoats grama)	6. *Panicum virgatum* (switchgrass)

*List of sites in Methods.

all prairie sites (Table 1), and a similar, but weaker, link exists for members of the sunflower family (Table 2). Missouri prairie showed the lowest overall affinities to any of the other tallgrass sites. The outlying Arizona grassland species showed no close relationship to any of the tallgrass locations.

It is noteworthy that the floristic similarity among all sites for the grasses was greater than that among the composites. The lower limit of similarity among sites for composites fits with a widely held belief among systematists that the sunflower family (Asteraceae) contains taxa that are evolving rapidly (Lane 1997). Perhaps the Holocene separations of the last ±11,000 years among all the tallgrass areas have been sufficient to form genetic distinctions within the Asteraceae that are recognizable taxonomically. There also are hints that the species from the sunflower family may show regional affinities among species in Kansas, Nebraska, Iowa, and

Oklahoma, with less linkage to those in Colorado and Missouri. The tallgrass prairie of Missouri is a more restricted fit for both the Poaceae and the Asteraceae. Information from Tucker Prairie near Columbia, Missouri, is helpful in understanding this finding. This site cannot be maintained without annual burning (Kucera 1996; DeYoung and Jordan 1924), in contrast to the other prairies sites where less frequent fires usually are employed as part of successful management strategies (Wright and Bailey 1982; Pyne et al. 1996).

Relict or Long Distance Seed Dispersal?

When our ideas about Colorado tallgrass prairie were first presented in 1986, a thoughtful listener suggested that these stands must be a result of long distance seed dispersal, not a relict of some past grassland ecosystem. Two facts argue against individual movement of species from the main tallgrass region into the Colorado stands at the eastern base of the Rocky Mountains. First, the agreement in species composition is high among all sites used in this study. Second, the similarity of the Colorado sites to those in the main region involves a great many species from two distinct families of flowering plants shown here, plus other families as well. It is extremely unlikely that this tallgrass assemblage in Colorado is the outcome of multiple long distance dispersal events.

The two most likely long distance dispersal vectors would be wind and birds. Wind dispersal of seeds is unlikely because winds at the base of the Rockies blow the wrong direction. The prevailing winds are strong westerlies. Birds could be a vehicle for long distance dispersal of seeds from the eastern Great Plains to Colorado. However, the generalized route for migratory song birds (Passerines) that move in the fall when seeds are ripe also is not in the necessary direction. Birds tend to migrate south over the eastern and east-central Great Plains, rather than west. However, on rare occasions flocks or individuals could stray westward in their journeys and stack up against the Front Range before progressing further south. Thus, they cannot be ruled out completely. However, such stacking seems a more likely explanation for the occasional plant appearing outside its normal range than for the transplanting of a whole flora. Until bird detours accompanied by seeds are documented, we will not know the true significance of any trans-plains dispersal. A great proportion of the migrant birds do pass over the outlying site in southeastern Arizona, but this grassland's species lists were not similar to those from the Great Plains' sites (Tables 1, 2). At present, the best explanation for the tallgrass prairie species assemblage in Colorado is that it is a relict of a past geologic time when tallgrass prairie was much more common west of the eastern Great Plains.

Persistence of relictual tallgrass prairie in Colorado presents another puzzle. The best explanation appears to lie beneath the soil surface. Branson and co-authors first built the case for this hypothesis in 1965 , although it had been suggested in 1952 by Livingston. Branson et al. (1965) pointed out that that the distribution of the relictual tallgrass species was linked tightly to scattered rocky soils in the foothills near Boulder. These soils, called Rocky Flats Alluvium, originated from glacial outwash of Pleistocene age. These rocky soils were deposited on top of the older, but more common, Pierre Shale. Branson and his co-authors state (1965: 316-17), "The quantities of water stored in the stony soil were necessarily much smaller than in the shale-derived soil where no moisture storage space is usurped by stone, but the retention forces were generally higher in the shale soil. The greater suction exerted by the shale-derived soil probably caused this site to be populated by species than can withdraw moisture from soils at higher stresses." We conclude that the tallgrass species persisted in this drier climate because they could continue growth under relatively high soil moisture conditions in these stony soils. A complementary role also may be played by climatic modifications in the immediate vicinity of the mountains, where summer orographic precipitation is common. Just a few kilometers further east in the vicinity of Denver, this precipitation is lower.

Threats to Tallgrass Remnants and Relicts

There are at least four imminent threats to the tallgrass prairie remnants and relicts. The first is continued urbanization of the Plains as a whole. Just as the Great Plains was the last part of the US to be settled permanently, so it appears to be the last to be heavily populated in comparison with almost all other regions of the United States. Colorado provides an example. On 15 May 1971, Will Moir compiled a list of 12 tallgrass prairie sites in the foothills of Boulder and Jefferson Counties, Colorado. We have revisited his sites many times over the intervening years. Seven persist today, but two of these are marginal now. The other five have been lost to road construction, overgrazing, and real estate developments. Fortunately, three of Moir's better sites were purchased by City of Boulder Open Space, perhaps as a result of Moir's efforts. Relictual tallgrass prairie in nearby Jefferson County is the focus of current conservation interest.

The second threat is overuse and mismanagement of remaining tallgrass prairie sites. In Boulder County, two of the seven persisting sites are in decline due (in our opinion) to fire suppression and overgrazing by domestic livestock. All are threatened as well by over-use for human (and dog) recreation. The 10,000 hectares of City of Boulder Open Space are used each year more heavily on a per ha basis than is nearby Rocky Mountain National Park. Unfortunately, we citizens who have taxed ourselves through many bond issues for purchase and protection of Open Space also continue to cause unintended destruction of this same space through overuse for recreation.

The third threat is from misunderstanding and ignorance. The aesthetic, ecological, and genetic values of tallgrass prairie are not widely known. Although some professional biologists, some local, state and federal governmental land managers, and many members of conservation societies are aware of the fragile nature and special value of these sites, these people need to become more effective communicators and educators. Unfortunately, people often favor tree and shrub invasion into relictual tallgrass over grassland conservation. Citizens have protested the cutting of ponderosa pine saplings that had migrated into a relictual tallgrass stand on Boulder Open Space or prescribed burning of the area. Although Boulder Mountain Parks and Recreation Department is using fire successfully for restoration of their tallgrass prairie stands, land managers generally are chary of using fire. Some local realtors also have expressed their desire for more pine lands because homeowners want to "live in the piney woods." This opposition to grassland preservation can be overcome with concerted education about the values of grassland. In Boulder, xeriscaping is stylish at present, and a "match the natural vegetation" plan fits in well. Local native plants are readily available when requested at several local nurseries. However, other landscape businesses and nurseries often recommend exotic plant materials rather than natives.

A fourth threat to tallgrass stands is invasion by non-native species. Certain non-native grasses such as smooth brome, cheat grass, Japanese brome, crested wheat grass and numerous non-grasses including knapweeds tend to overrun xeric prairie sites. In wetter areas, smooth brome, Kentucky blue grass, Canada thistle, purple loosestrife, and musk thistle have invaded successfully. Debates exist over what has facilitated these invasions. Certainly, fire suppression and long term overgrazing by domestic stock are contributors. Once the sod in a stand of tallgrass is grazed heavily, openings in the sod occur that are suited to colonization by alien species including thistles, knapweed, and introduced pasture grasses. Weed seeds come from nearby weed patches and from supplemental hay provided to the livestock. Santanachote (1992) compared the soil seedbank (viable seeds in the soil) of the Colorado tallgrass stands with those of the Kansas (Konza) prairie. She found the Colorado seed bank was comprised of 65% exotic species, while the Kansas one was comprised of only 35% exotic species. This likely reflects the greater urbanization that is occurring along the Front Range of Colorado, as well as the small size of the Colorado tallgrass relict. Weed management is an ever increasing component of land management (Randall 1996).

The prevailing modes of large scale conservation and restoration operations in weed plagued areas go under the names of Integrated Weed Management (IWM) or Integrated Pest Management (IPM) (Hobbs and Humphries 1995; Popay and Field 1996). These programs employ many approaches to the control of unwanted exotic plants and animals, and in agriculture they also may be employed against native organisms that interfere with agricultural goals, e.g., prairie dogs, coyotes, native shrubs and wildflowers. Several methods of control are employed, ranging from hand pulling of weeds and shooting exotic animals to attacking the unwanted species in several ways at once (IPM). In addition to hand pulling or hoeing, there are several favored technologies for ridding grasslands and grass lawns of non-wanted plants. One is the use of herbicides. Another is the use of biological control, involving the introduction of predators not found in our grasslands, especially insects, fungi, and bacteria that attack unwanted plants.

Herbicide applications can be effective, especially for short-term eradication of "weeds." But herbicides often have accompanying, unwanted side effects. For example, some herbicides affect humans and several cities are in the process of banning or curtailing their use (Small 1997). Some people are chemically sensitive to many of the herbicides and suffer serious health impairment such as asthma and immune system problems when spraying is done (Cox 1998). Most herbicidal chemicals are aimed at broad-leaved, non-grass plants, having been developed for agricultural field weeds. Wheat, oats, rice, barley, rye and corn all are grasses and relatively narrow-leaved. Selective killing of broad-leaved plants does not promote overall prairie health. In tallgrass prairie, broad-leafed natives, 'wildflowers', generally are severely damaged or killed by such chemicals even though the grass crops and native grasses survive. Our ecological knowledge of the complex food webs that are present in tallgrass prairies is not sufficient to predict the effects of selective elimination of native plant species (Joern 1995), even though herbicides are used widely in agriculture and horticulture to eliminate everything but grasses. The loss of native plant species, especially broad-leaved ones, leads readily to the elimination of native pollinating insects (Heywood 1989; Buchmann and Nabhan 1996; Campbell 1997). With broad spectrum herbicides that kill all vegetation, the environmental costs can be even greater. Herbicides, by killing native plants, also are likely to disrupt the lives of native animals as well. That is, the native insects including the pollinators (Buchmann and Nabhan 1996) and insects fed upon by birds are affected as well. It is easy to see how such actions may move through a food web in unintended ways.

The second technological solution, sometimes called 'biological control' (part of IWM and IPM), involves the importation of organisms from the homeland of the weed that are known to attack the target plant. In a few well documented examples, this has worked well (Louda and Masters 1993), but this technique has very serious risks as well (Thomas and Willis 1998). One of these has been documented recently by Louda and co-authors (1997). In this instance, a weevil was introduced into upper Great Plains prairies to deter exotic, weedy thistles. The weevil subsequently has attacked native thistles, some of which are rare, native wildflowers.

Some managers incorporate the use of exotic grazing animals, especially goats, sheep or cattle, for weed control (IWM) (Popay and Field 1996). Such grazer activities, while reducing the number of undesired plants, can disperse their seeds and fruits. If sheep, goats, or cattle are being fed a diet of noxious plants that are in seed, they may proceed to scatter the seed in packets of dung, offering seed colonizers a ready supply of fertilizer. Many weed seeds pass through the digestive tracts of grazers without detriment. Furthermore, overgrazing can open holes in the vegetation cover for weed establishment, as well as lead to the destruction of native species.

The problems with current methods of prairie conservation and restoration are clear. We have some constructive suggestions for sounder management practices. Educating the public about the value of fire, the dangers from each of the common management methods, and the overall value of grasslands is essential. Public involvement is the most meaningful component for conservation of tallgrass relicts and remnants. Reintroduction of fire into management plans will help. While hand pulling and hoeing of weeds can be futile in large areas, both seed collection from native tallgrass for reseeding work and hand maintenance of places where weedy invasions most occur, along trails and roadsides, are feasible. Finally, when tallgrass areas are slated for destruction, sod blocks should be collected and heeled into damaged prairie that has protection from immediate development.

We have reasons for optimism. Federal, state, and local land management agencies are becoming aware of the negative effects of weedy invasions. Scientific research that deals with control of alien species is being supported, plus more and more conservation magazines and scientific journals are devoting space to the topic of unwanted, invasive species. Citizen environmentalists are being mobilized to carry out labor intensive, effective control programs throughout this country.

Why Be Concerned About Tallgrass Prairie Remnants and Relicts?

We believe the scattered remainders of tallgrass prairie must become targets for conservation efforts. Americans have demonstrated their eagerness to save rain forests in tropical regions, but grassland conservation gets less publicity and world-wide support. Grassland conservation merits similar attention, and it is in our own backyard. The conservation effort is needed immediately, or the loss in genetic and ecological resources will be permanent.

Many justifications for conserving and restoring tallgrass remnants and relicts come to mind. The most obvious are aesthetic and ethical, to preserve the inherent beauty and natural heritage of tallgrass prairie for future generations. Second, compared with manicured lawns and gardens, it is relatively easy to maintain wildlands as open space adjacent to human habitation by using the vegetation that occurs naturally. Third, much more than prairie plants are lost when tallgrass prairie sites disappear. While some of the larger animals associated with tallgrass are extinct, extirpated from the prairie or confined (e.g., the Prairie Wolf, the Grizzly Bear, Bighorn Sheep, and the American Bison), many smaller species remain. For example, according to Risser et al. (1981) and Zimmerman (1993) 16 non-game bird species breed in mainland true prairie, and we have found 12 of these 16 persist in breeding in the Boulder tallgrass stands (Bock et al. 1995). Similarly, three of five small rodents found at Konza Prairie also occur in the Colorado tallgrass prairie (Peterson et al. 1985; C. Bock unpub. data.). The disappearance of the tallgrass prairie remnants and relicts will diminish a whole suite of organisms, both well known and obscure, that live and depend upon such places (Joern 1995).

And, there are strong scientific reasons for conserving the remaining tallgrass prairie stands. The majority of cultures throughout the world depend upon plants from grasslands, i.e., members of the grass family (Poaceae), as the bases for their diets. Corn, wheat, and rice all are grasses. The climate of the world, including that of the Great Plains, appears likely to be undergoing some permanent, although subtle, changes at present (Bock et al. 1991). The Great Plains is the largest ecosystem in North America, and it is essential to the food production industry, not only in the US and Canada; but also in those other nations that depend upon us for part of their food supply. Furthermore, the genetic resources within the native species of the tallgrass appear to be rich and highly varied (Keeler and Kwankin 1989; Normann et al. 1997). Within the genes of these grainbelt natives may be critical genetic resources to maintain grain production as our climate readjusts. Although potential dangers accompany genetic engineering for agriculture (Brown and Brown 1996; Parker and Kareiva 1996), slight changes in temperature and moisture regimes will foster more research for genetic material already adapted to warmer and drier environments, such as are predicted for the Great Plains. The relictual prairie remnants, especially those on the margins of this distribution, hold a disproportionate share of the existing genetic variation. The genetic resources stored in the remaining native tallgrass prairie species if lost, cannot be reinvented. The time for advocacy and effort is now.

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