

The Boulder Tallgrass Prairies
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THE BOULDER TALLGRASS PRAIRIES

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Cover photo. Tallgrass Natural Area Parcel 10 on Davidson Mesa. (The Eldorado Springs area is in the background.) Parcel 10 is a xeric (dry) tallgrass prairie with the dominant vegetation being big bluestem, whose tall flowering stems are visible in the photo, sideoats grama, and blue grama. Photo by Mike Figgs.

PART I - WHAT IS A TALLGRASS PRAIRIE?

By William L. Baker

Introduction

Tallgrass prairies should have been called "redgrass prairies". In September, the color is unmistakable at great distances. But why are there no parades of autos, no hourly radio announcements as the colors peak, no traffic jams as Denver rushes out to watch the bluestem turn? Bluestem? All three of the tallgrass prairie's major grasses (big bluestem, switchgrass, and indiagrass) do have bluish stems at times, and all three do turn red in September. A greater color change than bluestem's distant cousin, aspen, and more rare. But who would come out just to look at reddish "pastures"?

The prairie is more alive than any pasture. In the eastern plains, the tallgrass prairie was the major landscape feature, and in it developed a unique and rich biota. It is the setting of the Willa Cather novels, but its biological interactions may be more complex and rich than any human interactions. The complexities of the tallgrass prairie have been recently investigated by scientists under the U.S. part of the International Biological Program, and their results published in a monograph (Risser et al. 1981).

After settlement, the prairies yielded quickly to the plow where the soil was deep and black and fertile, or to livestock where shallow and rocky. Now, undisturbed remnants of the deep-soil tallgrass prairie are very few and tiny. Researchers have even reconstructed some prairies on plowed sites. The shallower, rockier tallgrass prairie is still present in a few large areas, particularly in the Flint Hills of Kansas and in northeastern Oklahoma. Because of its biological and cultural importance to the nation, Richard Mott, the new director of the National Park Service, has indicated that establishment of a tallgrass prairie national park is one of his highest priorities.

In Colorado, the "midgrass" prairie, with knee-high grasses (needle-and-thread, western wheatgrass), and the "shortgrass" prairie, with boot-high grasses (blue grama, hairy grama, buffalo grass), dominate the plains landscape. Tallgrass prairies were found only in a few places: first, in a narrow band along the mountain front, second, on a few rocky lava-capped mesas in southeastern Colorado (such as on Mesa de Maya), and third, along a few of the major streams near the eastern border of the state. These places all are somewhat moister than the rolling upland shortgrass and midgrass areas. Though one scientist (Wells 1970) thinks tallgrass prairies may have extended across the

entire Great Plains at the end of the most recent Ice Age, it is likely that the Colorado tallgrass prairies have been as limited in extent as they are now for the last 4000 - 7000 years.

Only in the last 125 years have the pressures of human populations impinged significantly on the Colorado tallgrass prairies. Now, few sites exist that are still relatively pristine. One tiny site is known on Mesa de Maya, but no good sites remain on the rivers near the eastern border. By far the largest and best examples of tallgrass prairie in the state are in a complex of tiny pieces in the Boulder area.

If the rich and interesting biota of these last remaining pieces are to be perpetuated, it is critical that these small remnants be maintained as closely as possible in their natural condition. It is only by appreciating and studying these last bits of wild nature that we can regain some sense of the richness of the biological world that is the ultimate source of all our human culture. Without this appreciation and without scientific knowledge of how wild ecosystems operate, it is difficult to know how best to manage the farms and fields that make up most of the settled country today.

"The first rule of intelligent tinkering," said Aldo Leopold, "is to save all the pieces." But it is not enough to just save all the species, the "pieces" of nature. The second rule of intelligent tinkering is to save a working example of how the pieces go together. We must perpetuate the living prairie; the falcon diving into the bluestem for a sparrow, the coneflower with its colony of ants and aphids, the rattlesnake and mouse. Not just the waving "redgrass", but the tallgrass prairie community within.

The Boulder Tallgrass Prairies

Location and setting

The Boulder Tallgrass Prairies occur along the floodplain of South Boulder Creek as well as on adjoining mesa tops and sides (Figure 1). It is likely that most of the sites either have water tables close to the surface or are covered with coarse gravels deposited as outwash during the melting of the glaciers. The coarse gravel acts, curiously, like a mulch (Branson et al. 1965) and decreases the amount of water lost from the soil to evaporation, so such gravel-covered sites are moister than adjoining more clayey sites. This coarse gravel is most abundant on terraces close to the mountain front, which partly explains the absence of tallgrass prairies from sites more than a few miles from the front.

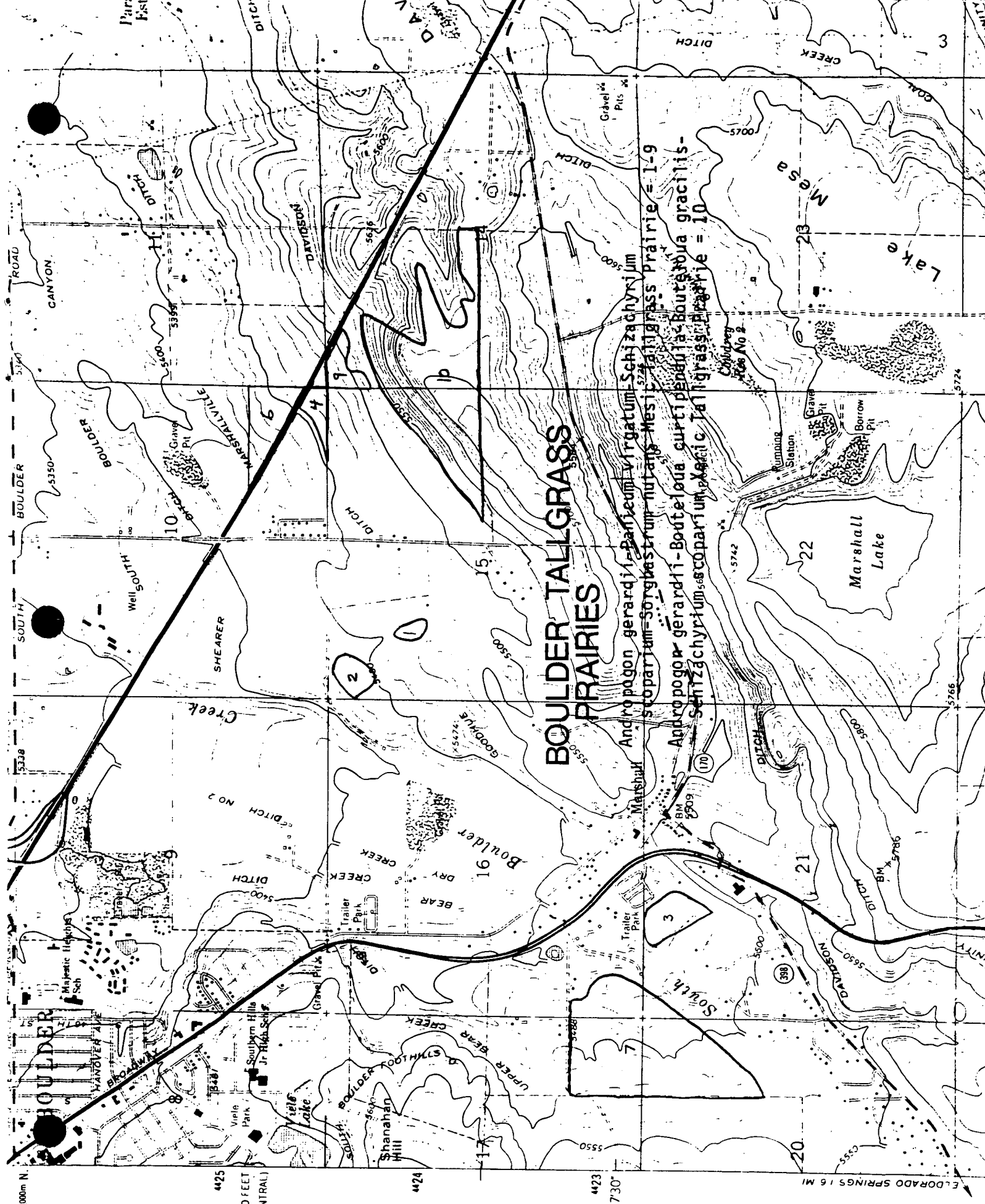


Figure 1. Map of the Boulder Tallgrass Prairies. Colorado Natural Areas designated sites are numbered.

Mesas such as Rocky Flats, and others farther south or north, formerly had extensive tallgrass prairies. Most of these areas have been overgrazed or now have houses or other uses. In addition, it is very likely that all the major streams from near Fort Collins south to the New Mexico border at one time had areas of tallgrass prairie along their floodplains. It is still possible, for example, to find a few stems of bluestem in the ditches along Lefthand Creek, or the St. Vrain or Cache la Poudre rivers. But only along South Boulder Creek are there acres of unplowed prairie along a floodplain in the state.

History of scientific and preservation interest

Tallgrass prairies were noted in Colorado by many early scientists (Bichel 1959, Branson et al. 1965, Clements 1904, Hanson 1957, Hanson and Dahl 1957, James 1930, Marr 1964, Ramaley and Kelso 1931, and Vestal 1914). But it is largely because of the interest of the City of Boulder and its citizens that pieces of the tallgrass prairie remain undeveloped. The protection of these pieces has been primarily the result of the efforts of one scientist, William H. Moir, and the director of the City of Boulder's Open Space Program, Jim Crain.

Moir, who studied the vegetation of the Boulder tallgrass prairies in the late 1960's and realized their significance, published two scientific papers about them (Moir 1969, 1972) and gave a talk about them at a National Prairie Conference (Moir 1972). He witnessed the loss of one tallgrass area in Boulder to housing construction, and began encouraging the City of Boulder to acquire and protect the remaining pieces. The City of Boulder's Open Space Program has now acquired most of these pieces.

In the early 1980's the Colorado Natural Heritage Inventory and the State of Colorado's Natural Areas Program became increasingly concerned that an active effort be made to manage the remnants in a manner compatible with the perpetuation of their natural values. In 1984 the remaining pieces owned by the City of Boulder were Registered and Designated as a State Natural Area, with a management plan to be developed jointly (see Appendix A).

In the summer of 1984 some basic research was conducted on tallgrass nesting bird species and vegetation, as part of a general inventory of City of Boulder Open Space lands. These studies are nearing completion.

The Colorado Native Plant Society has led field trips to the prairies in 1983 through 1985 and continues to be actively interested in their protection and management.

Vegetation

The flora of the Boulder Tallgrass Prairies is very similar to that of the eastern prairies in Kansas and Nebraska. The most complete list of plants is in Moir's papers (1969, 1972), though other collections have been made by William Weber at the University of Colorado's Museum of Natural History, and other botanists.

The major grasses that give the prairies their tallness are big bluestem (Andropogon gerardii, Figure 2), switchgrass (Panicum virgatum, Figure 3), and indiangrass (Sorghastrum nutans, Figure 4). In wetter areas prairie cordgrass (Spartina pectinata) can be found, and on the driest sites blue grama (Bouteloua gracilis) and little bluestem (Schizachyrium scoparium, Figure 5) are more common. The prairies include a rich variety of other grasses and wildflowers.

If one were to stand in a tallgrass prairie on the floodplain of South Boulder Creek and a floodplain in southern Illinois or eastern Nebraska, the prairies and their arrangement in the landscape would look remarkably similar. In both areas, the lower, wetter areas would have denser tallgrasses and more prairie cordgrass and switchgrass. The adjoining hills would have a drier form of prairie, with less dense tallgrasses and more little bluestem. These two geographical areas would have many additional plants in common, but also many different species.

The differences between the dry and wet kinds of prairies have been formalized in a technical classification of the natural vegetation of Colorado (Baker 1984) as two "plant associations": (1) Andropogon gerardii -- Bouteloua curtipendula -- Bouteloua gracilis Xeric Tallgrass Prairie (big bluestem -- sideoats grama -- blue grama Xeric Tallgrass Prairie), and (2) Andropogon gerardii -- Panicum virgatum -- Schizachyrium scoparium -- Sorghastrum nutans Mesic Tallgrass Prairie (big bluestem -- switchgrass -- little bluestem -- indiangrass Mesic Tallgrass Prairie). The first of these, the xeric prairie, also occurs on Mesa de Maya, and in scattered rocky areas across the plains. It is most similar to the dry, rocky tallgrass prairies in eastern Kansas and Oklahoma. The second, the mesic prairie, is still present in the western plains only along South Boulder Creek, but it is most similar to the deep-soil prairies of eastern Kansas and Nebraska and east as far as Illinois and Indiana.

PART II - A TALLGRASS PORTFOLIO

A. The Dominant Grass Species

(Descriptions from National Audubon Society, 1985)

Figure 2.

Big bluestem (Andropogon gerardii)

This tall ($3\frac{1}{2}$ ft, 1-2 m) grass usually is a bronze-red color in the fall. Flowers end in short bristles and are lined on short stalks that radiate in bunches from a single point, like fingers.



Figure 2

Figure 3.

Switchgrass (Panicum virgatum)

Switchgrass grows in large clumps 3-6 ft (1-2 m) tall. Flowers are tiny, petal-less, enclosed in several scales without bristles. The fruit is a small grain. Flower clusters are large, open and widely spaced. Leaves are 4-25 in (10-60 cm) long and curly.



Figure 3

Figure 4.

Indiangrass (Sorghastrum nutans)

This tall (3-8 ft; 90-240 cm) loosely tufted grass has spikelets that form shiny, golden-brown plumes. The tiny petal-less flowers are enclosed in hairy scales that end with a twisted bristle. Spikelets form a narrow cluster 10 in (25 cm) long. Leaf blades may reach 2 ft (60 cm) long, $\frac{1}{2}$ in (1.3 cm) wide, projecting from the stem at a 45° angle.



Figure 4

Figure 5.

Little bluestem (Schizachyrium scoparium or Andropogon scoparius)

Little bluestem plants are erect and clumped, usually 1-2 ft (.3-.7 m) tall. Spikelets are present in narrow terminal clusters on slender stems. The tiny petal-less flowers are enclosed by scales tipped by long, slender bristles. Leaves are 4-10 in (10-25 cm) long, 3/8 in (1 cm) wide, and slightly folded.



Figure 5

B. Site Photographs



Figure 6. View of the South Boulder Creek floodplain northeast of Eldorado Springs. Photo was taken from the top of a small mesa behind the Mesa Swim Club at the junction of State Highways 93 and 398. Parcel 3 lies between the Goodhue Ditch in the foreground, and the cottonwoods along South Boulder Creek in the center of the photo. Parcel 7 is in the distance between the cottonwoods and the mountain front. The vegetation in Parcel 3 is dominated by switchgrass and also contains much prairie cordgrass (*Spartina pectinata*). Parcel 3 is usually very wet, as shown by the areas of dark vegetation, which are rushes (*Juncus* spp.). Photo by Mike Figgs.



Figure 7. Unauthorized cattle grazing in Parcel 3 in April of 1985. Note the well worn cow paths through the site. It has not been determined to what extent grazing has altered the quality of the vegetation. Trailers visible in the background are part of the Sans Souci Trailer Park, which is the most convenient access for the public to Parcel 3. Photo by Mike Figs.



Figure 8. View of the South Boulder Creek floodplain from the top of Davidson Mesa looking northwest toward Boulder. The Boulder "Turnpike" (U.S. Highway 36) is visible in the center. Parcel 10 on Davidson Mesa occupies the immediate foreground. Parcel 9 is in the right center, from the base of Davidson Mesa to Highway 36. To the left of Parcel 9, notice the demarcation where the prairie is hayed; several irrigation ditches are also evident here. Parcel 6 is directly across Highway 36 from Parcel 9, and follows the highway to the center of the photo. Photo by Mike Figs.



Figure 9. Close-up photo of Parcel 6, looking west toward the mountain front. This site is a mesic (moist) tallgrass prairie, with the major grasses being big bluestem, switchgrass, little bluestem, and indiagrass. For access to the site, drive south on Cherryvale Road and turn left on the north side of the Highway 36 overpass. Park at the bottom of the hill and walk about 100 yards southeast along the highway. Photo by William L. Baker.



Figure 10. Fenceline contrast at the west edge of Parcel 2. The view is to the south, with the western edge of Davidson Mesa visible on the horizon line in the upper left. This photo illustrates how severe grazing can alter a tallgrass prairie into a weedy pasture. The big bluestem and switchgrass on the left side of the barbed-wire fence are 3 to 5 feet tall. The vegetation on the right side, outside Parcel 2, is 2 to 6 inches tall. Both properties are on City of Boulder Open Space. Photo by Nancy Lederer.

PART III - TALLGRASS PRAIRIE MANAGEMENT: A NATURAL AREAS PERSPECTIVE

By Susan M. Galatowitsch

Background

Since the early 1900's when Frederick Clements considered the vegetation of the grasslands to be a "disclimax" (that is, vegetation whose equilibrium is achieved and maintained by a natural disruptive force), many observations and studies have reinforced the concept that tallgrass prairies are "fire-derived and fire maintained" systems (Owensby 1972). Wildfires, primarily caused by lightning, were intermittently occurring at nearly anytime of the year (Jackson 1965). However, the highest frequency of fires may have occurred from fall to mid-spring when vegetation is dormant, humidities are low, soil surfaces are dry, and wind velocities are above average (Launchbaugh and Owensby 1978). Lewis and Clark reported that Native American tribes used fire to enhance new plant growth attracting large herbivores, primarily bison. Domestic cattle operations adopted this practice in the early 1900's to encourage early growth in tallgrass areas (Owensby 1972). Burning typically occurred in January or February. Subsequent range studies have established that to maximize production of the dominant grasses of the tallgrass prairie (warm-season perennials), prescribed burning should coincide with the start-up of growth of these grasses, which occurs in the late spring (Launchbaugh and Owensby 1978). Frequent burning is recommended for the eastern and central Great Plains, but is considered an experimental range practice in the western Great Plains.

Grasslands have been grazed since the Paleocene by numerous large mammals (Singh et al. 1983, Van Valen and Sloan 1966). After the last glacial retreat, 15,000 to 25,000 years before present, bison emerged as the dominant grazer in the Great Plains along with pronghorn antelope, elk, deer, prairie dogs, rabbits, rodents, and insects (Launchbaugh and Owensby 1978). Grasses, the dominant life form of the grasslands, have several adaptations that may have evolved as a response to fire and grazing pressures. These special features include placement of the growing point at the surface of the soil rather than elevated, the ability to have stem growth occur at several places along the length of the stem, and the ability to form mats (vegetative reproduction) (Owensby 1972). Bison and other native fauna of the grasslands historically moved in herds, intensively grazing and trampling areas. The

first domestic cattle operations before 1900 herded livestock over

ample acreage; in tallgrass range this resulted in the maintenance of native vegetation Owensby (1972). However, cattle confinement with barbed-wire fencing and more intensive use of the prairie resulted in drastic alterations of the vegetation components of the tallgrass prairie¹. Further, domestic cattle differ substantially in diet and grazing behavior from bison (Schwartz and Ellis 1981). Cattle are more selective in foraging and prefer grazing in low areas of the landscape.

Current Management Practices

Numerous studies across the Great Plains have resulted in range recommendations for tallgrass sites. Kansas recommendations would be expected to be most similar to Colorado relict sites because of a relatively comparable climate and nearby geographic position (Heitlinger, personal communication). Management recommendations for relict tallgrass sites will differ from most published range studies because (1) There are different objectives for managing a natural area such as the Boulder Tallgrass Prairies vs. managing for range production, and (2) there are major climatic differences between areas of the main distribution of tallgrass prairies and the Colorado foothill relicts.

Typical range practices seek to ... "make more efficient use of grazing resources that should increase livestock production and improve economic returns to producers, communities and the state (Launchbaugh and Owensby 1978). Managing to preserve a grassland as a natural area is pursued because

¹ Editors' Note: Kelting (1954) reports on some of these alterations from a detailed study comparing a virgin tallgrass prairie to a nearby moderately grazed pasture. His study found that grazing removes the mulch accumulation from the soil surface, which stimulates seed germination. Unfortunately, it was not native prairie seeds that were reproducing, but "weedy species which are characteristic of disturbed areas", the end result being that "the two communities were of different (species) composition." Additionally, cattle compacted the soil, which together with mulch removal increases the probability of the soil drying out faster than would occur in the virgin prairie.

In short, moderate grazing opens up the tallgrass prairie and introduces a drier and weedy midgrass prairie. Severe grazing can change western tallgrass prairie into a very dry shallow-soiled "shortgrass prairie". But it will not be a true shortgrass ecosystem, but rather a botanical junkyard full of short weeds and exotic grasses. (See Figure 10).

Many other studies have had similar findings (for example, Alderfer and Robinson 1947, Dunford 1954, Moir 1972, Nease 1948, Sheridan 1981, to name just a few).

"there is a high scientific value in preserving samples of typical environments both those relatively undisturbed by man and those which he has materially modified" (Subcommittee on the Conservation of Ecosystems 1967).

The assumption that if remnant grasslands are acquired and withdrawn from man's use, the vegetation will improve and maintain itself, may be misleading for tallgrass systems because of past uses of range and soil, current climate and weather patterns, the proximity to other agricultural uses, and excessive mulch accumulation that may occur in the absence of fire or grazing (Cosby 1975). Vegetation management to replicate historic factors can include one or a combination of the following methods; mowing, burning, grazing by domestic animals. Each method requires a knowledge of the plant community, the flowering time of plants in that community, and the results to be expected from such manipulations (Cosby 1975).

Although maintenance of a grassland in a "natural" state may be the objective for management schemes utilizing mowing, burning or grazing, the effects on vegetation vary for each treatment. A study completed on the Lake Andes National Wildlife Refuge in 1972 compared the effects of burning and mowing on vegetation composition and production. The data from this study indicated a greater production of big bluestem on the burned area over the mowed, but greater overall yield on the mowed (Cosby 1975). Differences in harvest dates of haying can also influence vegetation composition of tallgrass prairies. In the Kansas Flinthills it has been determined that harvesting hay in August or September rather than July reduces the warm-season perennial grasses and results in an increase of "undesirable vegetation" (Launchbaugh and Owensby 1978).

The timing of burning also influences vegetation composition. Late spring burns on a Kansas tallgrass prairie favor big bluestem, winter and early spring burns favor junegrass (*Koeleria cristata*) and sedges, and early-mid spring burns favor little bluestem (Towne and Owensby 1984). Late spring burns which favor warm-season perennials is the recommended range practice in the eastern and central Kansas tallgrass prairies. This results in a reduction of sedges and rushes, annual grasses, perennial forbs and shrubs (Launchbaugh and Owensby 1978). In the same research review, wildfires, which are the most common in late fall to early winter, were documented to reduce warm-season perennial grasses because of the reduction of soil moisture, exposure of dormant plant regenerative tissue to winter weather extremes, and the puddling action of early spring rains. Since there is no data on the frequency or seasonality of

natural prairie fires it is difficult to determine what the optimal prescribed burn techniques are for natural areas management. While the use of fire is an integral part of tallgrass natural areas management, it is doubtful that annual burning occurred before human intervention, and it is also doubtful that all or even most of the fires occurred in the late spring.

Although domestic livestock grazing has been documented to be more selective and uneven than that of bison, some natural areas managers find utility in using cattle to simulate the historic grazer-grassland situation. Of the standard range practices for tallgrass prairies -- continuous grazing, deferred grazing, deferred-rotation grazing, and intensive early stocking -- the last method has had some utility for natural areas managers (Heitlinger, personal communication). In South Dakota, intensive early (until May 1) range use resulted in heavy utilization of cool season exotic grasses and forbs (Cosby 1975). It must be noted that careful monitoring of the plant community is essential and that even several days prolonged use beyond the appropriate removal date can produce undesirable results. This careful monitoring is essential because intensive early stocking involves grazing twice the prescribed number of animals before the growth period of warm-season perennials.

In an Oklahoma study, one researcher found that moderate grazing of a tallgrass prairie favored little bluestem and caused a decline in switchgrass (Kelting 1954). In a study of Colorado tallgrass prairies, Moir found that grazing caused a decrease in abundance of big bluestem, indiangrass, and switchgrass while increasing blue grama, a shortgrass species, as well as fringed sage (Artemisia frigida), a common indicator of disturbance (Moir 1972).

While very light continuous grazing may at first seem to have potential for natural areas management, results have generally been poor. Cattle prefer low areas and concentrate foraging in small areas while leaving other areas untouched. The selectiveness and unevenness of cattle grazing cause this method to be a poor replicate of historic wild ungulate grazing effects.

The data and recommendations provided in this summary were derived from tallgrass prairies in the main area of this grassland type located several hundred miles to the east of the Colorado sites. The habitat for relict tallgrass prairies in Colorado differs from these areas by having less precipitation and by the proximity of the Front Range of the Rocky Mountains. For these reasons, management of tallgrass sites in Colorado must be considered experimental and must be pursued cautiously and scientifically.

Since very few areas of relict tallgrass prairies remain in Colorado, management should reflect the objective of natural areas rather than range sites. A basic understanding of vegetation dynamics including rate of mulch accumulation and growth and flowering times is needed before attempting large scale manipulations. Also, data on lightning and wildfire frequency as well as historical native fauna grazing would be helpful in attempting to replicate natural processes.

Current Management Status of Boulder Tallgrass Prairies

(Editors' Note) At the time of the Natural Area designation, a general management plan was agreed upon between the City of Boulder and the Colorado Natural Areas Program (CNAP). The city is responsible for the management of the properties, and has agreed to prepare a detailed management plan by December 31, 1985. CNAP will participate in the development of the plan. Parcels 3 and 6 will be for baseline monitoring, and have been excluded from grazing and haying. For more details, see 4.A. in the "Articles of Designation", which are in the Appendix.

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APPENDIX

COLORADO NATURAL AREAS PROGRAM
DEPARTMENT OF NATURAL RESOURCES
STATE OF COLORADO
COLORADO TALLGRASS PRAIRIE NATURAL AREA
ARTICLES OF DESIGNATION

These Articles of Designation, made this 20th of ~~November~~ 1984, by and between the Department of Natural Resources, State of Colorado, 1313 Sherman Street, Room 718, Denver, Colorado 80203, hereinafter the Department, and the City of Boulder, Municipal Building, 1777 Broadway, Boulder, Colorado 80302, hereinafter the City of Boulder.

WHEREAS, the City of Boulder owns and manages certain lands as open space in eight parcels and totaling 269 acres as described in Exhibits A and B, attached hereto and incorporated herein by reference, and known as the Colorado Tallgrass Prairie Natural Area situated in the County of Boulder, State of Colorado, hereinafter the Property; and

WHEREAS, the City of Boulder has declared that the best use of the Property is that it be preserved and protected, as evidenced by the proposed designation of the areas by the City as a "protected area;" and

WHEREAS, the Department is authorized to conduct and administer the provisions of the Colorado Natural Areas Act (C.R.S. 1973, 36-10-101, et seq.) which established within the Department the Colorado Natural Areas Program, hereinafter the Program, and the Colorado Natural Areas Council, hereinafter the Council; and

WHEREAS, the Department has determined, pursuant to its criteria, that the Property is a natural area and that it would be desirable to include the

Property within the Colorado Natural Areas System as a designated State Natural Area; and

WHEREAS, as a result of the attributes of the Property, the Property provides one or more of the benefits described in C.R.S. 1973, 36-10-104(2).

NOW THEREFORE, it is hereby agreed that:

1. Designation of the Property as a Natural Area. Upon filing of these Articles of Designation with, and acceptance of same by the Department, with the advice and approval of the Council, the Property described in Exhibits A and B, attached hereto and incorporated herein by reference, shall become a designated natural area and thereby shall become part of the Colorado Natural Areas System. Said designated natural area shall be known as the Colorado Tallgrass Prairie Natural Area.

2. Purpose of Designation. The Department has determined, upon recommendation by the Council, that the Property qualifies as a natural area to be included in the Colorado Natural Areas System due to the following:

A. Botanically, the Property represents good quality examples of, and the largest known area in Colorado, for:

1) Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium - Sorghastrum nutans Mesic Tallgrass Prairie (Big bluestem - switchgrass - little bluestem - yellow indiangrass Mesic Tallgrass Prairie).

2) Andropogon gerardii - Bouteloua curtipendula - Bouteloua gracilis - Schizachyrium scoparium Xeric Tallgrass Prairie (Big bluestem - sideoats grama - blue grama - little bluestem Xeric Tallgrass Prairie).

B. The Property contains grasslands which are known to be rare nationally and statewide. The tallgrass prairie remnants contain a unique Colorado flora similar to flora in the tallgrass prairie areas of the eastern Great Plains (eastern Kansas, Nebraska, Minnesota, Wisconsin, and Illinois).

C. The Property contains several unique animals, including the grasshopper sparrow (Ammodramus savannarum) (uncommon in Colorado).

D. The Property provides, among other benefits, the following benefits:

1) It serves as an example of the native condition in studies relating to air, water, and soil quality and habitat productivity and can serve as a baseline for re-establishing or restoring the native condition.

2) It provides outstanding opportunities for scientific research and study in the fields of botany, ecology, and zoology.

3) It serves as a resource from which new knowledge may be derived and as a reservoir of genetic material which has present and future value to scientific inquiry.

4) It serves as an area of high aesthetic value, scenic grandeur, and exemplary natural features.

3. Rights and Duties of the Department. The Department shall list the Property as a designated natural area of the Colorado Natural Areas Program and shall provide the City of Boulder with a Certificate of Designation and a signed copy of the Articles of Designation indicating said designation. This designation evidences the desire of the Department that the Property be protected from impacts adversely affecting the attributes for which the Property is designated.

A. Access.

The Department agrees that user-access to the Property will be the responsibility of the City of Boulder.

B. Visitation.

The Department may visit the site at any time to determine current uses and conditions for consistency with the Program. Following the visitation, the Department will consult with land provide any resulting reports to the City of Boulder.

4. Rights and Duties of the City of Boulder. The management of the Property shall be the responsibility of the City of Boulder, which agrees to preclude all development of the Property except as deemed necessary to protect the area for the purpose for which it is established and to protect the natural features of the Property.

- A. A management plan for the Property will be completed by December 31, 1985, to provide management guidelines for each of the eight parcels. The management plan will detail the control or restriction of grazing of domestic animals and the cutting of grass for hay, on a parcel-by-parcel basis. The objective of the management plan is to increase the viability of the native grassland species on the Property. The plan will include, but not be limited, to:

1. A parcel-by-parcel detail of how the grazing of domestic animals and the cutting of grass for hay will be controlled or restricted from the Property. Cutting frequencies and grazing levels will be reviewed upon expiration or renewal of grazing leases. Parcels number 3 and 6, as described in Exhibit A and on the attached map of the Property, will be used to establish ecological baselines for monitoring the Property. Grazing and haying will be excluded from parcels 3 and 6 by January 1, 1985.

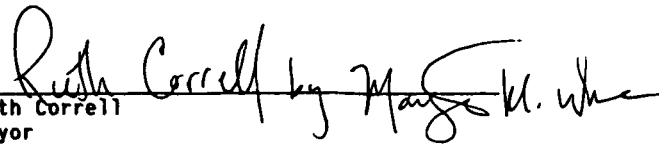
2. Various grassland management techniques which will be used on the Property. Options will include, but not be limited to: periodic burning, cutting, and planting.
 3. In the development of the management plan, expertise will be sought from the Department and from researchers familiar with management of native prairie ecosystems.
- B. No hunting will be allowed within the Property.
 - C. No spraying of chemicals banned by the United States Environmental Protection Agency will be allowed within the Property, except when necessary as required by law. Hand spraying, where feasible, will be used.
 - D. No surface occupancy will be allowed for oil and gas leasing or extraction on those areas having City of Boulder-owned minerals. Any mineral leasing agreements for City of Boulder-owned minerals will include no surface occupancy stipulations.
 - E. No public use of motorized vehicles will be authorized within the boundaries of the Property.
 - F. The City of Boulder will provide the Department with basic information on the condition and uses of the Property based on a brief form provided annually to the City of Boulder by the Department.
 - G. The City of Boulder will continue to exercise all of its legally mandated rights and duties regarding the Property.
5. Default. If either party reasonably believes that the other party is in default in any of its obligations under this Agreement, it may give the other party written notice of the alleged default. Promptly thereafter, the parties shall confer and make a good faith effort to


correct the default and to resolve any difference of opinion which may exist as to the respective rights and duties under this Agreement. Default by the City of Boulder may result in the removal of the Property from the Colorado Natural Areas System.

6. Termination. If either party desires to terminate this Agreement, it shall so notify the other party and give said other party an opportunity to confer regarding the reasons for termination. No less than 30 days after said initial notice, the notifying party may terminate this Agreement by notice to said other party. At the request of the City of Boulder, following termination of this Agreement, the Department shall execute and deliver to the City of Boulder a release of all its right, title, and interest in the Property which may arise out of this Agreement.
7. Notice. All notices to be given pursuant to this Agreement shall be in writing and shall be sent postage prepaid by registered or certified mail, return receipt requested, to the addresses first listed above or to such other person or address as the party to be notified may have designated prior thereto by written notice to the other party. Any notice so mailed shall be effective upon receipt.
8. Amendments. These Articles may be amended in writing by the parties hereto with approval of the Council.

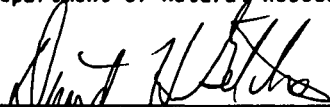
IN WITNESS THEREOF, the parties hereto have executed this Agreement of the first day written above.

CITY OF BOULDER


Ruth Correll
Mayor



Joseph W. de Raismes
City of Boulder Attorney

STATE OF COLORADO
Department of Natural Resources


David H. Getches
Executive Director

APPROVED:

Colorado Natural Areas Council


Theodora Colborn
Chair

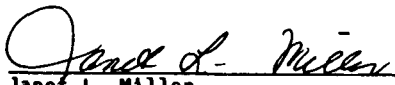

Janet L. Miller
Deputy Attorney General

EXHIBIT A:

Boulder Tallgrass Prairie Natural Area
Legal Description

- Parcel 1: Approximately 4 acres located in the Northwest quarter of Section 15, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 2: Approximately 8 acres located in the Northwest quarter of the Northwest quarter of Section 15, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 3: Approximately 22 acres located in the Northwest quarter of Section 21, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 4: Approximately 6 acres located on the Southeast quarter of the Southeast quarter of Section 10, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 6: Approximately 17 acres located in the South half of the Southeast quarter of Section 10, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 7: Approximately 99 acres located in the Southwest quarter of the Southwest quarter of Section 16, Township 1 South, Range 70 West; and in the Southeast quarter of the Southeast quarter of Section 17, Township 1 South, Range 70 West; and in the East half of the Northeast quarter of Section 20, Township 1 South, Range 70 West; and in the Northwest quarter of the Northwest quarter of Section 21, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 9: Approximately 13 acres located in the Northwest quarter of the Northwest quarter of Section 14, Township 1 South, Range 70 West as outlined on the attached map.
- Parcel 10: Approximately 100 acres located in the Northwest quarter of Section 14, Township 1 South, Range 70 West and in the Northeast quarter of Section 15, Township 1 South, Range 70 West as outlined on the attached map.

EXHIBIT B

Map of Boulder Tallgrass Prairie Natural Area -- See Figure 1, pg. 3.

WHAT IS THE BOULDER COUNTY NATURE ASSOCIATION?

The BCNA is a non-profit, tax-free organization dedicated to fostering an awareness, understanding and appreciation for the natural history and heritage of Boulder County. Associated with the County Parks and Open Space Department, BCNA helps collect, interpret and disseminate natural and cultural resource information about features which contribute to the environment of the county.

ACTIVITIES

Three functions have been identified as the initial basis of activity for the BCNA:

Natural and Cultural History Data Base -

One of the first and continuing tasks is the gathering together of our current knowledge about Boulder County's natural and cultural history... in essence, a bibliography of such materials as natural area studies, flora and fauna studies, historical research, wildlife inventories, weather phenomena, and geology research.

Environmental and Cultural Research -

By piecing together what is known comes the ability to discover what is not known. The BCNA hopes to identify informational needs, and encourage and support new scientific investigation and research. Studies may be conducted by BCNA members, other individuals, or non-profit groups such as universities.

Environmental Education

A major function will be the dissemination of natural and cultural history information to the public through such avenues as nature hikes, slide programs, publications, seminars, and support for interpretive facilities in the County. Many of the educational activities will be in support of the existing County Parks and Open Space "Discover Nature" program.

YOUR ROLE IN BCNA

The strength of BCNA lies in active member support. All members have a vote in the Association, and can become involved in the various committees - from data collection, to research, to interpretive services. The membership also elects a Board of Directors who provide guidance for the Association and set priorities. Members can take advantage of publications, nature classes, and seminars at discount rates.

FINANCIAL SUPPORT

BCNA funds come from member dues, donations and publication sales. As a non-profit corporation, BCNA also has the ability to acquire and hold real and personal property which may be appropriate toward furthering the objectives of the Association.

MEMBERSHIP APPLICATION

Boulder County Nature Association

Name _____

Address _____

City _____ State _____ Zip _____

Telephone # _____

General Member \$10, Student and Senior Citizen (65+) \$5, Family \$15, Life Member \$300, Corporate Member \$500

Members receive a quarterly newsletter. There are quarterly seminars and outings. The membership year is January 1 through December 31. Make check payable to Boulder County Nature Association and mail to: BCNA, 3893 N. 75th St., Boulder, CO 80301.