

1949

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### Recommended Citation

Hayden, Ada and Aikman, J. M. (1949) "Considerations Involved in the Management of Prairie Reserves," *Proceedings of the Iowa Academy of Science*, 56(1), 133-142.

Available at: <https://scholarworks.uni.edu/pias/vol56/iss1/19>

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## **Considerations Involved in the Management of Prairie Reserves**

By ADA HAYDEN AND J. M. AIKMAN

### THE PRAIRIE RESERVE IN IOWA

#### *Present Status*

Iowa is known as a prairie state yet native grassland is not generally recognized by Iowans, for the virgin prairie which originally covered five-sixths of the state has been largely removed by the mechanics of farming, and only the characteristic soil profile of the prairie remains to mark its boundaries. The few scattered tracts of prairie which still persist as parts of undivided estates have been the source of the two state-owned reserves. According to a projected plan of the state Conservation Commission others will be acquired, where possible, representing various soil associations and climatic variations.

#### *Concept of Native Reserve*

The native prairie reserve is to be regarded as an historic preserve illustrative of the native cover as the settlers found it; as a living museum of fauna and flora; as a reference specimen of vegetative structure; as an example of the native landscape; and as a field laboratory where such scientific observations and experiments may be conducted as will not injure the area.

#### *Need for Study*

It is essential by vegetational analysis, to identify the plant communities of the tract and to determine their present status as to extent of disturbance and degree of recovery. Concurrently, a soil survey should be made and climatic limits determined as a basis of correlation of the environment and the prairie plant community. Quantitative comparison of the vegetation and environment of the prairie communities with those of adjacent comparable areas is necessary for an adequate understanding of general plant-environment relations in the area.

These type areas represent for Iowa remnants of its native cover significant in conditioning the glacial soils of the state which are her greatest natural resource. The areas of virgin soil will be very valuable for comparison with the surrounding cropped territory. However, close mowing through half a century or more has

deprived the soil of organic matter normally deposited on the surface of the soil and also materially reduced the organic increment below ground during this period. It has also limited the reproduction by seed of early maturing species. Even the tiling of surrounding land has doubtless modified the original water supply with resultant influence upon the biological processes in the soil and the vegetative complex characteristic of the particular topography and climatic aspect. The probable thinning of the ground cover during the haymaking era has made the prairie community subject to invasion by ruderals such as timothy, red clover and excessive quantities of blue grass, particularly around roadside borders.

#### *Care of Native Reserves*

The principles involved in the care of native reserves relate to :

1. Maintenance of all characteristic species of the climatic aspect.
2. Retention of the representative associations of the climax phase.
3. Provision for return of the aerial and subterranean plant structures to the soil in their roles of winter protection and accumulation of humus.
4. The conservative application of processes stimulating to the vegetation in a manner comparable with the pruning, stirring, and levelling forces exercised by the formerly present, co-dominant animals of the biome. The selection of these procedures necessitates inquiry into the relative values of mowing or controlled burning for removal of excessive residues, alternating with a *laissez faire* policy.

The above considerations require familiarity with the general structure of the true prairie and the nature of its environment throughout its range; so the salient aspects of prairie structure will be briefly reviewed.

#### *The Nature of the Grassland*

No complete description of the great grassland formation in its primitive condition has ever been made because cultural activities incident to the advance of the agricultural frontier anteceded academic records, modern research methods, and even scientific interest in native grassland. Nevertheless, Malin (9) notes that the forest man who so effectively adapted the European pattern of life to the environs of the forest region prevailing east of the hundredth meridian was baffled by his lack of knowledge of how to live in the grassland. His failure to adapt the life pattern of the forest man to dwelling in the grassland and the lack of equipment with which to conquer his environment checked the advance of the

tide of settlement on the brink of the grassland for nearly a generation (15).

Though no complete account exists concerning the aspects of the virgin grassland formation throughout its domain, nevertheless the monographic writing of Weaver, Clements, and others have brought together a descriptive picture of the vast grassland domain in North America with reference to the characteristic aspects of the various physiographic and climatic associations which constitute the grassland climax. The group of researches concerned with the restoration of western ranges where overgrazing has been wide-spread will doubtless be valuable in providing principles for the restoration of the true prairie existing in Iowa even though the time of recovery to the climax stage may vary with the geographic location. Since the native prairie of Iowa was a part of the true prairie association of the grassland formation, the natural boundaries of the grassland climax with its subordinate associations should be kept in mind in the problem of preservation of relict tracts.

#### THE GRASSLAND FORMATION

##### *Extent*

The grassland formation is the most extensive and the most varied of all the climaxes of the North American continent. According to Weaver, it extends from the highlands of central Mexico across the entire United States and northward into Canada. In the form of the closely related sub-climax it reaches eastward to Indiana, Ohio and Michigan. The eastern half is massive and broken only by the fringing forests of river valleys, but the western is greatly interrupted by the many mountain ranges.

Throughout the entire grassland formation, the climate is more favorable to grasses than to trees or shrubs or to any other type of vegetation. But within the wide range of grassland climate marked differences exist. The chief factors which influence growth are differences in precipitation and relative rates of evaporation. Since rainfall decreases from east to west in the mid-continental area, several different kinds or associations of prairie have resulted. Each is limited by a different minor grassland climate.

##### *Prairie Life Forms*

Prairie everywhere is characterized by the abundant and dominant grasses which constitute the prevailing life form. The grass plant, depending on its method of vegetative growth, may assume

the bunch or the sod life form. Intermingled with the grasses is a great variety of sub-dominant, herbaceous, broad-leaved plants, the forbs. The grasses fall into three groups whose presence geographically or locally is determined by available soil moisture in relation to the rate of water loss to the atmosphere. The tall grasses, including the big bluestem, Indian grass, wild rye, switch grass, and slough grass, reach a height of five to eight feet; the mid grasses, such as little bluestem, needlegrass, prairie drop seed, side-oats grama and June grass are two to four feet high; and the short grasses illustrated by buffalo grass and blue grama usually vary in height from six inches to one and one-half feet.

The prairie is a community of great complexity. Variations in its structure result from differences in regional precipitation, local differences in habitat factors, and from changes brought about by the advance of the seasons. All of the dominant and nearly all of the sub-dominant species are perennials. Climax prairie is a closed community. Reproduction is largely vegetative.

#### *Iowa Prairie*

The type of grassland which originally covered Iowa and surrounding states was true prairie. Its prevailing grasses were mid-grasses which according to Weaver and Clements (13) covered the climax areas to the exclusion of other species and the tall grasses were confined to meadows, ravines, and the bases of slopes. During the period of settlement, the mid grasses suffered much from over-grazing, clearing, and burning, with the result that their tall grass competitors gradually moved up the slopes and today appear to be essential members of the prairie relicts. The two types have been referred to as high and low prairie, but the tall grasses actually formed post climax meadows; and they make a disclimax when they replace the mid grasses more or less completely as a result of human disturbance. The Iowa reference specimens of prairie should doubtless be surveyed with the above concepts in mind, and recovery as well as maintenance should be approached with the intent of facilitating natural processes.

#### *Comparative Researches on the Character of Prairie*

As a background for maintenance of isolated prairie reserves, the following excerpts from the monograph of Weaver and Fitzpatrick (14) are pertinent: "One hundred and thirty-five selected areas of tall grass prairie were studied for a period of five years. They were representative of the vegetation of the eastern one-third of Nebraska, the western one-third of Iowa, and adjacent areas in

Kansas, Missouri, South Dakota, and Minnesota. They varied in size from 20 to 360 acres and were uniformly distributed throughout an area of 60,000 square miles. The study was made to determine the structure, development and continuity of the prairie; to better understand the importance, significance and utilization of grassland; and to furnish a permanent record of a rapidly vanishing vegetation.

“Practically all of the prairies had been mowed annually, some for more than fifty years. It has been repeatedly demonstrated that removal of plant cover after it is mature has no harmful effect upon the vegetation. Although the mowing was done close to the soil surface, there still remain 2.5 — 3 inches (often more on lowland) of unmowed stubble with dead basal leaves among which accumulates fallen debris during “hay making,” as well as the late autumnal growth. Consequently, the soil is fairly well protected from erosion by wind and water, sudden fluctuations of temperature, and is by no means bare. Occasionally mowing is replaced by burning or infrequently fire may run over the area late in winter or spring after the vegetation has been mowed.

“Undoubtedly the removal of the plants does have an effect not only upon the quantity of organic material that would ultimately return to the soil but also upon the density and composition of the plant cover. Sampson (11), working in Illinois, states: ‘Occasional areas may be found that are seldom disturbed by man. It is in these least disturbed tracts where the dead grass remains from year to year that the dominant plants maintain their purest stand. The secondary species become insignificant being represented only as scattered individuals here and there’ . . .

“Experiments over a period of 3 to 5 years have shown that the accumulation of debris greatly retards growth in spring. The soil warms more slowly since it does not receive the usual insolation. Not only is there an actual diminution of basal cover, but also certain of the smaller and earlier species are greatly handicapped in growth and tend to disappear. Thus, occasional fires every two or three years renovate unmowed prairies and are distinctly beneficial if they occur in spring before growth is renewed. . . .

“Two points of much importance should be emphasized. The remaining prairies were found on all types of topography and soils. . . . Moreover, wherever the undisturbed prairie is found, it is unmodified by invaders from the surrounding cultural vegetation. Sometimes tracts of grassland separated by many miles from their kind are entirely intact and, judging by other continuous

areas, quite unchanged. Just what changes have occurred from its condition 60 to 90 years ago, when it formed a part of the magnificent prairie which seemed to continue indefinitely are unknown. . . .

“The amount of living organic materials in prairie soils is very great, often three to four tons an acre in a surface of four inches. Thus, when the farmer mows his prairie in the fall and the yield is two or three tons of air dry hay per acre, he is leaving a still larger amount of living plant material in the surface four inches of the meadow. Since 65 percent of prairie species extend their roots beyond five feet, it is seen that the bulk of the prairie is below and not above the surface of the soil” (12).

It seems apparent that the cumulative deposits of vigorous prairie vegetation through countless generations before settlement took place have built up both subterranean and aerial accumulations of humus; and that in the prairie relicts which have been mowed, the preponderance of organic material below the surface of the soil has been sufficient to offset the annual mowing which removes a lesser portion of the annual organic deposits than are accumulated underground.

#### *The Historic Background of the True Prairie Biome*

*Influents.* The prairie vegetation characterized by the dominant life form of the grasses was, in its natural state, the range of animal dominants whose reactions upon the environment resulted in certain responses. The dominant animal throughout the grassland biome was the bison. It was estimated at 12 million, or a bison to 20 acres throughout the true prairie, according to Clements and Shelford (1). It is the opinion of N. L. Stiles of Cherokee, Iowa that within the past two hundred years the buffalo existed in Iowa only as summer feeders (10). Other mammal influents of the true prairie in Iowa were the gray wolf, the coyote, the badger, and species of the ground squirrel. The two major influents are now extinct. Though the behavior of domestic cattle is similar to that of the bison, the bison was migratory in habit and hence its influence was only periodic. Its chief effect on plants consisted of grazing, trampling, wallowing, and trail making; but these activities were not directly comparable to the habits of domestic cattle. It is thought, however, that the application of the following methods offer a practicable substitute for the processes which occurred in primeval nature and though it was employed in drier aspects of the true prairie the basic practices are valid.

## MANAGEMENT OF PRAIRIE RESERVES

*Reconditioning of Over Used Ranges in the True Prairie Zone*

In the reconditioning of over used ranges, some principles have been derived for their renewal. The following treatment has been employed in true prairie environs by Dr. E. T. Dyksterhuis (5) who states:

“Possibly no material should be removed until the invading plants have been crowded out. This may require three to seven years. Meanwhile mowing just before winter would no doubt hasten recovery. After recovery it may not be necessary to mow at all. It is assumed that an occasional accidental fire will occur and in this way somewhat simulate original prairie conditions.

“When mowing is employed, even late September may not be late enough to insure that the climax grasses have replenished carbohydrate stores in the roots following the low point of maturation of seeds. Mowing should be deferred until the basal leaves of dominants are dry to within a few inches of the surface. Then carry the sickle-bar on the mower high enough to avoid clipping any appreciable amount of the green tiller shoots that arise around the bases of old plants in the fall after seed maturation. Mulch from mowings should be left on the ground until no bare ground shows from above and then this condition should be maintained. If excessive amounts of mulch should accumulate, and if it were desired to remove some of the material for hay or stable bedding this can now be accomplished without disturbing the natural mulch on the soil. To do this it will be necessary to avoid use of the old dump-rake and require use of a side delivery attachment on the sickle-bar of the mower. These are available commercially. When the hay windrowed by the mower is dry, it is removed with a pick-up bailer. This leaves the humic mulch layer intact and also adds some fresh mulch.

“Original grazing conditions would be very difficult to simulate. If grazing animals were ever to be used, large numbers for short periods would doubtless be more effective than smaller numbers for longer periods. For example, one cow for each acre from September 15 through October will level a lot of old material and bring it in contact with the soil as well as distribute some mature seeds that will be ingested but not digested. The high rate of stocking for a short period will result in more uniform use over the area as a whole and will not seriously handicap individual species. This is probably closer to natural conditions than the alternative. Long periods with light stocking result in grazed-out spots and extreme



weakening of certain very choice species, such as big bluestem which are cropped repeatedly through the growing season until root reserves are exhausted."

#### *General Considerations Involved in Prairie Management*

From the foregoing discussion several aspects concerned with the maintenance of the balanced condition of prairie vegetation may be mentioned:

Disturbed prairie tends to return to the climax stage if the disturbing influences such as close and early annual mowing, grazing, or burning are removed. In prairies undisturbed for long periods of time, the dominant plants occur in their purest stand and the secondary species tend to disappear. Ruderals disappear first. With rare exceptions the prairies remain free from weeds.

Removal of the major portion of the seasons aerial growth effects the quantity of material that would return to the soil as well as the density and composition of the plant cover. The annual subterranean deposits in the soil exceed the aerial, but tend to be reduced in quantity in proportion to reduction in volume and vigor of the aerial portion of the prairie. Fire appears to have no beneficial effects which specialized mowing, when necessary, does not accomplish. Delayed mowing permits the vegetation to maintain the under-ground food supply, mature seed, form a winter mulch, and also retains a variety of the native species including the more delicate.

#### *Special Consideration Involved in the Management of Iowa Prairie*

In Iowa, with the exception of its western border, prairie is growing near the eastern moisture limits of the prairie climate. The rainfall-evaporation ratio approaches 100 per cent. For this reason, several considerations are important in the management of average Iowa prairie which can be ignored in the management of prairie on the western border of the true prairie association:

Because of more favorable conditions for plant growth, the total carbon and nitrogen content of the soil become progressively greater eastward. (6). Periodic removal of excess organic matter from virgin or rehabilitated prairie in Iowa will usually be necessary. In contrast, moisture conditions farther west may be sufficient to produce only the requisite quantity or even less than the requisite quantity of organic matter for adequate prairie maintenance.

Invasion of bluegrass under the mesic conditions favorable for

its growth seems to be much more difficult to control in Iowa prairie tracts than in prairies farther westward where conditions become progressively less favorable for the growth of bluegrass. Any kind or degree of disturbance which reduces the stand or vigor of the prairie vegetation tends to open up the closed community of the prairie and make possible the invasion of bluegrass.

The mesic prairie of Iowa is very susceptible to invasion by woody plants. Bordering most of the streams in Iowa, tree and shrub communities have invaded, for varying distances, soils which exhibit the typical prairie profile (7). Extensive destruction of the closed prairie communities account for much of the recent invasion. Not all of the vanquished prairie was destroyed by plowing. Especially on the broken land bordering streams, grazing was the cause of its destruction through the introduction of bluegrass, a forerunner to the invasion of trees and shrubs. Gully erosion and depletion of nitrogen from the surface soils resulting from the gradual destruction of the prairie combined with reduced competition of the prairie plants appear to be the chief factors which enabled the woody plants to invade areas formerly occupied by prairie. In the invasion of disturbed prairie by trees and shrubs, in comparison with bluegrass, the height factor is very important. When the woody plants become successfully established, light relations are favorable to them rather than to the prairie plants. No artificial plantings of trees or shrubs should be introduced around the border of prairies because they introduce artificial environmental conditions such as shade, protection from wind, and cause abnormal accumulations of snow in winter.

With the above considerations in mind, a very conservative approach should be made to management of the recently acquired prairie tracts. The following procedures are recommended:

1. The state-owned areas should be protected by wire fencing from vehicular traffic and grazing.
2. The vegetation should probably be left intact for several years to insure the recovery of native species and the elimination of weeds. Management practices should evolve gradually on the basis of quantitative determination of the response of the vegetation to modifications in treatment.
3. Reconnaissance surveys and other studies should be made as soon as possible in order to place on record basic data. These should include: a map of soils, a map of vegetative associations and a taxonomic list of plants.

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